On the Architecture of Pāṇini's Grammar*

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Abstract. The descriptive technique of Pāṇini's *Aṣṭādhyāyī* has deeply influenced modern linguistic theory and practice. But Pāṇini had no predetermined "theory of grammar". The rich array of formal devices and categories of his analysis emerge from nothing more than rigorously making it as short as possible. I review the overall organization of his grammar, the types of rules and the categories that they apply to, and the principles which govern their application and interaction in the system. I present in outline Pāṇini's treatment of the major topics of Sanskrit grammar: syntax, word-formation (primary and secondary derivation, compounding), nominal and verbal inflection, and phonology. The analysis reveals that central aspects of what linguistics ascribes to Universal Grammmar, including levels of representation, thematic roles, and rule ordering, are motivated within the *Aṣṭādhyāyī* merely by the goal of achieving maximum compression. This finding is itself of considerable theoretical interest.

Keywords: Pāṇini, Sanskrit grammar, syntax, morphology, phonology, simplicity, thematic roles, levels of representation, rule ordering.

1 Organization of the Grammar

1.1 Introduction

Pāṇini's grammar is universally admired for its insightful analysis of Sanskrit. In addition, some of its features have a more specialized appeal. Sanskritists prize the completeness of its descriptive coverage of the spoken standard language (*bhāṣā*) of Pāṇini's time, and the often unique information it provides on Vedic, regional and even sociolinguistic usage.[1] Theoretical linguists of all persuasions are in addition impressed by its remarkable conciseness, and by the

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[1] Whitney's attempt to discredit Pāṇini on matters of fact was almost unanimously repudiated by Sanskritists (Bühler 1894, von Schroeder 1895, Thieme 1935). The better we come to understand Pāṇini's rules, the more their accuracy is vindicated (see e.g. Kiparsky 1979:13.)

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rigorous consistency with which it deploys its semi-formalized metalanguage, a grammatically and lexically regimented form of Sanskrit. Empiricists like Bloomfield also admired it for another, more specific reason, namely that it is based on nothing but very general principles such as simplicity, without prior commitments to any scheme of "universal grammar", or so it seems, and proceeds from a strictly synchronic perspective. Generative linguists for their part have marveled especially at its ingenious technical devices, and at intricate system of conventions governing rule application and rule interaction that it presupposes, which seem to uncannily anticipate ideas of modern linguistic theory (if only because many of them were originally borrowed from Pāṇini in the first place).

This universal admiration of Pāṇini poses a problem. Why do linguists who don't approve of each other nevertheless agree in extolling Pāṇini? Each school of linguistics seems to fashion its own portrait of Pāṇini. In the following pages I propose to reconcile the Bloomfieldian portrait of Pāṇini with the generative one by showing how the grammar's extremely rich formal principles and thematic groupings of rules emerge from nothing more than rigorously requiring the description to be as simple as possible. To this end, I discuss some of the aspects of the *Aṣṭādhyāyī* that are of particular linguistic interest. These include insights into the organization of grammar, as well as descriptive generalizations that either support or call into question certain contemporary theories. I will begin with an exposition of some of the general features of the grammar and then examine in turn its "syntax", "morphology", and "phonology", on the understanding that these are themselves emergent constellations of rules rather than predetermined components into which the description is organized.

Needless to say, this perspective compels me to be highly selective, and to set aside a vast number of technical aspects that are crucial to a deeper understanding of the system. Although the text of the grammar is probably preserved rather well, it requires interpretation. Some of the principles that determine the application of its rules are not stated in the grammar itself, and must be inferred. A massive commentatorial tradition is concerned with just this, offering ingenious (and it must be said, sometimes too ingenious) criticism and justification of the wording of Pāṇini's rules. Modern research is complementing this with a reconstruction of Pāṇini's grammatical thinking in historical perspective, with a view to determining the structure of the grammar through internal analysis, using actual Sanskrit usage to help settle interpretive dilemmas about the precise intent of rules, and gleaning additional hints from phonetics, ritual, and other related areas. In this field it is unfortunately impossible to avoid controversy, and the reader should realize that practically everything that follows is subject to challenge.

A final note of caution before we move on. The fact that Pāṇini studied a single language, with simplicity as the guiding principle of the analysis, has certain corollaries which must be appreciated if we are not to pass anachronistic judgments on the grammar. Some formulations in the *Aṣṭādhyāyī* reflect what we might regard as purely notational simplifications which do not correspond to any linguistically significant generalizations. For example, the word order of rules is usually chosen so as to maximize syllabic contraction between words. Almost all the genuine

generalizations are there, but so are some spurious one. This is the inevitable result of adopting a formal economy principle in the absence of cross-linguistic criteria for determining the substantive content of notational conventions.

1.2 Components

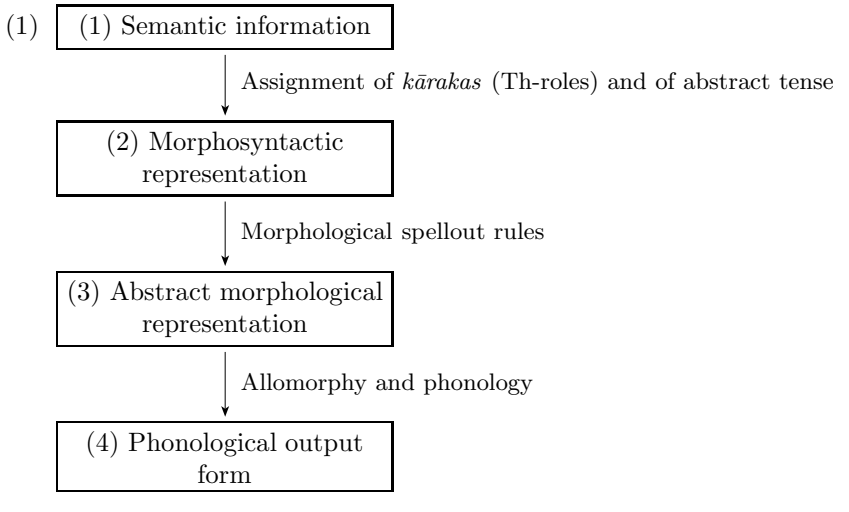
The grammar has four distinct components:

a. *Aṣṭādhyāyī*: a system of about 4000 grammatical rules.
b. *Śivasūtras*: the inventory of phonological segments, partitioned by markers *(anubandhas)* to allow classes of segments *(pratyāhāras)* to be designated by a set of special conventions.
c. *Dhātupāṭha*: a list of about 2000 verbal roots, with subclassification and diacritic markers encoding their morphological and syntactic properties.
d. *Gaṇapāṭha*: a list of 261 lists of lexical items which are idiosyncratically subject to certain rules. Some of the lists are open-ended, and (like the *Dhātupāṭha*) they have to some extent been modified by later grammarians.

The rules of the *Aṣṭādhyāyī* make reference to classes defined on the elements in the other three components by means of conventions spelled out by rules of the *Aṣṭādhyāyī* itself. Thus, while none of the components is intelligible in isolation, together they constitute a complete integrated grammar and lexicon.

1.3 Levels

The rules of the *Aṣṭādhyāyī* fall into three broad classes, each of which effects a mapping between what we (from a somewhat anachronistic modern perspective) could see as different levels of representation. Thus, the grammar analyzes sentences at a hierarchy of four levels of description, which are traversed by three mappings in the direction from semantics to phonology (Kiparsky & Staal 1969, Bronkhorst 1979, Joshi & Roodbergen 1980).



This is the top level of articulation of the grammar. Each part has a further rich internal organization, as described below.

Extending and modifying a discussion by Houben 1999, I should like to make more precise what the interface between the levels looks like, and why it is directional. Consider the sentence whose output (phonological) form is shown in (2):

(2) *vánād grā́mam adyópétyaudaná āśvapaténā́pāci*
'When Āśvapata came from the forest to the village today, he cooked some rice.'
(*literally:)* 'Having come. . . , rice was cooked by Ā."

Retracing its derivation backwards, the morphological analysis is as follows (capitals are silent diacritics that show grammatical properties):

(3) **vána-N̄asI grā́ma-am adyá upa-ā-iṆ-Ktvā odaná-sU**
forest-AblSg village-AccSg today Prep-Prep-go-Abs rice-NomSg
áśva-páti-aṆ-Ṭā á-ḌUpacAṢ-CiṆ-ta
A.-descendant-InstrSg Aug-cook-AorPass-3Sg

At the next higher, morphosyntactic level, the arguments are assigned thematic roles *(kārakas)* and the root is assigned abstract tense, in this case *luṅ* 'aorist':

(4) a. Sentence 1:
(1) *vána* 'forest': source *(apādāna)*
(2) *grā́ma* 'village': goal *(karman)*
(3) *adyá* 'today': temporal location *(adhikaraṇa, kāle)*
(4) *āśvapatá* 'descendant of *Aśvapati*': agent *(kartṛ)*
(5) *upa-ā-iṆ+Ktvā* 'approach, reach', absolutive
b. Sentence 2:
(1) *odaná* 'rice': goal *(karman)*
(2) *āśvapatá* 'descendant of *Aśvapati*': agent *(kartṛ)*
(3) *ḌUpacAṢ+luṅ* 'cook', aorist tense

The derivation is initiated by constructing the morphosyntactic analysis (4) on the basis of the ontology of the events and the speaker's wish to express certain features of it *(vivakṣā)*. This initial stage includes the following steps:

(5) a. The participant which is independent bears the role of agent *(kartṛ)*.
b. When there is a separation, the participant which is fixed bears the source role *(apādāna)*.
c. The participant which is primary target of the action bears the goal/ patient role *(karman)*.
d. Roots denoting recent past events (events which have occurred previously on the present day) are assigned Aorist tense *(luṅ)*.
e. The suffix *Ktvā* is assigned (instead of aorist tense) to express to the root denoting the prior event if it has the same agent as the posterior event.

Formally, (5a-c) are definitions.

The grammar is a device that starts from meaning information such as (5) and incrementally builds up a complete interpreted sentence. A representation at a given level can be mapped, usually in more than one way, into a representation at the next level, which incorporates all the information accumulated in the derivation so far. For example, a given propositional content can be expressed in several different ways at the next level as a semantically interpreted morphosyntactic representation. The final result is a phonetic representation with an associated full semantic, morphosyntactic, and morphological interpretation.

The mapping between each successive pair of levels is constrained by the representations at those levels and at earlier levels. Later levels play no role. So, the morphology-to-phonology mapping (level 3 → level 4) in (1)) responds to semantic and syntactic factors (levels 1 and 2), but the semantics-to-morphosyntax mapping (1 → 2 in (1)) never cares about phonology or morphology factors (levels 3 and 4). And the morphosyntax-to-morphology mapping (2 → 3) is sensitive to semantics (level 1), but not to phonology (level 4).

Moreover, the morphology/phonology mapping (3 → 4) differs fundamentally from the others. It is the only one which allows destructive (non-monotonic) operations such as substitution and deletion. Both morphological elements and phonological segments may be replaced by other morphological elements or segments, or by zero. (The decision to treat allomorphy as replacement was a fateful one, as we shall see.) These processes create extensive opacity, i.e. application of rules in non-surface-true contexts, which forces use of a Pāṇinian counterpart to extrinsic ordering. In contrast, the mappings between the other levels are strictly monotonic. For example, there are no processes which delete *kārakas* or abstract tenses, or which replace one *kāraka* or abstract tense by another. In this system, it is really true that "phonology is different" (Bromberger and Halle 1989).

The two asymmetries just outlined imply an intrinsic directionality of Pāṇinian derivations. They cannot run in the other direction, because the required information about higher-level representations is not available at lower levels. Both the top-to-bottom nature of conditions on rule application, and the non-monotonic character of the morphology/phonology mapping, make derivations irrecoverable.

An example of the "top-down" kind of rule which does *not* occur would be: "The agent of a gerundive is assigned genitive case if it bears initial accent." What *does* occur are phonological rules (3 → 4) which are sensitive to semantic or thematic information (levels 1, 2), such as:

(6) 6.2.48 तृतीया कर्मणि
tṛtīyā karmaṇi (45 kte ca) (6.2.1 prakṛtyā pūrvapadam)
third-Nom *karman*-Loc
'The first member of a compound with a [deleted] instrumental case keeps its original accent if the second member is a past participle that denotes the Goal (i.e. passive)'

According to this rule, we have *áhi-hata* 'killed by a snake' (passive, initial accent), but *ratha-yātá* 'gone by cart' (active, with default final accent). The morphological representation of the compounds is parallel. Both have a first member in the instrumental case, and a second member in the participle suffix *-Kta*.

(7) **a. ahi-Ṭā han-Kta-sU**
snake-Instr kill-PP-Nom

b. ratha-Ṭā yā-Kta-sU
cart-Instr go-PP-Nom

They are differentiated only at the morphosyntactic level. In (7a), instrumental case expresses the agent role and the participle suffix *-Kta* expresses the goal/patient role. In (7b), instrumental case expresses the instrument role and the participle suffix *-Kta* expresses the agent role. Instrumental case expresses either of these roles by rule (8):

(8) 2.3.18 कर्तृकरणयोस्तृतीया

kartṛkaraṇayos tṛtīyā
agent-instrument-LocDu third-Nom

'The third (triplet of case endings) expresses *kartṛ* or *karaṇa*'.

After *yā* 'go', the suffix *-Kta* can be either active or passive (i.e., personal as well as impersonal):

(9) 3.4.72 गत्यर्थाकर्मकश्लिषशीङ्स्थासवसजनरुहजीर्यतिभ्यः

gatyarthākarmakaśliṣaśīṅsthāsavasajanaruhajīryatibhyaḥ
go-meaning-intrans-*śliṣa*... AblPl

'*Kta* expresses agent, process, and goal/patient, after verbs meaning "go", intransitives, *śliṣa* 'embrace', ...'

(How this works exactly will be explained in section 1.4.1.)

The upshot is that accent in this class of compounds depends not on the morphology (not even on the abstract morphological representation prior to the deletion of stem-internal case endings), but on the thematic relations that the morphology expresses. Such examples constitute a potential challenge to theories of grammar in which phonology is a module that does not have access to thematic role information. A project for the future is to determine whether such data can be reconciled with a modular view of grammar. In this case, a solution might be to treat the accentuation of compounds as part of their morphological composition, and to view the input to compounding as a thematic/semantic representation (rather than as a syntactic structure, as Pāṇini does).

The organization into "levels" described here flows from the strict adherence to economy. It would be misleading to say that (1) reflects a "theory of grammar". It is just the simplest and most efficient way to describe the language. We might want to take this as evidence that language is "really" organized that way, but we would be taking that step on our own as theoretical linguists.

Like the levels themselves, the directionality was not necesarily assumed in constructing the system either. More likely, it is another emergent property of the analysis, which reflects a real asymmetry of language. Let us see how this might be the case.

1.4 How Simplicity Dictates the Form and Grouping of Rules

1.4.1 Headings and Gapping

Almost all technical aspects of the grammatical system are motivated ultimately by the fundamental requirement of simplicity (economy, *lāghava*). Simplicity dictates the formation of technical terms, many basic analytic decisions, and the wording and grouping of rules. Consider the formation of patronymics — derived nouns that designate a descendant of the person named by the base. A descendant of Upagu is called *Aupagavá*, formed by the suffix *-aṆ*, phonologically *-a*, with a diacritic *Ṇ* which causes *vṛddhi* strengthening of the stem's initial syllable; general rules accent the suffix, and truncate the stem-final *-a* before it. With the other patronymic suffixes, *-aṆ* constitutes a subclass of *taddhita* suffixes ('secondary' denominal derivational suffixes), which share a number of properties: they are added to nominal stems *(prātipadikas)*, and they are optional, in the sense that there is a synonymous analytic expression: *Aupagavá* is synonymous with *Upagor apatyam* 'Upagu's descendant'. *Taddhita* suffixes in turn are a subclass of suffixes *(pratyaya)*, which share some more general properties, such as being placed after the base, and being accented (in the default case). Finally, suffixation is a subtype of word-formation, and all such processes share the property of applying only to semantically related elements: the two conjoined phrases *kambalam upagor, apatyaṃ devadattasya* 'the blanket of Upagu, the descendant of Devadatta' do not correspond to **kambalam Aupagavo devadattasya* 'the blanket Aupagava Devadatta'.

Such shared properties are not repeated for each suffixation rule; they are stated just once in a heading with the appropriate scope. Suffixes — essentially the items introduced in books 3–5 of the grammar — are governed by the headings (10) and (11).

(10) 3.1.1 प्रत्ययः
pratyayaḥ
suffix-Nom
'(an item introduced in the rules up to the end of 5) is (termed) *pratyaya* "suffix"'

(11) 3.1.2 परश्च
paraś ca
following-Nom and
'and (an item introduced in the rules up to the end of 5) follows'

(12) 3.1.3 आद्युदात्तश्च
ādyudāttaś ca
initial-accent-Nom and
'and has initial accent'

Rule [12] causes suffixed forms to be accented on the first syllable of their (last added) suffix. This is merely the default case which is realized if none of the more specific accent rules is applicable. There are many classes of suffixes with special accentual properties and many special rules for the accentuation of compounds and other derived words, which have priority over [12].

The other, more specific properties of *taddhita* suffixes and of their patronymic subclass are specified by rules that head the rules that introduce these elements.

(13) 4.1.1 ङ्याप्प्रातिपदिकात्
ṅyāpprātipadikāt
Ṅī-āP-stem-Abl
'after (an item ending in the feminine suffixes) *Ṅī*, *āP*, or (after) a nominal stem'

(14) 4.1.76 तद्धिताः
taddhitāḥ
taddhita-NomPl
'denominal suffixes'

(15) 4.1.82 समर्थानां प्रथमाद्वा
samarthānāṃ prathamād vā
semantically-related-GenPl first-Abl optionally
'After the first semantically related stem [marked by a pronoun in the genitive case in each rule], optionally [preferably].'

All these headings contribute to the rule that suffixes *-aṆ*:

(16) 4.1.83 प्राग्दीव्यतोऽण्
prāg dīvyato 'ṇ
up-to *dīvyati*-Abl *aṆ*-Nom
'Up to rule 4.4.2, the accented *taddhita* suffix *aṆ* is added after the first semantically related nominal stem [marked by a pronoun in the genitive case in each rule].'

The meaning of *aṆ* is specified separately in a later rule. Since most *taddhita* suffixes are polysemous, and complex sets of meanings may be shared by several suffixes, the assignment of meanings to *taddhitas* is decoupled from their affixation. The meaning rules are interspersed with the suffixation rules in such a way as to permit the maximally simple wording of each. For example, the basic meaning of the several patronymic suffixes is assigned jointly by rule (17):

(17) 4.1.92 तस्यापत्यम्
tasyāpatyam
his descendant
'(The suffixes *aṆ* etc.) denote 'descendant' [of the stem corresponding to the genitive pronoun in the rule].'

It should be clear from these examples that the rules in text as it stands are not intelligible on their own. Rather, a rule is a condensed formulation from which a complete rule may be constructed by following certain interpretive procedures.

Throughout the grammar, rules of the same type are grouped together and the expressions which they have in common are omitted from each individual rule and stated once and for all as a heading at the beginning of the group. Every rule that comes under the heading must then be understood as implicitly including the expression in the heading, in so far as it is compatible with the rule's wording. Such major headings divide the *Aṣṭādhyāyī* into overlapping topical sections. In principle any shared property (trigger, target, intervening

element, other conditions) may be the basis for such a grouping of rules. For the phonological rules, for example, the most important headings have to do with two kinds of shared properties: the DOMAINS in which rules are applicable, and the INTERACTION of rules in derivations.

Rules get their full meaning not just from special headings, but from other ordinary derivational rules, by a technical generalization of the "gapping" processes of natural language (*anuvṛtti*, Joshi and Bhate 1984).

(18) GAPPING: An element of a rule is continued in the next rule if it is compatible with it. When an element is discontinued, all its modifiers are also discontinued.

Since gapping requires adjacency, related rules must be grouped together so that their shared parts can be factored out.

1.4.2 Blocking

Simplicity leads directly to another device which determines the organization of the whole grammar, BLOCKING *(utsarga/apavāda)*. By convention, special rules block incompatible general rules, which allows a simpler (and more natural) wording of the general rule.

(19) BLOCKING: If the domain of rule A is properly included in the domain of rule B, and both rules cannot apply, then A blocks rule B in the overlapping domain.

The rules so related need *not* be grouped together in the grammar. The grouping of rules is instead designed to maximize gapping and the generality of headings. In this way, there emerges a clear topical organization of the grammar. E.g. suffixation processes occupy a continuous block of rules (books 3-5 in the conventional numbering scheme, which is probably not original).

To see the interplay between gapping and blocking in topical groups of rules on a small scale we turn again to *-aṆ*. It is just the most general ("elsewhere") patronymic suffix. Various classes of stems require other patronymic suffixes in their place, which have the same meanings and all the other general properties that we listed. For example, a class of stems, among them those ending in *-pati* 'lord', form their patronymics with the suffix *-Ṇya*, e.g. *Prajāpati* → *Prājāpatyá*. This exception has in turn an exception: a class of compounds in *-pati*, listed in the *Gaṇapāṭha*, require not *-Ṇya*, but *-aṆ* again, e.g. *Aśvapati* → *Āśvapatá*. Since these rules all come under the sway of (10)–(17), they must be grouped together in their scope. Maximal concision is achieved by grouping together the two *-aṆ* rules, the general case and the exception to the exception, followed by the *-Ṇya* rule, the first-order exception. That way *-aṆ* has to be repeated just once. So in the grammar rule (16) is immediately followed by:

(20) 4.1.84 अश्वपत्यादिभ्यश्च
aśvapatyādibhyaś ca (83 aṆ) (82 samarthānāṃ . . .) . . .
'*Aśvapati*-etc.-Abl
'The *taddhita* suffix *-aṆ* is also added after the first syntactically related stem which belongs to the class *Aśvapati* etc.' [Exception to 4.1.85].

(21) 4.1.85 दित्यदितिआदित्यपत्युत्तरपदाण्ण्यः
dityaditiādityapatyuttarapadāṇ ṇyaḥ (82 samarthānāṃ . . .)
diti-aditi-āditya-pati-second-word-Abl ṇya-Nom
. . .

'The *taddhita* suffix *-Ṇya* is added after the first syntactically related stems *Diti . . .* and after compounds in *-pati*.'

The example seems absurdly simple, but it represents a common situation that already exceeds the expressive power of some modern theories designed to deal with networks of related morphological processes and "elsewhere" relations. The device of inheritance hierarchies, for example, establishes a nesting of subclasses, where each class specifies its own special properties and otherwise inherits the properties of its mother class by default. In such a hierarchy, the suffix *-aṆ* and its properties must be listed twice (Deo 2007).

(22)
-aṆ
|
-Ṇya
|
-aṆ

The *-aṆ* that is an exception-to-an-exception cannot inherit its properties from the regular (default) *-aṆ* at the top of the hierarchy across the intervening *-Ṇya*, so the fact that the two *-aṆs* are identical in all their morphological idiosyncrasies is an accident.

Morphologists have identified two types of blocking, FORMAL and SEMANTIC. In formal blocking, a morphological process, typically paradigmatic, is blocked by the existence of a more specific process that conveys the same meaning, as in our patronymic example. (An English illustration is the blocking of word-level plural **mans* by the stem-level plural *men*.) In semantic blocking, a word with a specialized meaning delimits the meaning of a (formally related or unrelated) derived word. The instrumental meaning of *-er*, which is blocked by the existence of a more specialized word denoting the instrument. E.g. a *cutter* is any cutting implement other than a knife, scissors, adze, chisel, axe, or other specially designated item, and a *sweeper* is any sweeping implement other than a broom, brush, or other specially designated item. In modern Greek, the regular diminutive/hypocoristic meaning of the productive suffix *-aki* is blocked by idiomatic meanings of words in *-aki*: because *sakaki* means 'coat', its compositional meaning 'little sack' is blocked.

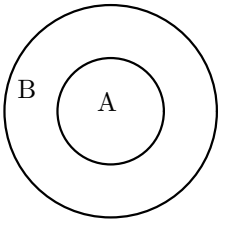
For Pāṇini, formal and semantic blocking are not symmetrical. Since affixes expressing the same meaning compete with each other, formal blocking is an automatic consequence of the principles of the grammar. Therefore, where blocking does not actually obtain — that is, when there in fact are two derivatives with the same meaning — the rule introducing one of them must be explicitly designated as optional. In the case of semantic blocking, the default is just the opposite, for meanings do not formally compete with each other in the system. Therefore,

when semantic blocking actually obtains, a special rule or condition is required. For example, the intensive suffix *yaN̄* is added to roots to express repetition *(kriyāsamabhihāra*, 3.1.23). With certain roots, *yaN̄* is added in an idiomatic meaning: with roots meaning 'go' it denotes a crooked manner, e.g. *cañkramyate* 'meanders' (3.1.24), and with roots such as *lup* 'cut', *sad* 'sit' it denotes a sloppy manner, e.g. *sāsadyate* 'slouches'. The point is that these special meanings block the general meaning of the intensive: *cañkramyate* and *sāsadyate* do not mean 'goes repeatedly', 'sits repeatedly'. Such semantic blocking is readily handled in Pāṇini's grammar, but requires an extra effort (in this case, the mention of *nityam* in the rule). A more central and systematic case of semantic blocking is the disjunctive assignment of thematic roles discussed below.

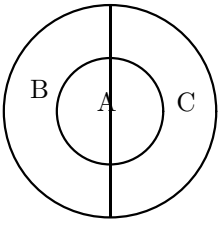
Collective blocking generalizes the blocking relation between special and general rules from pairs of rules to sets of arbitrary size. Blocking is then induced not only by a domain inclusion relationship between two rules, but also by a domain inclusion relationship between a rule and a *set* of rules.

(23) Collective blocking: If the domain of rule A is properly included in the union of the domains of a set of rules $\mathcal{R} = \{R_1, R_2, \ldots R_n\}$, A blocks each of the rules in $\mathcal{R}$.

So rule A blocks both B and C below:



Regular blocking



Collective blocking

An example of collective blocking are the rules that resolve sequences of adjacent vowels in close contact. (24) shows three processes, glide formation (rule (25)), monophthongization (rule (26)), and contraction (rule (27)), stated directly below:

(24) *adya iha apāci odanaḥ* → *adyehāpācyodanaḥ* 'the rice was cooked here today'

(25) 6.1.77 इको यणचि
iko yaṇ aci (72 saṃhitāyām)
ik-Gen *yaṇ*-Gen *ac*-Loc
'*i, u, ṛ, ḷ* → *y, v, r, l* before a vowel, in close contact.'

(26) 6.1.87 आद्गुणः

ād guṇaḥ (77 aci) (72 saṃhitāyām)
a-Abl *guṇa*-Nom
'*a* (short or long) and a vowel are (together) replaced by *guṇa (a, e, o)*, in close contact.'

(27) 6.1.101 अकः सवर्णे दीर्घः

akaḥ savarṇe dīrghaḥ (84 ekaḥ pūrvaparayoḥ) (72 saṃhitāyām)
aK-Gen same-color-Loc long-Nom

'*aK (a, i, u, ṛ, ḷ)* and a following vowel of the same color are (together) replaced by a long vowel, in close contact.'

There is no proper inclusion relationship between the environments of any two of the three rules [25], [26], and [27]. Rules [25] and [27] overlap for *i+i, u+u*, [26] and [27] overlap for *a+a*, and [25] and [26] have no common domain. If the rules are taken pairwise, there is no possibility of blocking here. But if we take the three rules together, it is evident that the input to [27] is a proper subset of the *combined* inputs to [25] and [26]. From this point of view, [27] has no domain of its own, and by generalized blocking should set aside each of the other two rules in their respective shared domains. This is the correct result, for it is true that [27] always wins both over [26] (*a+a* → *ā*, not *a*) and over [25] (*i+i* → *ī*, not *yi*).

These three rules are merely the top nodes of an intricate blocking hierarchy. The principal restriction on (26) is (28).

(28) 6.1.88 वृद्धिरेचि

vṛddhir eci (87 ād) (72 saṃhitāyām)
a-Abl *guṇa*-Nom
'*a* (short or long) and *e, o, ai, au* are (together) replaced by *vṛddhi (ā, ai, au)*, in close contact.'

E.g. *upetya odanaḥ* → *upetyaudanaḥ* (see (2)). (28) is in turn blocked by (29):

(29) 6.1.94 एङि पररूपम्

eṅi pararūpam (91 upasargāt, dhātau) (87 āt) (72 saṃhitāyām)
eṅ-Loc following-form-Nom

'*a* (short or long) followed by *e* or *o* in a root are (together) replaced by the second vowel.'

For example, *upa-elayati* → *upelayati (*upailayati)*. But (29) is itself blocked by (30):

(30) 6.1.89 एत्येधत्यूठ्सु
etyedhatyūṭhsu (88 vṛddhiḥ) (87 āt) (72 saṃhitāyām)
eti-edhati-ūṬh-LocPl
'*a* (short or long) and *e, o, ai, au* in (the roots of the verbs) *eti-edhati* and in (the replacement) *ūṬh* are (together) replaced by *vṛddhi (ā, ai, au)*, in close contact.'

E.g. *upa-eti* → *upaiti (*upeti)*. Finally, (31) blocks (30):

(31) 6.1.95 ओमाङोश्च
omāṅoś ca (94 eñi pararūpam) (87 āt) (72 saṃhitāyām)
om-āÑ-LocDu and
'*a* (short or long) with (the first *e* or *o* of) *om* or *āÑ* are (together) replaced by the second vowel.'

E.g. *upa-ā-itya* → *upetya (*upaitya)* (see (2)).

By a similar reasoning, rule (32) collectively blocks rules (27) and (26), the latter vacuously.

(32) 6.1.97 अतो गुणे
ato guṇe (96 apadāntāt) (72 saṃhitāyām)
aṬ-Gen *guṇa*-Loc
'Short non-final *a* followed by *guṇa (a, e* or *o)* are (together) replaced by the second vowel.'

This gives e.g. *grāma-am* → *grāmam* in (2).

1.5 Word Integrity

The integrity of words appears not only in word-formation processes (p. 39, and see also (137) below), but also in phonology. The general principle is that phonological processes across word boundaries are "invisible" *(asiddha)* to word-internal phonological processes. This has two aspects. Phonological processes applicable within words have priority over phonological processes applying to combinations of words. And when the application of a process to a combination of words creates the conditions for the application of a process within a word, the word-internal process does not apply. (Translated into rule ordering terminology: rule applications across word boundaries do not feed or bleed rule applications inside words.) Let us illustrate these points with the phonological rules just discussed. The following pairs of words each show the sequence *a i i*, but it is resolved in two different ways depending on where the word boundary comes.

(33) a. *a+yaj+a+i indra-am* → *ayaja indram*
b. *atra i+ij+atuḥ* → *atrejatuḥ*

The right results are obtained if word-internal applications of the rules are given precedence over applications across word boundaries.

(34) Correct derivation of *á-yaj-a indram* 'I sacrificed to Indra'
á-yaj-a-i indra-am
á-yaj-e indra-am (26) 6.1.87 **ād guṇaḥ**
á-yaj-a indram (32) other rules

(35) Wrong derivation:
á-yaj-a-i indra-am
á-yaj-a īndram (27) 6.1.101 **akaḥ savarṇe dīrghaḥ**,
(32) 6.1.97 **ato guṇe**
*á-yaj-endram (26) 6.1.87 **ād guṇaḥ**

The following example shows how phrase phonology does not feed word phonology. By 7.4.59 **hrasvaḥ**, the vowel of a reduplicant is shortened. By the general convention 1.1.48 **eca ig ghrasvādeśe**, when *e* is shortened it becomes *i*. (36) shows that the *e* which arises by sandhi (which is part of both words by the convention 6.1.85 **antādivacca**) does not shorten:

(36) Right and wrong derivations for 'he sacrificed here'
atra i-yā́j-a
atreyā́ja (correct output) (26) 6.1.87 **ād guṇaḥ**
*atriyā́ja 7.4.59 **hrasvaḥ**

Similarly, from *pacāva idam* 'let us two cook this!' the vowel contraction rule *ād guṇaḥ* derives *pacāvedam*, where the *e* does not undergo rule 3.4.93 **eta ai**, which turns *e* into *ai* in imperative suffixes (as in 1.Du. *pacāvahai*).

(37) Right and wrong derivations for 'let us two cook this!'
pácāva idam
pácāvedam (correct output) (26) 6.1.87 **ād guṇaḥ**
*pácāvaidam 3.4.93 **eta ai**

1.6 The *Siddha*-Principle

The fundamental principle governing the interaction of rules in the grammar is the *siddha*-principle:

(38) सर्वत्र सिद्धवत्
sarvatra siddhavat
everywhere effected-like
'(Any rule) is treated as having taken effect when applying any (rule).'

The *siddha*-principle has a positive and a negative aspect. The positive aspect is that, if A creates inputs to B, the effects of A are taken into consideration when applying B (in traditional terminology, *ādeśalakṣaṇabhāva* 'giving scope to an operation conditioned by the input'; in ordering terminology, A takes effect before B, FEEDING ORDER). The negative aspect is that, if A deprives

B of inputs, the effects of A are also taken into consideration when applying B (*utsargalakṣaṇapratiṣedha* 'prohibition of an operation conditioned by the input', or equivalently, A precedes B, BLEEDING ORDER). What the *siddha*-principle says is that rules interact in a TRANSPARENT way, under the slogan "environment-changing rules first".

The *asiddha* relation can be defined as follows.

(39) In a derivation where rules A and B are applied to ϕ in that order, rule A is *asiddha* if and only if the result is identical to the result of applying A and B to ϕ simultaneously, and distinct from the result of applying them to ϕ in the opposite order.

The *siddha*-principle is a default principle which can be defeated at cost. The usual method of defeating it is to declare a rule *asiddha* '(treated as) not having taken effect, suspended, invisible' with respect to the rule that it makes opaque. In a smaller group of cases, where bleeding must be blocked but feeding is still allowed, a different method is used: the output of the opacity-causing rule is declared to be *sthānivat* '(treated) like the input'.

Most rules which must be prevented from feeding or bleeding other rules are collected into two special sections whose headings stipulate *asiddhatva* (the *asiddha* property) for all of them. The most important group extends from 8.2.1 though the last three sections of the grammar, and is called the *Tripādī* 'Three Sections'. It is headed by one of the most famous rules of the Aṣṭādhyāyī:

(40) 8.2.1 पूर्वत्रासिद्धम्
pūrvatrāsiddham
before non-effected
'(any rule in this section is treated as) not having taken effect when applying any previous (rule of the grammar)'

The effect of (40) is to fix the application of the rules in the last three books to the order in which they are enumerated in the grammar (modulo blocking of general rules by special rules). The rules in this section, therefore, are organized like the rules of a classical generative phonology.

For example, in the derivation of Instr.Pl. *rājan-bhis* → *rājabhiḥ* 'by the kings', the final *-n* of the underlying stem *rājan-* is deleted by rule (41).

(41) 8.2.7 नलोपः प्रातिपदिकान्तस्य
nalopaḥ prātipadikāntasya (8.1.16 padasya)
n-null-Nom stem-end-Gen
'stem-final *n* is deleted (at the end of a word)'

Rule 7.1.9 substitutes the suffix *-ais* for *-bhis* after short *a*, e.g. *vṛkṣa-bhis* → *vṛkṣa-ais (→ vṛkṣaiḥ)* 'by the trees'. Because (41) is in the *Tripādī* section and rule 7.1.9 is outside the *Tripādī* section, (40) correctly blocks (41) from feeding 7.1.9 in *rājabhiḥ*.

In the derivation of *pakva* 'cooked' from underlying *pac-Kta*, two processes are applicable. Rule 8.2.52 requires the replacement of *-ta* by *-va* after the root *pac*, and 8.2.30 requires substitution of the root-final *-c* by *-k* when an obstruent follows. If *-ta* → *-va* applied first, it would bleed *-c* → *-k*, yielding the wrong form **pacva*. In order to ensure that the suffix change 'does not count' with respect to *-c* → *-k*, it is placed *after* it in the *Tripādī*. It is thereby *asiddha* with respect to it, i.e. it fails to bleed it. In this way, both types of opacity can be dealt with by designating a rule as *asiddha*.

Other ways to defeat the *siddha*-principle will be discussed below.

Let us note here that the *siddha*-principle actually extends beyond the ordering relations of feeding and bleeding. The following example serves to illustrate the point. In the derivation of *susyūṣati* 'wants to sew', the input *siv+sa+ti* (underlying *ṣivU+saN+tiP*) is subject both to replacement of *v* by *ū* (by 6.4.19 **chvoḥ śūḍ anunāsike ca**) and to reduplication (copying of the root by 6.1.9 **sanyañoḥ**). The *siddha*-principle tells us (correctly) that the the replacement of *v* by *ū* takes effect "before" the copying of the root: *siv+sa+ti* → *syū+sa+ti* → *syū+syū+sa+ti* (→ *suṣyūṣati* by other rules). The reverse procedure would have resulted in the wrong form: *siv+sa+ti* → *siv+siv+sa+ti* (→ **siṣyūṣati* by other rules). There is no question of feeding or bleeding here, but the order of application is transparent whereas the reverse order would be opaque. The reader may wish to check that (38) has the correct effect. Reduplication is done on the base where *v* has been replaced by *ū*, and conversely (but irrelevantly, in this case) the replacement of *v* by *ū* is done on the reduplicated form. This results in the correct output.

2 Syntax

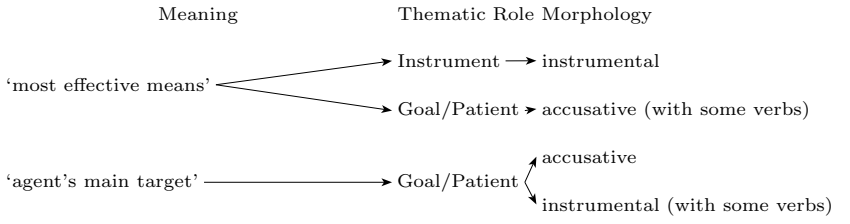
2.1 Pāṇini's Treatment of Clausal Syntax

Pāṇini accounts for sentence structure by a set of grammatical categories which allow syntactic relationship to be represented as identity at the appropriate level of abstraction. Unlike the phonology and morphology of the *Aṣṭādhyāyī*, the syntax is strictly structure-building. There is no deletion in the syntax, and no movement. Passive sentences are not derived from actives, and nominalizations are not derived from sentences. They are in fact generated in parallel by the same rules in a way which permits their structural parallelism to be captured to the fullest extent.

The pivotal syntactic categories are the *kārakas*. *Kārakas* are roles, or functions, assigned to nominal expressions in relation to a verbal root. They are systematically related to semantic categories, but the correspondence is not one-to-one. One *kāraka* can correspond to several semantic relations and one semantic relation can correspond to several *kārakas*. These correspondences are duly

stated in the grammar. *Kārakas* in turn are the categories in terms of which the assignment of case and other morphological elements is formulated.

(42)



The grammar does not specify any constraints on the order of words in a sentence. This is not surprising since Sanskrit is a "free word order language", even though it is clear that not every permutation of words in a sentence is equally felicitous and that there do exist constraints on scrambling, even though they are poorly understood. For example, the constituents of non-finite complements and adjuncts may not be freely scrambled with their containing clauses. Gérard Huet (p.c.) points out that word order seems to be important for quantification. Even more regrettable from the viewpoint of a modern syntactician is that the grammar is silent on the conditions under which anaphoric elements are bound.

Control relations, such as the determination of the understood agent of infinitives and participles, are stated by means of coreference conditions. There is no question of deletion, or of designated null elements as in many modern tratments of these constructions.

Pāṇini does, however, assume a process of ellipsis, according to which words which are obvious from the context can be omitted. Although ellipsis is an extragrammatical process which is not stated as a rule of grammar, Pāṇini has carefully considered the consequences of this process for his grammatical system and explicitly taken account of them in several syntactic rules of his system.

2.2 Linking and Kārakas

Pāṇini's grammar represents a sentence as a little drama consisting of an action with different participants, which are classified into role types called *kārakas*. There are six of them: Agent (*kartṛ*), Goal (*karman*), Recipient *(saṃpradāna)*, Instrument *(karaṇa)*, Locative *(adhikaraṇa)*, and Source *(apādāna)*.) Some *kārakas* correspond to more than one semantic role and some semantic roles correspond to more than one *kāraka*). Thus, in the grammatical derivation, the *kārakas* mediate between meaning and morphosyntactic surface structure. The grammar provides a set of explicit rules which interprets them semantically and it also contains explicit rules which in turn relate them to various morphosyntactic elements that express them.

Here is the basic paradigm:[2]

[2] To make it easier to follow, I omit *sandhi* here, writing e.g. *pacati odanam* for *pacaty odanam*.

	Sentences	**Nominals**
Active:		
	kr̥ṣṇa-ḥ pac-a-ti odan-am Krishna-Nom cook-3Sg rice-Acc 'Krishna cooks rice'	kr̥ṣṇa-ḥ pāc-aka-ḥ odana-sya Krishna-Nom cook-Ag-Nom rice-Gen 'Krishna (is) a cooker of rice'
	kr̥ṣṇa-ḥ svap-iti Krishna-Nom sleep-3Sg 'Krishna sleeps'	kr̥ṣṇa-ḥ svap-itr̥-∅ Krishna-Nom sleep-Agent-Nom 'Krishna (is) a sleeper'
Passive:		
	kr̥ṣṇ-ena pac-ya-te odana-ḥ Krishna-Ins cook-Pass-3Sg rice-Nom 'Rice is cooked by Krishna'	kr̥ṣṇ-ena pak-va-ḥ odana-ḥ Krishna-Ins cook-PP-Nom rice-Nom 'Rice cooked by Krishna'
Stative:		
		kr̥ṣṇ-ena pak-ti-ḥ odana-sya Krishna-Ins cook-Proc-Nom rice-Gen 'Krishna's cooking (of rice)'
	kr̥ṣṇ-ena sup-ya-te Krishna-Ins sleep-Pass-3Sg 'Krishna sleeps' (impers. pass.)	kr̥ṣṇa-sya svap-na-ḥ Krishna-Gen sleep-Proc-Nom 'Krishna's sleep'

What is the relation between the active, passive, and stative constructions? And what is the relation between the structure of sentences and the structure of nominals? Pāṇini's solution is non-derivational on both counts. It introduces a set of grammatical categories in terms of which the related structures can be represented as identical at the appropriate level of abstraction. Actives and passives, sentences and nominals, are alternative realizations of the same underlying relational structure; their derivation is just parallel but — aside from morphological details — identical. In this respect Pāṇini's grammar represents a *pure form of lexicalism.*

The crucial categories used in this abstract level of representation are the *kārakas.* The basic principles governing the relation between *kārakas* and morphosyntactic surface structure are:

(43) a. Every *kāraka* must be "expressed" (*abhihita*) by a morphological element.
b. No *kāraka* can be expressed by more than one morphological element.
c. Every morphological element must express something.

"Expression" (*abhidhāna*) is thus a three-place relation, so this is a *licensing* approach akin to some modern "linking" theories of clause structure, rather than simply a mapping of two levels. It was, in fact, the inspiration for the first modern formulation of linking theory (Ostler 1979).

Formally, the one-to-one relation between roles and their morphological expression is given by the heading (44), which remains in force until the end of 2.3.

(44) 2.3.1 अनभिहिते
anabhihite
unexpressed-Loc
'if not (already) expressed'

The derivation of a sentence proceeds as follows. The lexicon associated with the grammar contains a list of verb roots (*dhātu*) and a list of nominal stems that are considered to be underived (*prātipadika*). The derivation is initiated by selecting items from the lexicon and deciding upon a semantic relation between them. The verb's tense is chosen on the basis of the intended time reference (present tense for ongoing time, in these examples, though the full system is quite complex), and grammatical number is assigned to nominal expressions on the basis of how many things they are intended to refer to (in the present example, singular). The participants are assigned their role types; in this case, Agent (*kartṛ*) and Goal (*karman*). Their semantic correlates in these examples are straightforward.

The functions specified for the morphological elements include the following:

(45) a. Instrumental case expresses the Agent and Instrument roles.
b. Accusative case expresses the Goal/Patient role.
c. Active verb endings express the Agent role.
d. Passive verb endings express the Goal/Patient role if the verb has one, otherwise the Process (*bhāva*).
e. Nominalizing suffixes express the Agent (e.g. *-aka*), the Goal/Patient (e.g. the Passive Participle), or the Process (e.g. *-ti*).

(46) 1.4.49 कर्तुरीप्सिततमं कर्म
kartur īpsitatamaṃ karma
agent-Gen most-aimed-at-Nom *karman*
'the primary goal of the *kartṛ* 'agent' is called *karman*'.

The word *īpsitatama* is the superlative of *īpsita* (cf. 1.4.26, 36), which is the past participle of *īps*, the desiderative of *āp* 'attain', so it means 'primary goal'.

The basic expression of *karman* is either the accusative case or the finite verb endings (*la*):

(47) 2.3.2 कर्मणि द्वितीया
karmaṇi dvitīyā
karman-Loc second-Nom
'the second (triplet of case endings) expresses *karman*'.

(48) 3.4.69 लः कर्मणि च भावे चाकर्मकेभ्यः
laḥ karmaṇi ca bhāve cākarmakebhyaḥ (67 *kartari***)**
la-Nom *karman*-Loc and process-Loc and intransitive-AblPl
'*la* expresses *kartṛ*, *karman*, or, after (roots) having no *karman* (intransitives), process.'

Depending on which option is chosen in [48], active or passive sentences are derived.

(49) 1.4.54 स्वतन्त्रः कर्ता
svatantraḥ kartā
independent-Nom agent-Nom
'the independent one is called *kartṛ*.'

The basic expression of *kartṛ* is either instrumental case by [8], or verb inflection by [48]. If the option of expressing the *kartṛ* role by the verb endings is chosen, the *kartṛ* itself is inflected in the nominative case by [50]:[3]

(50) 2.3.46 प्रातिपदिकार्थलिङ्गपरिमाणवचनमात्रे प्रथमा
prātipadikārthaliṅgaparimāṇavacanamātre prathamā
stem-meaning-gender-number-only-Loc first-Nom
'the first case expresses only the gender and number of what the word's stem denotes'

E.g. *devadattaḥ pacati* 'D. cooks', *sthālī pacati* 'the pot cooks', *agniḥ pacati* 'the fire cooks'. Kātyāyana and Patañjali observe that the *kartṛ's* independence is a relative matter and has to do with how the speaker wants to present a situation. Thus, in *sthālī pacati* there is presumably a human agent of cooking at work but since he is not mentioned in the sentence the pot comes to be the independent agent from a grammatical point of view. In *pācayaty odanaṃ devadatto yajñadattena* 'D. makes Y. cook rice', Yajñadatta is independent relative to the act of cooking even though he is in turn prompted by a causer (*hetu*), see [51]:

(51) 1.4.55 तत्प्रयोजको हेतुश्च
tatprayojako hetuś ca
that-prompter-Nom *hetu*-Nom and
'the prompter of that (viz. of the *kartṛ*) is called *kartṛ* and also *hetu* 'cause'.

We will diagram the way roles are expressed by morphology by means of lines linking the verb with the nominals bearing its roles. The morphological element that "expresses" the role is boxed, and subscripted with the name of the role. For example, in [52] the connection line on top shows that the verb inflection *-ti* expresses that *Krishna* is the Agent of *pacati* "cooks", and the one below shows that the accusative ending *-am* expresses that *odana* "rice" is the Goal/Patient of *pacati* "cooks".

(52) kṛṣṇaḥ paca[ti]$_{AGENT}$ odan[am]$_{GOAL}$ 'Krishna cooks rice'

The three mutually exclusive choices available for verb endings (see [45c,d,e]) give rise to respectively the active, passive, and stative sentences and nominals.

Suppose we choose the first option, of having them express the Agent. In that case, they will be spelled out as the appropriate ending of the *active* voice, which will ultimately yield *pacati*. The spell-out rules for *kārakas* then assign the correct case pattern as follows. By the leading principle (43) that each *kāraka* must be expressed, and no *kāraka* may be expressed more than once, since Krishna's Agent role is already expressed by the present tense, this role may not be expressed by an instrumental case on the noun. Krishna is therefore assigned nominative case, which does not express any thematic role. And since the present

[3] This is a non-traditional interpretation but it is the one accepted by most modern scholars.

tense expresses the Agent role, it cannot also express the Goal function of *odana* "rice". Since this role *must* be expressed, an accusative case ending on the nominal is therefore obligatory.

The passive is generated if we instead choose the option of having the verb morphology express the Goal role of *odana* "rice". In that case, *odana* must get nominative case (for if the accusative were chosen, the role would be expressed twice, which is forbidden by (43b)). The Agent function of *kṛṣṇa* must now be expressed by the instrumental ending, which is *-ena*:

(53) kṛṣṇ[ena]$_{AGENT}$ pacya[te]$_{GOAL}$ odanaḥ 'Rice is cooked by Krishna'

The statives are generated by choosing the third option, of having the tense express, not one of the verb's roles, but the verbal "Process" itself. The Agent must then be expressed by the instrumental case ending. For finite verbs, this structure is not available if the verb is transitive (has a Goal).

(54) kṛṣṇ[ena]$_{AGENT}$ supya[te]$_{PROCESS}$ 'Krishna sleeps' (impers. pass.)

The analysis of the corresponding active, passive, and stative nominalizations is entirely parallel to that of the sentences:

(55) kṛṣṇaḥ pāc[aka]$_{AGENT}$ odana[sya]$_{GOAL}$ 'Krishna (is) a cooker of rice'

(56) kṛṣṇ[ena]$_{AGENT}$ pak[va]$_{GOAL}$ odanaḥ 'Rice (is) cooked by Krishna'

(57) kṛṣṇ[ena]$_{AGENT}$ pak[ti]$_{PROCESS}$-ḥ odana[sya]$_{GOAL}$ 'The cooking of rice by Krishna'

(58) kṛṣṇa[sya]$_{AGENT}$ svap[na]$_{PROCESS}$-ḥ 'Krishna's sleep'

2.3 Logical and Grammatical Subject

The concepts "subject" and "object" as such play no role whatsoever in Pāṇini's grammar. We have already seen that there is nothing like a rule that says "the subject is assigned nominative case", or "the object gets accusative case". Then what about the other phenomena which Western grammatical descriptions analyse by means of those grammatical relations, specifically: *(1)* subject-verb agreement, *(2)* anaphora, *(3)* control of PRO. How does Pāṇini cope with them without invoking the subject relation?

2.3.1 Agreement

From the perspective of Western grammar, the verb agrees with the grammatical subject. The system of licensing already described provides an ingenious and simple formulation, and better descriptive coverage. The agreement pattern in active, passive, and stative sentences is shown in [59]:

(59) a. aham pac-ā-mi odana-m
I-Nom cook-1Sg rice-Acc
'I cook rice'

b. aham svap-imi
I-Nom sleep-1Sg
'I sleep' (active)

c. mayā pac-ya-te odana-ḥ
I-Instr cook-Pass-3Sg rice-Nom
'Rice is cooked by me'

d. mayā sup-ya-te
I-Instr sleep-Pass-3Sg
'I sleep' (impersonal passive)

The verb agrees with the 1Sg pronoun in [59a,b], but not in [59c,d]. Why? Recall that the finite verb ending "expresses" one of three things: *(1)* the Agent, *(2)* the Goal, or *(3)* the Process. So the relational structures of [59] are:

(60) a. aham pacā my$_{AGENT}$ odan am$_{GOAL}$ 'I cook rice'

b. aham svap imi$_{AGENT}$ 'I sleep'

c. mayā$_{AGENT}$ pacya te$_{GOAL}$ odanaḥ 'Rice is being cooked by me'

d. mayā$_{AGENT}$ supya te$_{PROCESS}$ 'I sleep' (impersonal passive)

and the agreement rule we need is:

(61) If the verb ending expresses the role of a first or second person pronoun, it is first or second person, otherwise it is third person.

The "elsewhere case" (third person) arises both when the ending expresses the *kāraka* of a third person nominal, as in [60c], and when it expresses no *kāraka* at all, but rather "Process", as in [60b,d]. The verb and the nominal so linked are designated by Pāṇini as *samānādhikaraṇa*, "having the same substratum" (let's translate it as *coindexed*, for it isn't quite the same thing as "coreferential"). It is

the same relation as that which holds between the head and modifiers in a noun phrase. Thus, subject-verb person agreement and adjective-noun gender/number concord are in this treatment manifestations of the same semantic relationship.

Independent motivation for the coindexing treatment comes from the agreement of conjoined subjects. A conjunct nominal of the form 1P+3P gets 1P agreement, a conjunct nominal of the form 2P+3P gets 2P agreement:

(62) aham kṛṣṇa-ś ca pacā-vaḥ
I-Nom Krishna-Nom and cook-1Dual
I and Krishna are cooking

This follows without further stipulation from the rules already given.

Another way in which Pāṇini's coindexing account of agreement is superior to a subject-based account is seen in relative clauses like [63].

(63) paśya-ti mām ya-ḥ pacā-mi
see-3Sg me-Acc who-Nom cook-1Sg
'He sees me, who am cooking'

The "subject" is the third person relative pronoun *ya-* "who", but, as rule [61] predicts, the verb in fact agrees with the *head* of the relative clause, in this case with *aham* "I". Any rule specifying agreement in terms of subjects would have to be supplemented to get first or second person agreement here. Pāṇini's rule, however, covers this situation directly. In [63], the verb is coindexed with both *aham* "I" (first person) and with *yaḥ* "who" (third person), and first person verb agreement is correctly enforced as before.

Since Sanskrit is a typical "*pro*-drop language" the pronouns which trigger first and second person verb agreement are not necessarily expressed. Indeed, they are usually absent. Pāṇini's grammar simply assumes that words can be freely omitted in sentences when they are evident from the meaning or context. This was considered a phenomenon which falls outside the domain of sentence grammar, so there are no rules of ellipsis in the grammar. Still, we can be sure that Pāṇini considered ellipsis a rule-governed discourse process because some rules of grammar that he does formulate make reference to the results of ellipsis, for reasons that have to do with his general theory of rule interaction. This says that if rule A has the effect of bleeding rule B (eliminating inputs to it), A has priority over B in the order of application; hence ellipsis should take place before any rule that refers to the ellipsed elements — in other words, ellipsed elements should have no syntactic effects. In cases where this convention does *not* yield the right results, Pāṇini explicitly arranges for the ellipsed elements to be "visible" by means of special conditions on rules. This is the procedure he follows to prevent *pro*-drop from bleeding agreement. He complicates his agreement rule to say that pronouns trigger agreement even when they are not overtly expressed. In this way, agreement is entirely unaffected by whether the triggering pronoun is overtly present or subjected to ellipsis.

To ensure that person agreement applies properly even when pronouns are dropped, the agreement rules (64), (65) must stipulate that agreement takes place even when the pronoun is present just in the input *(sthāniny api)*.

(64) 1.4.105 युष्मद्युपपदे समानाधिकरणे स्थानिन्यपि मध्यमः
yuṣmady upapade samānādhikaraṇe sthāniny api
yuṣmad-Loc adjunct-Loc coindexation-Loc input-Loc even
madhyamaḥ
middle
'the second set of person endings are added in coindexation with the stem *yuṣmad* 'you', even if underlying'

(65) 1.4.107 अस्मद्युत्तमः
asmady uttamaḥ (105 upapade samānādhikaraṇe sthāniny
asmad-Loc last
api)

'the last set of person endings (= first person) are added in coindexation with the stem *asmad* 'I', even if underlying'

(66) 1.4.108 शेषे प्रथमः
śeṣe prathamaḥ
rest-Loc first
'elsewhere the first set of person endings (= third person) are added'

Thus, *kārakas* make possible an ingenious treatment of verb agreement which not only gets around the potential problem which the lack of the concept "subject" would seem to cause, but actually explains a set of cases which are problematic for accounts of agreement that rely on such a concept.

2.3.2 Anaphora

The second important area where the subject relation is invoked in Western grammar is anaphora (Binding Theory). For example, the antecedent of a reflexive pronoun in many languages must be a grammatical subject. As it happens, the antecedent of a reflexive pronoun in Sanskrit is normally the *logical* subject — for example, the Agent phrase in a passive. This generalization is inexpressible in any binding theory which relies on the notion "grammatical subject" (however defined), but it is easy in Pāṇini's system. The antecedent is just the *kartṛ*. Again, the absence of grammatical relations, far from being a liability of Pāṇinian grammar, turns out to be consistent with the right generalizations about Sanskrit.

2.3.3 Control and Ellipsis

The third area where grammatical relations might play a role is "control" of the PRO subject of nonfinite verbs (infinitives and absolutives). In Sanskrit, this depends on the *kārakas* in an absolutely essential way. Contrary to English, where PRO subjects are coreferential with the containing clause's subject or object, in Sanskrit they are coreferential with its Agent or Goal. In particular, if the main clause is passive, the controller of an adverbial participial clause is the grammatical subject in English, and the Agent (its "logical subject") in Sanskrit. For example, the literal English translation of our example sentence [2]

entails that the rice arrived in the village, in Sanskrit it means that Āśvapata arrived in the village. Pāṇini states the appropriate control principle at the level of thematic roles, as a condition requiring that the absolutive must have the same Agent as its governing verb.

(67) 3.4.21 समानकर्तृकयोः पूर्वकाले
samānakartṛkayoḥ pūrvakāle (19 ktvā) (3.1.91 dhātoḥ) (3.1.1-2
same-agent-AblPl prior-Loc
pratyayaḥ. . .)

'When two events have the same agent, *Ktvā* is suffixed to the root which denotes the prior event.'

This accounts correctly for the interpretation of the absolutive in sentences such as (2). It also predicts correctly that Sanskrit has no passive absolutives (i.e. no analogs to English *having been eaten*).

So far so good. But when we turn to infinitive purpose clauses, a question arises about how the licensing mechanism works in these control structures. The infinitive of purpose is introduced by rule

(68) 3.3.10तुमुन्ण्वुलौ क्रियायां क्रियार्थायाम्
tumuṇṇvulau kriyāyāṃ kriyārthāyām
tumUN-ṆvuL-NomDu action-Loc action-purpose-Loc
'(the *kṛt* affixes) *tumUN* and *ṆvuL* are added (after a root) denoting an action which is the purpose of another action'

Thus, the infinitive *-tum* seems to express the Agent role (in virtue of being a *kṛt* suffix), and purpose. We seem to face the problem that the theory apparently predicts that sentences like [69a,b] are ungrammatical, and [69c] grammatical, and the facts are exactly the other way around:

(69) a. kṛṣṇa-ḥ paca-ty odana-m bhok-tum
Krishna-Nom cook-3Sg rice-Acc eat-Inf
'Krishna cooks rice to eat'

b. kṛṣṇ-ena pac-ya-te odana-ḥ bhok-tum
Krishna-Instr cook-Pass-3Sg rice-Nom eat-Inf
'Rice is cooked by Krishna to eat'

c. *kṛṣṇ-ena pac-ya-te odana-m bhok-tum
Krishna-Instr cook-Pass-3Sg rice-Acc eat-Inf
'Rice is cooked by Krishna to eat'

The reason the system seems to predict wrongly that [70a] and [70b] is ungrammatical is that the Goal role that *odana* "rice" bears in relation to *bhoktum* "to eat" is not expressed, and the reason it seems to predict that in [70c] is grammatical is that all roles are apparently properly expressed:

(70) a. kṛṣṇa-ḥ paca ti$_{AGENT}$ odan am$_{GOAL}$ bhok tum$_{AGENT,PURPOSE}$

b. kṛṣṇ ena$_{AGENT}$ pacya te$_{GOAL}$ odanaḥ bhok tum$_{AGENT,PURPOSE}$

c. kṛṣṇ ena$_{AGENT}$ pacya te$_{GOAL}$ odan am$_{GOAL}$ bhok tum$_{AGENT,PURPOSE}$

The solution to this problem is a constraint, apparently presupposed by Pāṇini, to the effect that:

(71) A nominal cannot have a role with respect to more than one verb. (The "Th-criterion".)

So, since *odana* is the Goal of *pacati* in the sentences of [70], it can't also also bear a role with respect to the subordinate infinitive *bhoktum*. Accordingly, [70c] is ungrammatical because the accusative case of *odanam* has no function (does not express any role). In the grammatical sentences [70a,b], all morphological elements are licensed, so the sentences are OK.

But then what expresses the relation between *odana* and *bhoktum* in those sentences? The answer is: nothing. There is in fact no direct relation between them. The Goal of the infinitive *bhoktum* is not *odana* itself, but an ellipsed pronoun in the subordinate clause that anaphorically refers to *odana*.

(72) a. kṛṣṇa-ḥ paca ti$_{AGENT}$ odan am$_{GOAL}$ bhok tum$_{AGENT,PURPOSE}$ (en am)$_{GOAL}$

b. kṛṣṇ ena$_{AGENT}$ pacya te$_{GOAL}$ odanaḥ bhok tum$_{AGENT,PURPOSE}$ (en am)$_{GOAL}$

This analysis correctly predicts the possibility of sentences in which the main verb's object and the infinitive's object are distinct:

(73) a. kṛṣṇa-ḥ kāṣṭhāni bhinat-ti odana-m pak-tum
Krishna-Nom firewood-pieces split-3Sg rice-Acc cook-Inf
'Krishna splits firewood in order to cook rice'

b. kṛṣṇ-ena kāṣṭhāni bhid-ya-nte odana-m pak-tum
Krishna-Instr firewood-pieces split-Pass-3Pl rice-Acc cook-Inf
'Firewood is split by Krishna in order to cook rice'

The infinitive constructions in question furnish another interesting example of an explicit reference to ellipsis in Pāṇini's rules. Consider the range of elliptic variants of a sentence such as

(74) aham edh-ān āhar-tum gacchā-mi
I-Nom firewood-Acc fetch-Inf go-1Sg
'I'm going to fetch firewood'

As before, the pronoun *aham* can be freely omitted without consequences for the syntax of the sentence. The same is true, with one exception, for the other words in the sentence, in the appropriate contexts:

(75) a. *edhān āhartum* ('Where are you going?') 'To fetch firewood'.
b. *āhartum gacchāmi* ('What about the firewood?') 'I'm going to fetch (it)'.
c. *edhān* ('What are you going to fetch?') 'Firewood'.
d. *āhartum* ('What are you going to do to the firewood?') 'Fetch (it)'.
e. *gacchāmi* ('Are you fetching the firewood?') 'I'm going to'.

However, one of the logically possible patterns of deletion, [76a], is ungrammatical, just as its English counterpart. But if we change the case of the noun into the dative, the sentence is OK again!

(76) a. **edhān gacchāmi* 'I'm going firewood'.
b. *edhebhyo* (Dative) *gacchāmi* 'I'm going for firewood'.

To account for the ungrammaticality of [76a] and for the grammaticality of [76b] Pāṇini adds a special rule of case assignment to his grammar.

(77) 2.3.14 क्रियार्थोपपदस्य च कर्मणि स्थानिनः
kriyārthopapadasya ca karmaṇi sthāninaḥ (13 action-meaning-complement-Gen and *karman*-Loc substitute-Gen **caturthī)**

'The fourth set of case endings (dative) expresses the *karman* of a substituted [in effect, deleted] verb which denotes an action whose purpose is another action.' which is

The verb deleted in [76a] is *āhartum* "to fetch"; it is construed with *gacchāmi* by Pāṇini's rule for purpose complements (3.3.10). Therefore, 2.3.14 applies to yield [76b]. In accord with the *siddha*-principle (38), the deleted verb would be invisible were it not for this rule. In accord with the blocking principle, (77) automatically blocks the general rule which states that accusative case expresses a Goal.

Returning to control, in a superficially similar construction with a class of "equi" verbs, such as *icchati* "want", the pattern of grammaticality judgments in the passive is the opposite of that in [70b,c]:

(78) a. kṛṣṇa-ḥ iccha-ti odana-m bhok-tum
Krishna-Nom want-3Sg rice-Acc eat-Inf
'Krishna wants to eat rice'
b. *kṛṣṇ-ena iṣ-ya-te odana-ḥ bhok-tum
Krishna-Instr want-Pass-3Sg rice-Nom eat-Inf
'Rice is wanted by Krishna to eat' (contrast the grammatical [70b])
c. kṛṣṇ-ena iṣ-ya-te odana-m bhok-tum
Krishna-Instr want-Pass-3Sg rice-Acc eat-Inf
'Rice is wanted by Krishna to eat' (contrast the ungrammatical [70c])

For these verbs, Pāṇini provides a specific control rule.

(79) 3.3.158 समानकर्तृकेषु तुमुन्
samānakartṛkeṣu tumun (157 icchārtheṣu)
same-agent-ed-LocPl tumUN-Nom
'*tumUn* is added after a root that is construed with a root denoting 'want' that has the same agent'

(80) a. kṛṣṇa-ḥ iccha ti$_{AGENT}$ odan am$_{GOAL}$ bhok tum$_{SAME-AGENT}$

b. kṛṣṇ ena$_{AGENT}$ iṣya te$_{PROCESS}$ odanaḥ bhok tum$_{SAME-AGENT}$

c. kṛṣṇ ena$_{AGENT}$ iṣya te$_{PROCESS}$ odan am$_{GOAL}$ bhok tum$_{SAME-AGENT}$

Note that in [80b] *-te* (in its passive function) cannot link *odanaḥ*, because of principle [71].

With yet a third class, "raising"-type verbs such as *śak* "can", the pattern in the passive is once more reversed:

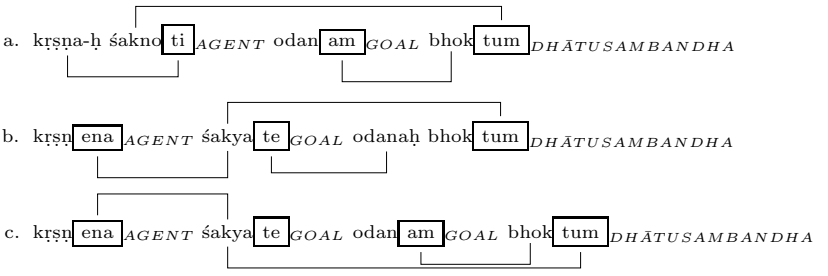
(81) a. kṛṣṇa-ḥ śakno-ti odana-m bhok-tum
Krishna-Nom can-3Sg rice-Acc eat-Inf
'Krishna can eat rice'
b. kṛṣṇ-ena śak-ya-te odana-ḥ bhok-tum
Krishna-Instr can-Pass-3Sg rice-Nom eat-Inf
(passive of [a])
c. *kṛṣṇ-ena śak-ya-te odana-m bhok-tum
Krishna-Instr can-Pass-3Sg rice-Acc eat-Inf
(passive of [a])

Pāṇini explicitly provides for this class too by a special rule which stipulates that the infinitive suffixes, such as *tum*, in connection with roots of the *śak* class, express *dhātusambandha* "verb union" (Joshi 1971).

(82) 3.4.1 धातुसंबन्धे प्रत्ययाः
dhātusaṃbandhe pratyayāḥ
root-connection-Loc suffix-PlNom
'(words ending in the following) suffixes are connected to verbal roots'

In virtue of this verb union process, combinations like *bhoktum śaknoti* "can eat" are treated exactly like a single predicate for purposes of the grammar's licensing constraints. The data in [81] then follows:

(83)



Finally, participial constructions with object control require a special rule:

(84) 3.2.124 लटः शतृशानचावप्रथमासमानाधिकरणे
laṭaḥ śatṛśānacāv aprathamāsamānādhikaraṇe
lAṬ-Gen ŚátṚ-ŚānaC-NonDu non-Nominative-coindexed-Loc
'When present tense *lAṬ* is not coindexed with a nominative, it is replaced by the participle endings *-āna, -a(n)t*'.

This rule obligatorily turns [85a] into [85b], and thus at one stroke accounts for all the data — for the ungrammaticality of [85a], which could otherwise be parsed by the system, for the grammaticality of [85b], and for the ungrammaticality of the corresponding passive [85c], which violates [84].

(85) a. *kṛṣṇa-ḥ paśya-ti Yajñadatt-am gaccha-ti
Krishna-Nom see-3Sg Yajñadatta-Acc go-3Sg
'Krishna sees Yajnadatta go'
b. kṛṣṇa-ḥ paśya-ty Yajñadatt-am gacch-ant-am
Krishna-Nom see-3Sg Yajñadatta-Acc go-Part-Acc
'Krishna sees Yajnadatta goes'
c. *kṛṣṇ-ena dṛś-ya-te Yajñadatta-ḥ gacch-an
Krishna-Instr see-Pass-3Sg Yajñadatta -Nom go-Part-Nom
'Yajnadatta is seen go by Krishna'

2.4 Non-thematic Objects

Any linking theory must deal with the fact that verbs can have objects which are not thematically related to them. I would like to propose that this is intended to be covered by an additional rule which assigns the *karman* role:

(86) 1.4.50 तथायुक्तं चानिप्सीतम्
tathāyuktaṃ cānīpsitam (49 kartuḥ, karma)
so-connected and non-goal-Nom
'also that which is likewise connected, even if not a goal of the agent, is called *karman*'.

Its wording is obscure and the interpretation is disputed. Traditionally it is taken to cover 'non-desired' objects, e.g. *viṣaṃ bhakṣayati* 'he eats poison'. More recently the proposal is gaining ground that its purpose is to account for the cases where double objects are permitted: e.g. *gāṃ payo dogdhi* 'he milks the cow (of)

milk', *pauravaṃ gāṃ bhikṣate* 'he begs Paurava for a cow', *mānavakaṃ dharmaṃ brūte* 'he teaches the boy duty', *gargān śataṃ daṇḍayati* 'he fines the Gargas a hundred', *ajāṃ grāmaṃ nayati* 'he leads the goat to the village'. Joshi suggests that *tathāyuktam* specifies that the second *karman* allowed by this rule should be connected to the main *karman* allowed by the preceding rule. However, this should have been expressed as **tadyuktam*. Kiparsky 1982, 41 proposes that this is in effect a transderivational rule, which sanctions the assignment of *karman* to an argument which does not satisfy the definition of [46] **kartur īpsitatamaṃ karma** provided that there is another sentence in which it does function as a *karman* by rule [46]. Thus, *gāṃ payo dogdhi* would be licenced by the existence of both *gāṃ dogdhi* 'he milks the cow' and *payo dogdhi* 'he milks milk', but in the double-object construction only one of them is *īpsita*. Ungrammatical sentences such as **gāṃ dogdhi kumbham* 'he milks the cow the pot' would be excluded because the second *karman* is not *tathāyukta* (cf. **kumbham dogdhi*). Ungrammatical sentences such as **gāṃ dogdhy ajām* 'he milks the cow the goat' would be excluded because they would have to have two parallel *īpsita karmans*.

My suggestion is that the same rule extends to non-thematic objects in the "conjunct participle" construction, which are otherwise not covered by the grammar. In this construction, a participial modifier constitutes the semantic predicate of its head noun, combining with it into the functional equivalent of an argument or adjunct clause. The head can be an object, as in (87a,b), or a passivized subject, as in (87c):

(87) a. **taṃ mantriṇā hataṃ śrutvā nyavedayan ...**
him-Acc minister-Instr kill-PPP-Acc hear-Abs inform-Impf-3Pl ...
'after hearing that the king had been killed by his minister, they informed ...' (⊅ 'after hearing the king') (Mbh. 3.283.4)

b. **taṃ vaí pakṣapucházantam eva sántam ná**
him-Acc Part wing-tailed-Acc just being-Acc not
pakṣapucházantam iva paśyanti
wing-tailed-Acc as-if see-3Pl
'although he in fact has wings and a tail, people do not see him as having wings and a tail' (⊅ 'people do not see him') (ŚB 7.1.1.20)

c. **havyavāhanaḥ śrūyate nigṛhīto vai purastāt**
fire-Nom hear-Pass3Sg caught-Nom Prt once
pāradārikaḥ
adulterer-Nom
'fire is heard (said) to have been once caught as an adulterer' (⊅ 'fire is heard') (*Mbh* 2.28.17)

The objects *tam* in (87a) and in (87b), and the passivized subject *havyavāhanaḥ* in (87c), do not bear a thematic relation to the main verb that governs them; their thematic role comes from the conjunct participle. Thus, they do not satisfy the definition of the *karman* relation in (46). To receive accusative case, and to be passivized in accord with the grammar, they must however have the status of *karman*. My proposal is that these sentences are *transderivationally* sanctioned

by (86) through analogy to parallel sentences where the corresponding argument is in fact legitimately an object, viz. *taṃ śrutvā* 'having heard him', *taṃ paśyanti* 'they see him', *havyavāhanaḥ śrūyate* 'the fire is heard.'

A problem is that the participle constitutes an anaphoric domain, in the sense that its implicit subject can (anaphorically) control the null subject of embedded nonfinite clauses:

(88) **māṃ tu dṛṣṭvā pradhāvantam anīkaṃ saṃpraharṣitum**
me-Acc Part see-Abs rushing-Acc front-Acc cheer-Inf
tyajantu harayas trāsaṃ
abandon-Imp3Pl monkey-Pl fear-Acc
'when they see me rush to the front to restore morale, may the monkeys lose their fear' (*(R.* 6.360.37)

Here the agent of *saṃpraharṣitum* is *māṃ* 'me' and not *harayas* 'the monkeys'. Therefore, it is not just a *karman* but also a *kartṛ*.

The third rule that introduces the *karman* role is:

(89) 1.4.51 अकथितं च
akathitaṃ ca (49 kartur īpsitatamaṃ karma)
unstated-Nom also
'Also an unexpressed primary goal of the agent is *karman*'.

I think *akathita* should be understood literally as *asaṃkīrtita* 'not mentioned, left out' or *avivakṣita* 'not intended to be expressed' *in the sentence* and that the rule takes care of "object pro-drop".[4] It specifies that ellipsed *karmans* are to count as *karmans* for purposes of the rules of grammar. About a dozen rules of the grammar distinguish between verbs with and without a *karman* (*akarmaka* vs. *sakarmaka*, roughly intransitive vs. transitive). It is crucial that transitive verbs count as *sakarmaka* even when their object is not overtly expressed. For example, rule 1.4.52 states that the agent of *akarmaka* verbs is a *karman* in the causative, e.g. *devadattam āsayati* 'he makes D. sit down'. But verbs with implicit unexpressed *karmans* are still *sakarmaka*, e.g. *dohayaty aśūdreṇa* (not **aśūdram*) 'he makes a non-*śūdra* milk (it)'. To get this it was necessary to frame the present rule because the *siddha*-principle would otherwise cause ellipsed elements to be invisible (Kiparsky 1982, 41-44).

2.5 Semantic Competition among *kārakas*

The rules assigning *kāraka* designations are headed by (90), (91), which ensure that any given argument gets only one role (semantic blocking again).

(90) 1.4.1 आ कडारादेका संज्ञा
ā kaḍārād ekā saṃjñā
'up to *kaḍāra*-Abl one term

[4] Tradition takes it to mean that whatever is not mentioned in the previous rules is *karman*, but is unable to provide a satisfactory interpretation on this basis.

'up to [the first occurrence of the word] *kaḍāra* (the end of 2.2), (only) one technical term (is to be assigned)'

(91) 1.4.2 विप्रतिषेधे परं कार्यम्

vipratiṣedhe paraṃ kāryam
conflict-Loc last to be applied'
'in case of conflict, the last (rule) is to be applied'

For example, in *dhanuṣā vidhyati* 'he pierces by means of a bow' (i.e. with arrows shot from a bow), *dhanuṣ* 'bow' satisfies both the definition of the source role (*apādāna*), and the definition of the instrument role (*karaṇa*), since it is both the "fixed point" from which the arrows move off and the "means" for launching the arrows.

(92) 1.4.24 ध्रुवमपाये ऽपादानम्

dhruvam apāye 'pādānam
fixed-Nom separation-Loc *apādāna*-Nom
'in a separation, the fixed point is (called) *apādāna* ('source')'

(93) 1.4.42 साधकतमं करणम्

sādhakatamaṃ karaṇam
most-effective-means-Nom *karaṇa*
'the most effective means is (called) *karaṇa* ('instrument')'

As a result of [90], [91] it is only designated as a *karaṇa* by the later rule 1.4.42, so that the grammatical sentence *dhanuṣā vidhyati* 'he pierces with a bow' is derived and the ungrammatical sentence *dhanuṣo vidhyati* 'he pierces from a bow' is not derived.

The heading that introduces the *kāraka* terms is continued through [51] 1.4.55.

(94) 1.4.23 कारके

kārake
role-Loc
'to express a role'

The characterization of the *kāraka* roles raises some interesting questions that semanticists still wrestle with. Let us sample this domain by taking a look at the discussion around the *kāraka* called *apādāna* 'source', introduced by (92): The basic expression for *apādāna* is the ablative case.

(95) 2.3.28 अपादाने पञ्चमी

apādāne pañcamī
source-Loc fifth-Nom
'the fifth case expresses *apādāna*'

E.g. *vanāt* 'from the forest' (see (2)). Kātyāyana notes that in cases such as *aśvāt trastāt (dhāvataḥ) patitaḥ* 'he has fallen from a shying (running) horse', *sārthād gacchato hīnaḥ* 'he has strayed from the moving caravan' the horse and caravan are not fixed. Patañjali argues that this is no problem because they are fixed *in relation to* the object which moves away from them (Joshi & Roodbergen 1975).

The main problem is how to characterize the source relation outside of the domain of physical movement. Subsequent special rules (all with *apādānam* continued from (92)) provide explicitly for this. (96) and (97).

(96) 1.4.25 भीत्रार्थानां भयहेतुः

bhītrārthānāṃ bhayahetuḥ
fear-protect-meaning-GenPl fear-cause

'In connection with (roots) meaning 'fear' and 'protect' the cause of fear is (called) *apādāna*'.

E.g. *caurebho bibheti* 'he fears thieves', *caurebhyo rakṣati* 'he protects from thieves', and in derivatives such as *bhīma* (by 3.4.74 *bhīmādayo 'pādāne*). Patañjali retorts that these verbs denote a mental separation and therefore are already covered by Pāṇini's rule. Similarly:

(97) 1.4.26 पराजेरसोढः

parājer asoḍhaḥ
overcome-Gen unbearable-Nom

'In connection with *parāji* "to be overcome", that which one cannot endure is (called) *apādāna*.'

E.g. *adhyayanāt parājayate* 'he is tired of studying'. Patañjali says: "A thoughtful person observes: study is a pain, it is difficult to memorize things, and teachers are hard to satisfy. (And so,) having (first) formed a connection (with study) in his mind, he (then) desists (from it). This being so, we can manage by (1.4.24) **dhruvam apāye 'pādānam**." Kātyāyana notes that roots denoting disgust, cessation, and neglect should be specified in the rule: *adharmāj jugupsate* 'he is disgusted by wrong', *dharmān muhyati* 'he neglects *dharma*', for which Patañjali proposes the same account.

Going further, Patañjali proposes that the basic rule (92) can handle examples like *yavebhyo gā vārayati/nivartayati* 'he wards off/turns away the cows from the barley', *kūpād andhaṃ vārayati* 'he keeps the blind man away from the well', *upādhyāyād antardhatte* 'he hides from the teacher', *upādhyāyād adhīte* 'he learns from his teacher', *śṛṅgāc charo jāyate* 'the arrow is made out of horn', *gomayād vṛściko jāyate* 'the scorpion originates from cowdung', *himavato gaṅgā prabhavati* 'the Ganges arises from the Himalayas', so that all the special rules for them can be eliminated.

For more recent insightful discussion of various non-movement source and goal relations see Talmy 1988 and Fong 1997. Fong defines a more abstract notion of source which can be parametrized in different domains.

3 Morphology

3.1 Categories and Word-Formation Processes

Suffixation consists of adding a suffix *(pratyaya)* to a base *(aṅga)*. The rules in chapters 3 - 5 (a section of about 1800 rules) deal with suffixation, and are headed by (10) and (11). A base of affixation is defined as *aṅga* by [98]:

(98) 1.4.13 यस्मात्प्रत्ययविधिस्तदादि प्रत्यये ऽङ्गम्

yasmāt pratyayavidhis tadādi pratyaye 'ṅgam
what-Abl suffix-rule-Nom that-beginning-Nom suffix-Loc base-Nom
'whatever an suffix is appended to, together with anything that follows it before the suffix, is an *aṅga* "base"'

Bases are of three categories:

- *dhātu* '(verbal) root'
- *prātipadika* '(nominal) stem'
- *pada* 'word'

Roots are either basic (defined in [99]) or derived (defined in [100]).

(99) 1.3.1 भूवादयो धातवः

bhūvādayo dhātavaḥ
bhū-beginning-PlNom root-PlNom
'*bhū* etc. (the items listed in the *dhātupāṭha*) are (termed) *dhātu* "root"'

(100) 3.1.32 सनाद्यन्ता धातवः

sanādyantā dhātavaḥ
saN-beginning-ending-PlNom root-PlNom
'items ending in *san* etc. (the suffixes introduced in rules 3.1.5 ff.) are (termed) *dhātu* "root"'.

Nominal stems are also either basic or derived. Basic nominal stems are defined in [101].

(101) 1.2.45 अर्थवदधातुरप्रत्ययः प्रातिपदिकम्

arthavad adhātur apratyayaḥ prātipadikam
meaning-having-Nom non-root-Nom non-suffix-Nom base
'an element which has a meaning and is not a *dhātu* or a *pratyaya* [and does not end in a *pratyaya*], is (termed) *prātipadika*' "base"'.

The definition excludes not only suffixes, but also suffixed items. Words *(padas)*, for example, are not *prātipadikas*, for goodmany reasons. Suffixes, are *prātipadikas*, however, in so far as they fall under [102].

(102) 1.2.46 कृत्तद्धितसमासाश्च

kṛttaddhitasamāsāś ca (45 prātipadikam)
kṛt-taddhita-compound-PlNom and'

'elements ending in *kṛt* or *taddhita* suffixes, and compounds, are (termed) *prātipadika*'.

Rule (102) actually covers the majority of suffixed nominal forms, excepting only finished nouns *(padas)* and feminine stems (although the latter pattern with *prātipadikas* as inputs to inflection and secondary derivation, as provided for by (13) 4.1.1 **ṅyāp prātipadikāt**).

A WORD is defined as anything that ends in an inflectional suffix.

(103) 1.4.14 सुप्तिङन्तं पदम्

sup-tiṅ-antam padam
suP-tiṄ-ending-Nom word-Nom
'An element tha ends in *suP* (a case ending) or *tiṄ* (a person/number ending) is (termed) *pada* 'word'.

The definition covers indeclinable words too, for they are all assigned nominal inflectional endings, which are then deleted. Similarly, each member of a compound is a word because it contains a later deleted case ending. For instance, *rājapuruṣa* 'king's servant' is derived from *rājan-Ṅas+puruṣa-sU*, with an internal genitive case ending on the first member. The reason for this procedure is that it simplifies the morphological derivation of compounds and automatically accounts for certain phonological phenomena. For example, in *rājapuruṣa* 'king's servant' the first member *rājan-*, being a word, gets its correct form by an independently motivated phonological rule which deletes word-final *-n*.

How can the wordhood of an indeclinable or of the first member of a compound be due to its deleted case ending, given that the *siddha*-principle says that deleted material is invisible? The reason even deleted case endings confer wordhood is rule [104]:

(104) 1.1.62 प्रत्ययलोपे प्रत्ययलक्षणम्

pratyayalope pratyayalakṣaṇam
suffix-deletion-Loc suffix-effect-Nom
'when a suffix is deleted, the operations triggered by it still apply'

It sets aside the *siddha*-principle, so that words whose case endings are deleted by still count as *padas* for purposes of applying [103].

The following types of word-formation occur:

a. [Root + Suffix]$_{\text{Root}}$: desideratives, intensives, causatives.
b. [Word + Suffix]$_{\text{Root}}$: denominal verbs.
c. [Root + Suffix]$_{\text{Stem}}$: primary *(kṛt)* suffixes.
d. [Word + Suffix]$_{\text{Stem}}$: secondary *(taddhita)* suffixes.
e. [Word + Word]$_{\text{Stem}}$: compounding.
f. [Root + Suffix]$_{\text{Word}}$: verb inflection.
g. [Stem + Suffix]$_{\text{Word}}$: noun inflection.

3.2 The "Sup" Endings

Nominal stems (*prātipadikas)* are marked by suffixes for number and case. Sanskrit has three numbers (Singular, Dual, and Plural) and seven cases (Nominative, Accusative, Instrumental, Dative, Ablative, Genitive, Locative). (The vocative is not considered a separate case, but a use of the nominative, even though it does have distinctive endings in the singular.)

The underlying endings are enumerated in rule [105].[5]

(105) 4.1.2

Singular *(ekavacana)*	Dual *(dvivacana)*	Plural *(bahuvacana)*	
sU	au	Jas	Nominative *(prathamā)*
am	auṬ	Śas	Accusative *(dvitīyā)*
Ṭā	bhyām	bhis	Instrumental *(tṛtīyā)*
Ṅe	bhyām	bhyas	Dative *(caturthī)*
ṄasI	bhyām	bhyas	Ablative *(pañcamī)*
Ṅas	os	ām	Genitive *(ṣaṣṭhī)*
Ṅi	os	suP	Locative *(saptamī)*

As usual, *pratyāhāras* are formed from this list by combining a listed element with a diacritic to include all the intervening elements in the list, e.g. *suP* 'case ending', *suṬ* 'a "strong" case ending'. The endings are numbered in successive groups of three, with *(prathamā)* "first", *(dvitīyā)* "second", etc. serving as names of the cases. The first ending in each group is given the designation *ekavacana* 'singular', the second *dvivacana* "dual', and the third *bahuvacana* "plural".

The first case and the last three make up the basic format of a Pāṇinian substitution rule. Genitive case marks the item to be replaced, Nominative the replacement, Ablative the left context, and Locative the right context.

The underlying forms in (105) are basically those of the -C stems. In the *-a* declension, most of the singular endings have suppletive alternants. For example, the Instr., Abl., and Gen.Sg. endings are introduced by (106):

(106) 7.1.12 टाङसिङसामिनात्स्याः

ṭāṅasiṅasām inātsyāḥ (9 ataḥ) (6.1.4 aṅgasya)

Ṭā-ṄasI-Ṅas-PlGen *ina-āt-sya*PlNom

After a base ending in short *a*, the case endings *Ṭā, ṄasI, Ṅas* are replaced (respectively) by *ina, āt, sya.*

E.g. Instr.Sg. *Āśvapata+ā* → (106) *Āśvapata+ina* → [26] *Āśvapatena.*

This brings up another important rule which trumps the *siddha*-principle in a special set of cases:

[5] For the reader's convenience the items enumerated in the rule are here arranged into labeled columns and rows, with *sandhi* undone. Actually, of course, it is recited as running text, like the whole grammar, and the labels are assigned by rules as explained directly below.

(107) 1.1.56 स्थानिवदादेशो ऽनल्विधौ
sthānivad ādeśo 'nalvidhau
original-like-Nom substitute-Nom non-sound-rule-Loc'
'a substitute is treated like the original, except with respect to a phonologically conditioned operation'

This rule says that *non-phonological* properties of the input *are* inherited under replacement. Consider the derivation of Dat.Sg. *grāmāya*. After *-a* stems, Dat.Sg. *Ne* is replaced by *ya* by 7.1.13. The replacement then triggers lengthening by [108].

(108) 7.3.102 सुपि च
supi ca (101 ataḥ) (101 dīrghaḥ, yañi) (6.4.1 aṅgasya)
sUP-Loc and
'The final *a* of a nominal stem is lengthened before a case ending that begins with yañ (a glide, a nasal, *jh*, or *bh*).'

But [108] calls for lengthening before a *sup* (case ending), and, being introduced as a replacement, *-ya* obviously does not appear in the list of case endings that is subsumed under the *pratyāhāra sup* in [105]. Then how can *-ya* trigger the desired lengthening? The answer is that it "inherits" the status of a *sup* in accord with (107).

3.3 Verb Inflection

3.3.1 Vedic Versus Classical Sanskrit

Vedic verbs are inflected for person, number, mood, tense/aspect and voice. Finite verbs distinguish all these categories. Participles distinguish only tense/aspect and voice. Infinitives do not distinguish any of them.

A root can form up to four tense/aspect stems (though not every root has all four of them).

(109) a. The present stem *(pác-a-)*
b. The aorist stem *((a-)pā́k-ṣ-)*
c. The perfect stem *(pá-pac-)*
d. The future stem *(pák-ṣyá-)*

The perfect stem is formed by reduplication; the others are formed by suffixation. Every tense/aspect stem can be directly inflected for person (first, second, third), number (singular, dual, plural), and voice (active, middle) to make a complete finite paradigm, or it can undergo other affixation processes.

The present, aorist, and perfect stems are each inflected with a distinct set of person/number endings; the future stem is inflected exactly like the present stem. Present, aorist, and perfect (but not the future) distinguish four moods:

(110) a. Indicative
b. Optative
c. Subjunctive
d. Imperative

The inflection of the present stem marks a distinction between present tense and "imperfect" tense, which in spite of its name is not imperfective or progressive but simply a preterite. Imperfect tense has no modal or participial forms; its inflection resembles that of the aorist in having a prefixed augment and partly in the form of its person/number endings. Altogether, then, there are five tenses.

Person/number endings and participial endings mark a distinction between active and middle voice throughout. Middle voice has a reflexive function for some verbs, and passive verbs always take middle endings. However, many verbs simply require the middle endings for no particular reason. The present stem, moreover, marks passive by a special stem-forming suffix.

The restriction that the future and imperfect have no modal forms is curious. Why should modality not be distinctive in the future and imperfect, but only in the present, aorist, and perfect? The answer may be that the future and imperfect are pure tenses in the sense that they locate the time of an eventuality after and before speech time, respectively. Aorist and perfect, on the other hand, are *relative tenses* (or *aspects* in the Reichenbachian sense) which locate the time of an eventuality in relation to a *reference* time, which must itself be fixed in relation to speech time. In modal contexts, only the aspectual component of the aorist and perfect surfaces, not the temporal component. Since the future and imperfect don't have one, they have no moods. Suppose that pure tenses and moods turn predicates into propositions, while relative tenses or aspects are predicate modifiers (i.e. they turn predicates into other predicates). Then it would follow that pure tenses cannot be in the scope of modals, whereas relative tenses or aspects can.

This hypothesis is confirmed by a radical change in the tense/aspect system of Pāṇini's Sanskrit. It differs from the Vedic one in two respects. First, the perfect and the aorist are pure tenses, even with a modal component. The imperfect and perfect refer to non-current, historical past *(anadyatane)*, with the perfect furthermore specialized for reports of hearsay events *(paro 'kṣe)*. In reference to recent past events, the aorist is obligatory. Thus, a temporal opposition between near past and remote past, and a category of evidentiality (hearsay vs. witnessed) — more related to mood than to tense or aspect. The Vedic resultative aorist, as well as the aorist of relative anteriority, disappear, and the perfect loses its generic/habitual reading.

Secondly, there are no modal distinctions outside of the present. The perfect subjunctives, optatives, and imperatives of Vedic, as well as its aorist subjunctives, optatives, and imperatives, disappear.

On the assumption that pure tense cannot be modalized, the second change can be seen as a consequence of the first one. The loss of the aspectual function of the perfect and aorist entails the loss of their modal inflection as well.

At this stage, two new moods are introduced. Part of the morphological residue of the former aorist optative is refashioned as a new **precative** (also called **benedictive**) mood. The second new modal form is the **conditional**.

Formally it is a past of the future, made by inflecting the future stem with the imperfect endings. Although it is morphologically related to the future exactly like the imperfect is related to the present, it is functionally neither a future nor a past, but used for counterfactual (or sometimes just hypothetical) conditionals (like English subjunctive use of *would*).

The inventory of tenses was also enriched. Corresponding to the distinction between near past (aorist) and remote past (perfect and imperfect), a distinction arose between near future and remote future. The new remote future tense was created by grammaticalizing periphrastic expressions consisting of an agent noun in *-tar* (plus the inflected copula, in the first and second person).

The result of all these changes is a system which Pāṇini treats in terms of ten mutually exclusive tense/mood categories, each represented by an abstract affix which is spelled out morphologically in accord with agreement and other constraints. The names of the abstract affixes are really bundles of diacritic markers that encode some of their important shared morphological features. For example, the future and the conditional are *lṚṬ* and *lṚN̄*, and the marker *-Ṛ-* that they uniquely share triggers the introduction of stem-marking morpheme *-sya* after them. The fact that conditional mood *(lṚN̄)* also shares morphological properties with optative mood, imperfect tense, and aorist tense (for example, they take the so-called secondary endings) is captured by assigning these the respective names *lIN̄*, *lAN̄*, and *lUN̄* and letting the rules responsible for their shared morphology be triggered by the marker *-N̄* that all four categories uniquely share. The fact that future tense *(lṚṬ)* also has unique morphological properties in common with the present, the perfect, the remote future, the subjunctive, and the imperative, is captured by assigning these the respective names *lAṬ*, *lIṬ*, *lUṬ*, *lEṬ*, *loṬ*, and letting the rules responsible for their shared morphology be triggered by the marker *-Ṭ* that all six of them share.

These markers play a role only in the mapping to morphology. They are not suited for handling such functional and semantic affinities as exist between the ten abstract tense/mood affixes. These are captured by grouping the rules that introduce the *l-* affixes under common headings. For example, the three past tense affixes (aorist *lUN̄*, imperfect *lAN̄*, and perfect *lIṬ*) are assigned under the heading (113) 3.2.84 **bhūte** 'in reference to past time', which takes various nominal affixes under its scope as well.[6]

3.3.2 The *l*-Suffixes

There is much overlap and competition of meaning and use among the ten tenses and moods. All the tense/mood suffixes come under the headings (10) 3.1.1 **pratyayaḥ**, (11) 3.1.2 **paraś ca**, 3.1.91 **dhātoḥ**, which define them as *pratyayas* and ensure that they are placed after verbal roots.

[6] As predicted by the proposal in the text, the time reference of the latter is always relative. For example, in the sentence *agniṣṭomayājy asya putro bhavitā* 'his son will be someone who has sacrificed the *agniṣṭoma*', the past time reference of the suffix *-in* in *agniṣṭomayājin-* must be understood in relation to the future time reference of *bhavitā* 'will become'.

Present tense *(laṭ)* is introduced by:

(111) 3.2.123 वर्तमाने लट्
vartamāne laṭ
present-Loc *lAṬ*
'to denote ongoing time, *lAṬ* (present tense) is used'

Additional rules are concerned with extended senses of present tense. E.g. (112) records that the near future and the near past tend to be treated as ongoing time.

(112) 3.3.131 वर्तमानसामीप्ये वर्तमानवद्वा
vartamānasāmīpye vartamānavad vā
present-vicinity-Loc present-like optionally
'time near the ongoing is optionally *(vā)* denoted the same way as ongoing time'

In a *vārttika* on (111) 3.2.123, Kātyāyana notes that the rule must be augmented in order to account for the durative present: **pravṛttasyāvirāme śiṣyā bhavanty avartamānatvāt** 'present tense *(bhavantī)* must be specified for actions that have begun but not ended, because they are not (necessarily) going on (at the time of utterance)'. For example, one can truthfully say *ihādhīmahe* 'we are studying here' even though one is not studying while actually uttering that sentence. One must however have begun to study before that time and expect to continue studying after it. This use of present tense is already allowed by (112), so Kātyāyana's point is that it is not merely allowed but obligatory in these cases.

The three past tenses *lUN̄, lAN̄, lIṬ* tenses come under the heading (113):

(113) 3.2.84 भूते
bhūte
past-Loc
'in reference to past time, (the following) are suffixed to the root'

This heading extends not only over the past tenses, but also over a number of *kṛt* suffixes that locate an eventuality in past time, until it is canceled by (111) 3.2.123 **vartamāne laṭ**.

The aorist *(lUN̄)* is introduced by rule (114), as the default past.

(114) 3.2.110 लुङ्
luṅ (3.2.84 bhūte)
lUN̄
'in reference to past time, *lUN̄* (aorist tense) is suffixed to the root'

Imperfect tense *(lAN̄)* is limited to the remoter past.

(115) 3.2.111 अनद्यतने लङ्
anadyatane laṅ (3.2.84 bhūte)
non-current-Loc *lAN̄*
'in reference to non-recent past time, *laṅ* (imperfect tense) is suffixed to the root'

So is the perfect *(lIṬ)*, but with a further condition that it must be a hearsay report.

(116) 3.2.115 परोक्षे लिट्

parokṣe liṭ (111 anadyatane) (3.2.84 bhūte)

non-witnessed-Loc *lIṬ*

'in reference to non-recent non-witnessed past time, *lIṬ* (perfect tense) is suffixed to the root'

Are rules (114), (115) and (116) in a blocking relationship? This is a thorny question. According to the normal principles of interpretation of Pāṇini's grammar, the competition between three incompatible morphological elements should induce blocking. The perfect should block the imperfect, and the imperfect in turn should block the aorist. On this understanding, the aorist would refer only to eventualities that have happened earlier during the present day, the imperfect only to witnessed eventualities that have happened before the present day, and the perfect to non-witnessed eventualities that have happened before the present day.

Several specific formulations of Pāṇini's rules also presuppose such a blocking relation. If the aorist were not restricted to the recent past, there would be no sense in a special rule such as (117), which specifically allows for the optional use of the aorist for the remote past in a certain context (Subrahmanyam 1999: 282).

(117) 3.2.122 पुरि लुङ्चास्मे

puri luṅ cāsme (121 vibhāṣā) (84 bhūte)

purā-Loc *lUṄ* and not-*sma*-Loc

'in reference to remote past time, in combination with *purā*, in the absence of *sma*, also aorist tense (in addition to present tense or imperfect tense) is optionally (*vibhāṣā*) suffixed to a root'

In post-Pāṇinian usage, the aorist can refer to any past past event, whereas the imperfect and perfect are restricted as described above. Apparently, linguistic change has undone the original blocking relationship.

3.3.3 Person and Number Endings

The generalized tense/mood suffixes are replaced by the specific *tiN̄* endings which mark person and number.

(118) 3.4.77 **lasya**

(119) 3.4.78

Sg.	Du.	Pl.	
tiP	tas	jhi	(Active 3.p., *parasmaipada, prathama*)
siP	thas	tha	(Active 2.p., *parasmaipada, madhyama*)
miP	vas	mas	(Active 1.p., *parasmaipada, uttama*)
ta	ātām	jha	(Mediopassive 3.p., *ātmanepada, prathama*)
thās	āthām	dhvam	(Mediopassive 2.p., *ātmanepada, madhyama*)
iṬ	vahi	mahiN̄	(Mediopassive 1.p., *ātmanepada, uttama*)

These endings are themselves in turn subject to a variety of allomorphic replacements and phonological processes. The basic forms correspond to the

'primary' endings (used in the present tense, among others) in the active *(parasmaipada)*, and to the 'secondary' endings (used in the imperfect tense, among others) in the mediopassive *(ātmanepada)*. This choice of basic forms allows the simplest rules for deriving the allomorphs.

The principle that substitutes are treated like the original ((107) 1.1.56 **sthānivad ādeśo 'nalvidhau**) is very important here. It dictates that *tiN̄* substitutes inherit the properties of the *l*-endings they replace. For example, a *tiP* that replaces *lAṬ* counts as having the marker Ṭ. Similarly, the ending *ṆaL* that replaces *tiP* in the perfect counts as a *tiN̄* ending, even though it is not contained in the list (118).

3.4 Stem Formation: The *vikaraṇas*

3.4.1 The Tense/Mood Stems

Before those *l*-endings which belong to the *sārvadhātuka* class, a stem-forming element *(vikaraṇa)* is inserted, which together with the root constitutes the *aṅga* of the ending (by (98)). Which particular *vikaraṇa* is inserted depends on three things:

- tense/mood,
- voice (diathesis)
- the verb's conjugational class (in the present active only)

Each *l*-element represents a different tense/mood category. The three voices are determined by whether the endings have been chosen to denote the Agent, the Goal, or the Process (section 2.2). The ten conjugational classes are determined by the listing of verb roots in the *dhātupāṭha*.

The *sārvadhātuka l*-endings fall into two classes, the first of which roughly corresponds to the present system in the terminology of Western linguistics:

(120) a. *Present system: laṭ* 'present', *leṭ* 'subjunctive', *loṭ* 'imperative', *laṅ* 'imperfect', *liṅ* (optative in the *vidhi* 'hortatory/imperative' function)
b. *Non-present systems: luṅ* 'aorist', *luṭ* 'periphrastic (remote) future', *lṛṭ* '(near) future', *lṛṅ* 'conditional'

Each set of *sārvadhātuka l*-endings of the non-present system determines its own *vikaraṇa* in a straightforward way:

(121) a. Before *luṅ* (aorist) endings: *cli*
b. Before *luṭ* (remote future) endings: *tāsI*
c. Before *lṛṭ* (future) and *lṛṅ* (conditional) endings: *sya*

The aorist *vikaraṇa cli* is an abstract placeholder. It is always replaced by one of the actual endings according to the phonological shape and lexical identity of the root.

The *vikaraṇas* bear grammatical markers which among other things have effects on the form of the root, particularly on its accent and strong vs. weak grade, e.g. *kṛṣ+ŚaP+tiP* → *kárṣati* (first class), but *kṛṣ+Śa+tiP* → *kṛṣáti* (sixth class).

Also, they are themselves subject to alternations of stress and strong vs. weak grade, e.g. *su-nu-tiP* → *sunóti*, but *su-nu-mas* → *sunumás*.

The table on the next page shows the system of tense/mood stems in outline.

Before *l*-endings belonging to the present system, the choice of *vikaraṇa* depends on voice, and in the active, on the verb's conjugational class. If the *l*-endings denote the Goal or the Process, *yaK* is inserted by [122].

(122) 3.1.67 सार्वधातुके यक्
sārvadhātuke yak (66 bhāvakarmaṇoḥ)
sārvadhātuka-Loc *yaK*-Nom
'*yaK* is added before a *sārvadhātuka* suffix which denotes the Goal or the Process'.

The marker *K* on *yaK* blocks *guṇa* on the root by 7.3.84 *sārvadhātukārdhadhātukayoḥ*, in virtue of the prohibition 1.1.5 *knīti ca*. Thus we get the passive form *bhū-yá-te*, not **bhav-yá-te* etc.

If the *l*-endings denote the Agent, one of a set of other *vikaraṇas* is inserted before them. The choice depends on the conjugation class of the verb, which is an unpredictable lexical matter. The roots are listed in the *dhātupāṭha* in ten groups, each of which constitutes a different class. The default *vikaraṇa* is *ŚaP*, which is inserted by [123].

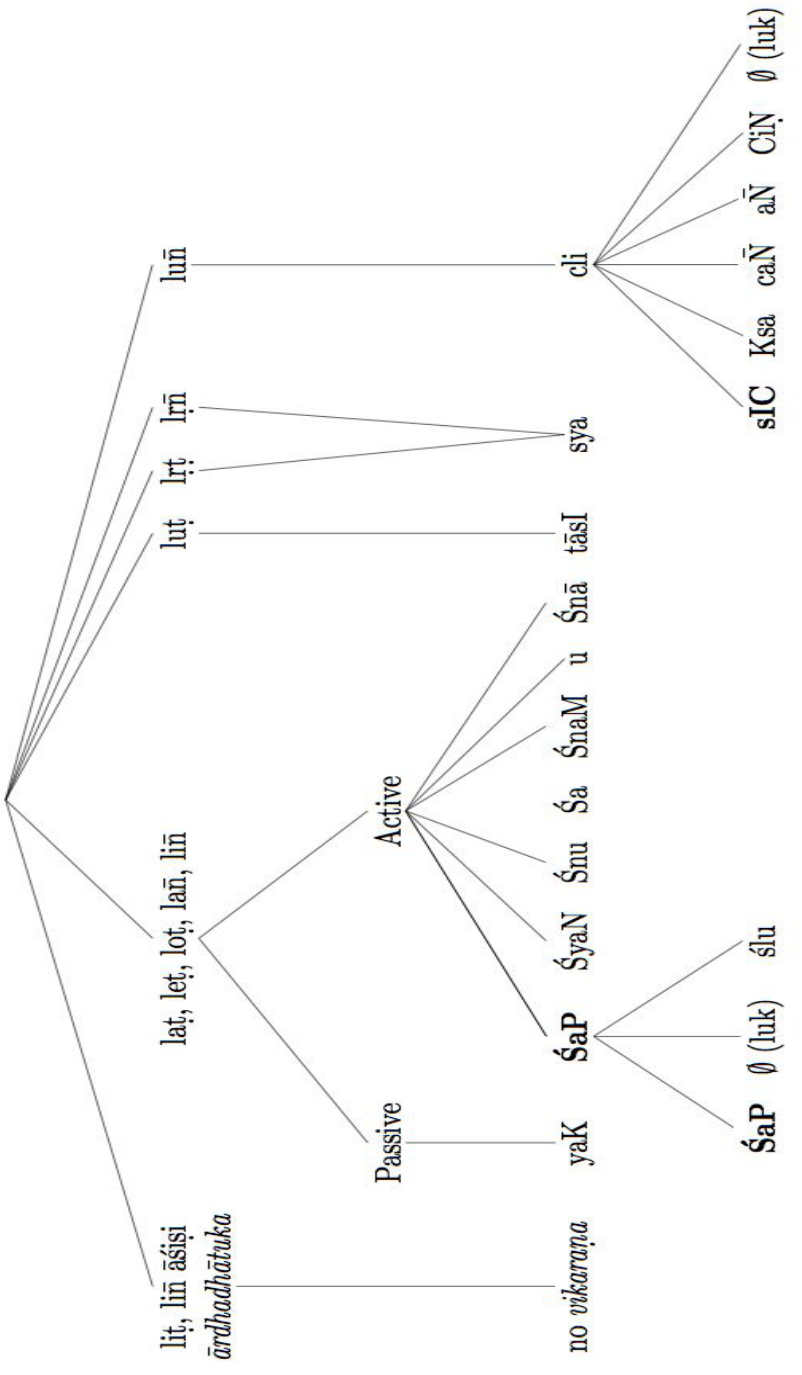
(123) 3.1.68 कर्तरि शप्
kartari śap (67 sārvadhātuke)
Agent-Loc *ŚaP*-Nom
'*ŚaP* is suffixed to the root before a *sārvadhātuka* suffix which denotes the Agent.'

ŚaP is added to roots of several conjugational classes: the first (the *bhū* class), the second (the *ad* class), the third (the *hu* class), the tenth (the *cur* class). It is also added to derived roots, including causatives and others with the suffix *ṆiC*, desideratives (*saN*), intensives (*yaṆ*), and denominal verbs, which all get the designation *dhātu* 'root' by (100) 3.1.32 **sanādyantā dhātavaḥ**.

In roots of the second and third class, *ŚaP* is deleted, or, more precisely, replaced by one of the two null elements *luK* and *Ślu*. They do not inherit the properties of *ŚaP*, because (124) 1.1.63 **na lumatāṅgasya** stipulates that deletion effected through replacement by these elements is not subject to (104), in effect reinstating the *siddha*-principle.

(124) 1.1.63 न लुमताङ्गस्य
na lumatāṅgasya (1.1.62 pratyayalope pratyayalakṣaṇam)
not *lu*-containing-Instr *stem-Gen*
'When a suffix is deleted by an element containing *lu*, the operations it triggers on an *aṅga* (stem) do not apply.'

For example, in *i-∅-más* 'we go', even though ∅ *(luK)* is a replacement of *ŚaP*, which triggers *guṇa* by 7.3.84 **sārvadhātukārdhahātukayoḥ**, it does not itself trigger *guṇa*.


liṭ, liṅ āśiṣi
ārdhadhātuka
laṭ, leṭ, loṭ, laṅ, liṅ
luṭ lṛṭ lṛṅ
luṅ
no vikaraṇa
yaK
ŚaP
ŚyaN Śnu Śa ŚnaM u Śnā tāsI
sya
cli
sIC Ksa caṄ aṄ CiṆ ∅ (luk)
ŚaP ∅ (luk) ślu
Passive
Active

Other classes of verbs receive different *vikaraṇas* by a set of special rules (*apavādas*) which block [123].

The marker *P* on *ŚaP* has several functions. One of its functions is to activate rule [125], which blocks it from getting accented by 3.1.3 *ādyudāttaś ca* (rule (12)).

(125) अनुदात्तौ सुप्पितौ
anudāttau suppitau
unaccented-DuNom *suP-Pit*-DuNom
'*Sup* endings (case-number endings) and endings marked with *P* are unaccented'.

Accent is then assigned by:

(126) 6.1.162 धातोः
dhātoḥ (159 antodāttaḥ)
root-Gen
'The final syllable of a root bears an *udātta* pitch accent.'

Another function of the marker *P* in *ŚaP* is to preclude the assignment of the marker $\bar{N}$ to it by [127].

(127) 1.2.4 सार्वधातुकमपित्
sārvadhātukam apit (1 ñit)
sārvadhātuka-Nom non*P-it*-Nom
'a *sārvadhātuka* which does not have the marker *P* has the marker $\bar{N}$'

If this redundancy rule were to apply, it would result in an undesired prohibition of *guṇa* by 1.1.5 *knīti ca*. The marker *P* blocks it, thus ensuring that forms like *bhū-ŚaP-tiP* → *bháv-a-ti* are correctly derived.

The marker *Ś* ensures that *ŚaP* is classed as *sārvadhātuka* (3.4.113 **tiñśit sārvadhātukam**). Another function of the marker *Ś* on *ŚaP* is to block rule [128] from replacing *ai* by *ā* before it in cases like *gai-ŚaP-tiP* → *gāyati* (↛ **gāti*).

(128) 6.1.45 आदेच उपदेशे ऽशिति
ād eca upadeśe 'śiti (6.1.8 dhātoḥ)
āT-Nom *eC*-Gen basic-form-Loc non-*Ś-it*-Loc
'An underlying root-final *eC* (a diphthong) is replaced by *ā*, except before an item with the marker *Ś*'.

The abovementioned *vikaraṇas* are inserted before *sārvadhātuka* suffixes representing the present system, listed in (120a). The remaining tense/mood categories are formed off distinct stems. Let's take a brief look just at the aorist verb form *apāci* in (2).

Before the *l*-endings representing the aorist (*lUṈ*), instead of *ŚaP* and the other *vikaraṇas*, the element *CLI* is inserted before them (independently of whether they denote Goal, Process, or Agent) by [129]. In other words, voice is neutralized in the aorist stem. This is done by rule (129), which blocks (123) 3.1.68 **kartari ŚaP**.

(129) 3.1.43 च्लि लुङि
cli luṅi
Cli-Nom *lUṄ*-Loc
'before (the endings replacing) *lUṄ*, *Cli* is inserted'.

Cli is in turn replaced by the specific aorist markers *sIC*, *Ksa*, *CaṄ*, *aṄ*, *CiṆ*, or deleted, under partly phonological, partly lexical conditions.

The verb *apāci* in (2) is special aorist passive form, which is restricted to the third person singular, and triggers deletion of the person/number ending after it:

(130) 3.1.66 चिण् भावकर्मणोः
ciṇ bhāvakarmaṇoḥ (44 cleḥ)
CiṆ-Nom Process-Goal-DuLoc
'To express the Process or the Goal (i.e. in the passive and in the impersonal passive), *CLI* is replaced by *CiṆ*.'

(131) 6.4.104 चिणो लुक्
ciṇo luk
Ciṇ-Gen *luk*
'After the aorist suffix *Ciṇ*, person/number endings are deleted.'

E.g. *pac-CLI* → *a-pāc-i-ta* → *a-pāc-i* 'was cooked'.

3.5 Morphological Lessons of Pānini's Grammar

3.5.1 Blocking and Substitution

As you will have noticed, the distribution of suffixes and the alternations in their shapes are bewilderingly complex; yet Pāṇini succeeds in extracting some fairly general patterns.

In addition to these regularities, some roots and affixes are subject to idiosyncratic alternations in various morphological contexts. There are two ways to handle such allomorphy in the grammar: blocking and replacement. In either case, one form in a set of alternating forms is chosen as basic, in such a way as to allow the simplest overall description. In the substitution method, the basic form is introduced by a general rule everywhere and then replaced by the other alternants in specific contexts. In the blocking method, the basic form is introduced by a general rule and the alternants by special rules which block the general rule in specific contexts. There is a close conceptual relationship between these two procedures, of which the tradition is well aware.

Normally the simplest description results if an actually occurring form is chosen as underlying form, and among the actually occurring forms the one with the widest distribution. But sometimes there are reasons to prefer a form with more restricted distribution, or even to posit an underlying form which does not occur as an actual form at all.

Pāṇini typically (though by no means exclusively) uses blocking in derivational morphology, and substitution in inflectional morphology. The main reason for this is that replacements by convention inherit the morphological properties

of the elements they replace (for example, they have the same effects on the vowel shape and accent of the stem to which they are added). In Sanskrit, at least, these properties are typically invariant in inflectional alternants, but vary in derivational alternants (presumably at least in part because paradigmatic leveling is more frequent within an inflectional paradigm).

The replacement and blocking techniques can also be combined. This method involves setting up a wholly abstract underlying form, and a rule replacing it by the basic allomorph, which in turn is blocked by the special allomorph. An example of this is Pāṇini's treatment of the aorist formative, which has several variants: *s, (sIC)*, (the basic allomorph), *sa*, *a* (with or without reduplication), and zero. These are all derived from an underlying *cli* which never surfaces in that form. It is always replaced, either by the basic allomorph *sIC* through a context-free rule, or in specific contexts by other allomorphs through rules like (130) which block *sIC*. The zero ending however is derived from *sIC* itself by replacement rules which substitute the null element *luk* for it.

3.5.2 The Nature of Sanskrit Allomorphy

Pāṇini's grammar reveals two important morphological generalization about Sanskrit. First, *the locus of suppletion is the morpheme:* all suppletion in Sanskrit verb inflection is either root suppletion or suffix suppletion. There is no "multi-morpheme suppletion" whereby sequences of morphemes are idiosyncratically replaced by other sequences of morphemes, and there is no "total suppletion" of entire words.

Secondly, the distribution of suppletive allomorphs is determined by the same contextual factors that determine the distribution of morphemes themselves, that is, by prosodic phonological conditions (from a contemporary perspective, syllable structure and accent) and by morphological classes.

A paradigm-centered approach could not capture either of these absolutely central generalizations.

3.5.3 Multiple Exponence and Null Exponence

Stump (2001) draws a distinction between what he calls realizational theories and incremental theories of morphology. Realizational theories hold that words are built up by spelling out features as affixes, while incremental theories hold that words are built up by percolating the features of affixes to the stem+affix combinations they enter into. According to Stump, the basic empirical issue that divides the theories is that incremental theories privilege one-to-one correspondences between morphemes and morphosyntactic features or feature bundles. Each morpheme of a word would be expected to correspond to a subset of its morphosyntactic features, and cases where several morphemes correspond to a single feature bundle, and cases where no morpheme corresponds to a feature bundle, would represent descriptive complications. On the realizational view, there is no such expectation. Where several morphemes correspond to a single feature bundle, there are simply several realization rules, and where no morpheme corresponds to a feature bundle, there is simply no realization rule. On the face of it, for example, for example, in the 3.Sg. aorist form *á-kār-ṣ-am*, one

might see four realizations of the aorist category: the augment *a-*, the lengthening of the root vowel, the suffix *-s-*, and the *-am* allomorph of the 1.Sg. ending.

Stump argues in favor of the realizational view on the grounds that the incremental view imposes arbitrary choices in cases of multiple exponence, and artificial solutions in cases of null exponence. Pāṇini's grammar of Sanskrit tends to show the opposite. Technically, it may be considered an incremental theory. Yet it adopts the one-to-one correspondence between morphological elements and morphosyntactic features as the baseline, entirely for reasons of descriptive simplicity. In nearly all cases of apparent multiple exponence, one of the morphemes turns out to be the bearer of the morphosyntactic feature bundle, and the others have a different function. Consider again *á-kār-ṣ-am*. The augment *a-* is added to three tense/mood categories (imperfect, aorist, and conditional), and (as Vedic shows) only in finite inflection. Thus, it is not a marker of the aorist. The lengthening of the root is a morphophonological process which is triggered not only in the aorist, but in a vast class of morphological categories under certain phonological conditions. The person/number allomorph *-am* is shared with the imperfect, the optative, and the precative, and the conditional, and also marks active voice. The "real" marker of the aorist in this class of aorists, then, is *-s-*. A similar argument can be given in almost every case of "multiple exponence" in Sanskrit. At least in this analysis, there is no arbitrariness and, at the theoretical level, no multiple exponence.

As for null exponence, Pāṇini's grammar reveals the exceptionless generalization that *null morphemes are always allomorphs of overt morphemes*. His morphological empty elements (*luk* etc.) are needed only as replacements of suffixes with phonological substance, never as morphemes in their own right. On the realizational view, there is no reason why that should be so.

I conclude that Pāṇini's descriptive practice constitutes evidence against the realizational view and in support of the incremental view, in so far as the one-to-one correspondence between morphemes and morphosyntactic feature bundles is a natural consequence of the latter but not of the former.

3.6 Derivational Morphology

3.6.1 The *Taddhita* Section

The treatment of secondary nominal derivation occupies almost a quarter of the *Aṣṭādhyāyī* and has an intricate structure. As mentioned, one of its most interesting features is that Pāṇini's technique enables the rules of suffixation to be separated from the rules of meaning assignment. Ingeniously exploiting this device in the *taddhita* section to deal with the competition among multiply polysemous suffixes, Pāṇini organizes the section as follows.

(132) Suffix$_1$

Suffixes which block Suffix$_1$ in all of its meanings:
Suffix$_{1'}$ with stem classes $X_{1'}$, $Y_{1'}$, ...
Suffix$_{1''}$ with stem classes $X_{1''}$, $Y_{1''}$, ...
etc.

Meaning$_{1a}$ of Suffix$_1$, Suffix$_{1'}$, Suffix$_{1''}$, ...

Suffixes which block Suffix$_1$ in Meaning$_{1a}$:
Suffix$_{1a'}$ with stem classes X$_{1a'}$, Y$_{1a'}$, ...
Suffix$_{1a''}$ with stems X$_{1a''}$, Y$_{1a''}$, ...
etc.

Meaning$_{1b}$ of Suffix$_1$, Suffix$_{1'}$, Suffix$_{1''}$, ...

Suffixes which block Suffix$_1$ in Meaning$_{1b}$:
Suffix$_{1b'}$ with stem classes X$_{1b'}$, Y$_{1b'}$, ...
etc.

(Repeat for Suffix$_2$, Suffix$_3$, ...)

3.6.2 Compounding

All compounds are derived by combining *padas*, each of which must have its own case ending, which is then deleted by [133]:

(133) 2.4.71 सुपो धातुप्रातिपदिकयोः
supo dhātuprātipadikayoḥ (58 luk)
suP-Gen root-stem-DuGen
'case endings in roots and stems are deleted'

The reason for this analysis is that it simplifies the morphological derivation of compounds. First, in some types of compounds the case endings are actually retained; these can simply be characterized as exceptions to deletion. Secondly, it accounts for the word status of each constituent by rule [134] (= [103]).

(134) 1.4.14 सुप्तिङन्तं पदम्
sup-tiṅ-antam padam
suP-tiN̄-ending-Nom word-Nom
'An element tha ends in *suP* or *tiN̄* is (termed) *pada* 'word'.

The word status of each member of a compound is required by the phonology. For example, in *rājapuruṣa* 'king's servant' the first member *rājan-*, being a word, loses its final *-n* by rule [41].

Compounding rules are of the form

(135) A$_{Nom}$ B$_{Instr}$ = 'A is compounded with B'

where the nominative item is called *upasarjana* and is positioned first in the resulting compound. For example, rule [136] compounds a genitive with its head:[7]

[7] In this rule, the tradition wrongly continues *vibhāṣā* from 2.1.11; for discussion see Kiparsky 1979, 39, Joshi and Bhate 1984, 95.

(136) 2.2.8 **षष्ठी**
ṣaṣṭhī **(2.1.2-4 sup, samāsaḥ, saha supā) (2.1.18 vā) (2.1.22**
sixth-Nom
tatpuruṣaḥ)

'[an item ending in] a genitive case suffix is (preferably) [compounded] (with [an item ending in] a case suffix) (to form a *tatpuruṣa*)'.

yielding such nominal stems as [[aśva+sya][pati+Su]] "horse-lord", which then by [133] lose their internal case endings, and get inflected with external case endings like any other nominal stem.

Compounds fall under the constraint (137) which governs all word formation.

(137) 2.1.1 **समर्थः पदविधिः**
samarthaḥ **padavidhiḥ**
semantically-related-Nom word-operation-Nom
"An operation on words is semantically related.'

The wording is not quite clear, but the rule is evidently designed to insure that compounding processes can combine a word with its modifier or complement, but not with a complement or modifier of another. As Patañjali points out, an external modifier cannot be ordinarily be construed with a member of a compound. For example, the compound *rājapuruṣaḥ* is analyzed as *rājñaḥ puruṣaḥ* 'king's servant', but the expression *ṛddhasya rājapuruṣaḥ* does not mean 'servant of a rich king', i.e. it cannot have the semantic bracketing ((ṛddhasya rājñaḥ) puruṣaḥ).

Patañjali on 2.1.1 discusses a number of interesting cases where compounds apparently violate this word integrity principle (Joshi & Roodbergen p. 35 ff.). They have not been systematically studied in modern grammar as far as I know. The examples seem to fall into certain natural classes.

One group consists of cases where an external modifier is construed with a governed member of a compound that bears an intrinsic relation to the governing member.

(138) **Devadattasya gurukulam** **(= kulaṃ guror Devadattasya)**
Devadatta-Gen teacher-family-Nom
'the family of Devadatta's teacher' *(lit.)* 'Devadatta's teacher-family'

These apparent syntax/morphology mismatches should probably be treated at the level of semantics. A semantic inheritance mechanism whereby properties of individuals become properties of groups to which those individuals belong is needed in any case. For example, *a laughing group of children* is really a group of laughing children: it is not the group that laughs, but the individual children that it consists of. Similarly, in (138) the property of being Devadatta's has been inherited from the teacher by the teacher's family. The cases where external modifiers are precluded are those where, on semantic grounds, such inheritance makes no sense. For example, the property of being rich is not inherited from a king by his servants.

In another group of cases, commonly found in literature, the external modifier seems to modify part of a compound whose head is a numeral or measure:

(139) **saktvāḍhakam āpāṇīyānām**
barley-measure-Nom for-sale-GenPl
'a measure of barley grains for sale' (Patañjali)

This is presumably to be analyzed as 'a barley-grain measure of a thousand (barley-grains)', like English *a student population of 1000*.

A third group mentioned by Patañjali seems to have a somewhat different character. It involves compounding of the negation prefix *a-*.

(140) **amāṣaṃ haramāṇam**
non-lentil-Acc taking-Nom
'not taking (even) a lentil' (Patañjali)

Similarly, *a-śabdam kurvan* 'not making (so much as) a sound' (*Āp.ŚS* 6.11.4) In these examples, literally 'taking a non-lentil', 'making a non-sound', the negation must clearly be construed with the verb, but is expressed on its object. This kind of negation can be construed as NP-negation forming an expression denoting a minimal amount, which is then interpreted like a negative polarity item, viz. 'taking not-(even-)a-lentil' = 'taking very little'. Again, once the semantics is understood, there is no need to assume a morphology/syntax mismatch.

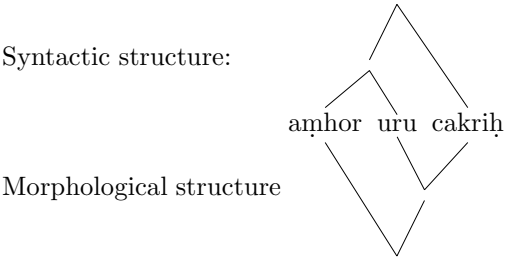
Interestingly, Wh-pronouns in Sanskrit can be freely compounded (like any other pronoun).

(141) **kiṃgotro nv aham asmīti? sāham etan na veda**
'what(Q)-family Part I am-Quote? she I this not know-1Sg
yadgotras tvam asi
what(Rel)-family you are.'
'So, what family am I from?' 'I don't know what family you are from.' (*ChUp* 4.4.1-2)

Words in Sanskrit are not "anaphoric islands", and anaphoric binding in Sanskrit is not a relation between maximal projections. This is just what we would expect since (as discussed above) the antecedent of reflexive pronouns in Sanskrit is normally determined at the level of thematic structure (the highest Theta-role).

Another type of apparent morphology/syntax mismatch has recently been discussed by Stump (2001:14), who says: "a compound's morphological structure needn't be isomorphic to its syntactic structure; in the Sanskrit expression [below], for example, the NP *aṃhór* 'distress (abl sg)' is syntactically dependent on *urú-* 'distance, relief' but is not itself part of the compound *uru-cákriḥ* 'causing relief (nom sg)'." His analysis posits the mismatch in (142).

(142)



But the fact that the complex nominal predicate *uru-cákriḥ* 'freeing, causing relief' assigns ablative case to its complement like *uru* 'free' does is no more exotic than the fact that the verbs *to relieve* and *to free* take the same kinds of PP complements that *relief* and *free* do (namely 'from' or 'of'). The generalization that such complements are inherited through morphological derivation can be readily dealt with in the morphology itself, and many theories of morphology have spelled out mechanisms for doing so.

In late classical literature, there occur however cases where the first, most deeply embedded member of *bahuvrīhi* compounds have external complements that cannot be explained away semantically.

(143) **pīnābhyāṃ madbhujābhyāṃ**
brawny-Instr my-arms-Instr
bhramitagurugadāghātasaṃcūrṇitoroḥ
whirled-heavy-club-crushed-thigh-Gen
whose thighs have been crushed by the strokes of the heavy club whirled around by my brawny arms (*Harṣacarita* 5.35)

4 Phonology

4.1 Phonological Domains

When there is no specific statement to the contrary, a phonological rule applies if and only if the conditioning context (the "trigger") and the undergoing element (the "target") are adjacent. If some class of elements may intervene between them, this must be specifically stated. Phonological rules may place other conditions on the relation between trigger and target, such as requiring them to form a base+suffix combination, to be within the same word or in the same metrical unit, to be in close contact, or to be semantically related. Each such relation determines a different kind of phonological domain. Rules which have one of these domains in common are listed together, in so far as possible, under a heading that specifies that domain for all of them.

Independently of this topical organization according to domains of application, rules fall into major groups on the basis of constraints on their mutual interaction. Conceptually, these constraints are all restrictions on the *siddha*-principle.

The schema in (1) makes no distinction between 'phonology', 'morphophonology', and 'allomorphy'. And indeed there seems to be no principled distinction made between them in the organization of the grammar. But now that we have seen how many of the theoretical distinctions made in contemporary linguistics emerge as if on their own in the *Aṣṭādhyāyī* because the economy principle forces certain groupings that correspond to them, we should ask whether something like these subdivisions can be discerned in the mapping from level 3 to level 4. In fact, it turns out that several metarules of the grammar stipulate different properties for two kinds of rules, which roughly correspond to allomorphy rules and phonological rules, and that the latter in turn fall into two types which correspond to what we would consider morphophonological and phonological.

The rules in the block from 6.4 through the end of 7 are restricted to combinations of an *aṅga* 'base' plus a suffix, in virtue of the heading (144).

(144) 6.4.1 अङ्गस्य
aṅgasya
base-Gen
'in place of (the final segment of) a base'

The need to restrict some rules in this way is illustrated by the contrast in (145), which shows that vowel sequences can be treated differently at the stem-suffix juncture in (145a) and across a word boundary in (145b).

(145) a. *śrī+as* → *śriyas* 'riches'
b. *śrī+artha+am* → *śryartham* 'for the sake of prosperity'

The *-iy-* in *śriyas* replaces *-ī-* by rule 6.4.77 (146).

(146) 6.4.77 अचि श्नुधातुभ्रुवां य्वोरियङुवङौ
aci śnu-dhātu-bhruvāṃ y-vor iyañ-uvañau (6.4.1
aC-Loc *śnu*-Root-*bhrū*-PlGen *y-v*-DuGen *iy-uv*-DuNom
aṅgasya)

'before a vowel, base-(final) *i, u* of (the conjugation marker) *Śnu*, of a root, and of *bhrū* 'brow' are replaced by *iy* and *uv*, respectively'

As a rule of the *aṅga* section, (146) is not applicable across word boundaries, as in (145b).

From our point of view, rule (146) would probably be considered "morphophonological". But many rules of the *aṅga* section also deal with "allomorphy". Recall rule (107), which states an important distinction between two sorts of replacement processes which corresponds to that distinction: non-phonological properties of the input are transferred from inputs to their replacements, while satisfaction of phonological properties is checked on the actual output string only (Joshi and Roodbergen 1985). Properties which depend on markers, therefore, are always carried over. For example, rule (147) replaces the absolutive suffix *Ktvā* by *LyaP* after a compound (prefixed) verb, except for the negation prefix *a(n)-*.

(147) 7.1.37 समासे ऽनञ्पूर्वे क्त्वो ल्यप्
samāse 'nañpūrve ktvo lyap
compound-Loc non-*aÑ*-initial-Loc *Ktvā*-Gen *LyaP*
'in a compound that does not begin with *aÑ*-, *Ktvā* is replaced by *LyaP*'

The suffix *Ktvā* is defined as a *kṛt* suffix (3.4.21). The replacement *LyaP* is introduced in (147), outside of the *kṛt* section, so it not a *kṛt* suffix. But (107) transfers the property of being a *kṛt* suffix from *Ktvā* to its replacement *LyaP*. The desired effect is that rule (148), which introduces the augment *tUK* after a short root before a *kṛt* suffix with the marker *P*, will also apply before *LyaP*.

(148) 6.1.71 ह्रस्वस्य पिति कृति तुक्
hrasvasya piti kṛti tuk
short-Gen *P-it*-Loc *kṛt*-Loc *tUK*
'*t* is inserted after a short vowel before a *kṛt* suffix marked with *P*'

E.g. *pra-kṛ-Ktvā* → *pra-kṛ-LyaP* → *pra-kṛt-ya*.

On the other hand, properties such as "having one vowel", or "beginning with a consonant" are not transferred. For example, rule 7.1.84 **diva aut** states that the final consonant of *div* 'the sky' is replaced by *au* before the nominative singular ending *-sU*: *div-s* → *diau-s* (→ 6.1.77 (25) *dyaus*) (compare e.g. dative singular *div-e*). If the output stem preserved the input's property of "ending in a consonant", rule 6.1.68 **halīyābbhyo dīrghāt sutisyapṛktaṃ hal** would wrongly apply to delete the ending *-s (*dyau)*. In other words, the phonological change of *-v* to *-au* must be taken into account when assessing whether the phonological conditions of rule 6.1.68 are satisfied.

Another distinction reminiscent of the morphophonology/allomorphy divide emerges, again on purely technical grounds, between substitutes consisting of one sound and substitutes consisting of more than one sound. The normal form of a phonological rule is:

(149) A → B / C__D

where A and B are single segments. The single-segment property of the change, and the adjacency of the triggering context (locality), typically hold not only for purely phonologically conditioned rules, but equally for morphologically conditioned and for lexically conditioned phonological rules, such as the change of *div* to *diau* just mentioned. In the default case, therefore, a substitute consisting of one sound will replace just one segment of the input, and this will be the last sound of the input if the trigger (the conditioning environment) is on the right, and the first sound of the input if the trigger is on the left. For example, *v* → *au* in *div+s* is triggered by the ending, so it is the *last* sound of the stem which is affected. This generalization is exploited to simplify the formulation of grammatical rules, by supplying the default behavior as a convention:

(150) 1.1.52 अलो ऽन्त्यस्य
alo 'ntyasya (50 sthāne) (49 ṣaṣṭhī)
aL-Gen last-Gen

'(a substitute replaces) the last sound (of a substituend specified in the genitive)'

(151) 1.1.54 आदेः परस्य
ādeḥ parasya (52 alaḥ) (50 sthāne)
initial-Gen following-Gen
'(a substitute replaces) the first (segment) (of a substituend) which follows'

A substitute consisting of more than one sound, on the other hand, typically replaces the whole input (because such a substitution most likely is an allomorphy process, we would say). For example, (147) **samāse 'nañpūrve ktvo lyap** substitutes *LyaP* for the *entire* ending *Ktvā*.

Naturally, substitutes that go against the default generalizations must be marked. Such contrary cases occur in both directions, and each is flagged by its own marker. "Short" substitutes that (contrary to the default) replace the entire input are marked by $\acute{S}$, and "long" substitutes that (contrary to the default) replace just one sound of the input are marked by $\bar{N}$.

To repeat, there is no reason to believe that Pāṇini had any principled rule typology analogous to those developed in many modern linguistic theories. He simply dealt with the morphology/phonology interface phenomena of Sanskrit by means of his usual grammatical technique, driven solely by the simplifying, generalizing imperative. Yet by consistently applying this technique he ended up framing conventions such as (107) and (150)-(151), which in their own way reflect approximately the distinction between what we would call allomorphic and morphophonological rules, on the basis of their purely formal properties.

Within phonological rules, other major classes emerge. Those which are restricted to apply in close contact *(saṃhitā)* are termed *sandhi* rules (from *samdhā-* 'put together, join'). The most important *sandhi* rules are in three groups, each headed by *saṃhitāyām* 'in close contact' (6.1.72–157, 6.3.114–139, 8.2.108–8.4.68). Smaller blocks of rules are limited to applying anywhere within the domain of a *pada* 'word' (8.4.1 ff.), and to the domain of a metrical *pāda* 'verse' (8.3.9 ff.). Words and metrical verses are also exactly the domains whose *edges* can block or condition the application of phonological rules. The absence or presence of a word on the left or right defines a sentence-initial or non-sentence-initial environment. Intonation rules can be semantically conditioned by a trigger which need not be in close contact to the undergoer, or even adjacent to it. A few rules require *both* close contact *and* semantic relationship between trigger and undergoer. The joint requirement of close contact and semantic relationship defines a domain which can be identified as the phonological phrase. Within this domain, certain sandhi processes that otherwise apply in close contact are suspended.

4.2 Types of Rule Interaction

The second major criterion by which rules are grouped is by shared constraints on their mutual interaction. Just as string adjacency is the unstated default relation between trigger and target, and those cases where some other relation between them obtains are specially provided for in the grammar, so there are

unstated default principles governing rule interaction, and those interactions which diverge from the default are specially provided for. What precisely the unstated default principles governing rule interaction are, however, is a matter of some controversy. As stated in section 1, my view is that Pāṇini assumed the *siddha*-principle, the word-integrity principle, and the blocking principle. Before proceeding I summarize what the tradition says on this matter.

4.2.1 The Traditional View

Traditionally the order of application of rules in the *Aṣṭādhyāyī* is determined by a hierarchy of four principles:

(152) Rule A supersedes rule B under the following conditions:
- a. if A follows B in the *Aṣṭādhyāyī* (A is *para)*,
- b. if A is applicable whether or not B applies (A is *nitya)*,
- c. if A is conditioned internally to B (A is *antaraṅga)*,
- d. if the inputs to which A is applicable are a proper subset of the inputs to which B is applicable (A is *apavāda)*.

The principles in (152) are assumed to form a hierarchy of increasing strength, so that [152b] takes precedence over [152a], [152c] over [152b], etc. Except for (152a) (see below), neither the principles nor the hierarchy are stated in the grammar, but several versions of them are made explicit by the traditional commentators. Not included in this list, but tacitly assumed by the tradition, is the fundamental principle that when a rule can apply to the output of another, it does, unless this is blocked by some other principle or rule.

The following paragraphs briefly present the motivation for each principle and for their hierarchy.

The *para* principle (152a) is stated in the grammar in connection with a set of definitional rules which must apply disjunctively. These definitional rules are gathered under the headings [90]-[91]. As was discussed above, this so-called *ekasaṃjñā*-section includes, among many others, the rules that map semantics to thematic roles (*kārakas*), which are placed in that section in order to prevent expressions from being assigned more than one role.

According to tradition, however, the precedence of *para* rules stipulated in (91) holds throughout the grammar.

A is a *nitya* 'constant' rule with respect to B if A is applicable whether or not B applies, but not conversely. A *nitya* rule has precedence over a non-*nitya* rule. This is equivalent to saying that bleeding order has priority over non-bleeding order, so we can call it the bleeding principle.

A simple example of the *nitya* principle is the derivation of *rud-hi* → *rudihi* 'weep!' (2Sg). Underlying *rud-hi* is potentially subject to two rules:

(153) 6.4.101 हुझल्भ्यो हेर्धिः
hujhalbhyo her dhiḥ (101 aṅgasya)
hu-jhal-PlAbl *hi*-Gen *dhi*-Nom
'after (the root) *hu* and after a base ending in an obstruent, *-hi* is replaced by *-dhi*'

(154) 7.2.76 रुदादिभ्यः सार्वधातुके
rudādibhyaḥ sārvadhātuke (35 iṭ valādeḥ)
rud-beginning-PlAbl *sārvadhātuka*-Loc
'after the roots *rud* etc., the augment *iṬ* is inserted before *sārvadhātuka* endings beginning with a *vaL* consonant'

Rule (154) bleeds (153), therefore precedes it.

When the *nitya* principle does *not* give the right results, special countermeasures are taken. Consider again the rules (147) and (148). At the stage *adhi-i-ya* (after *Ktvā* has been replaced by *LyaP* by (147) 7.1.37 **samāse 'nañpūrve ktvo lyap**), two rules are potentially applicable: contraction of a pair of like vowels into a single long vowel by (27) 6.1.101 **akaḥ savarṇe dīrghaḥ**, and insertion of the augment *-t (tUK)* at the end a short-vowel root by (148) 6.1.71 **hrasvasya piti kṛti tuk**. Since the augmentation is conditioned by a short root vowel, it is bled by contraction, which should therefore take effect first, and *t*-augmentation would then be blocked. The resulting form, **adhīya*, is however incorrect. So here the default principle leads to the wrong result. Therefore, a special rule is required which stipulates that vowel contraction (among other processes) is *asiddha* with respect to insertion of the augment *tUK*.

(155) 6.1.86 षत्वतुकोरसिद्धः
ṣatvatukor asiddhaḥ
ṣ-quality-*tUK*-DuLoc not-effected
'(these rules) are treated as not effected with respect to retroflexion of *s* and insertion of the augment *t*-'

The tradition operates with the correlative concepts *bahirāṅga* 'externally conditioned' versus *antarāṅga* 'internally conditioned', and posits the principle that *bahirāṅga* processes are *asiddha* with respect to *antarāṅga* processes. The tradition knows also a weaker version:

(156) a. **The strong AP:** A *bahirāṅga* rule is *asiddha* with respect to an *antarāṅga* rule *(asiddham bahirāṅgam antarāṅge).*
b. **The weak AP:** An *antarāṅga* rule takes precedence over a *bahirāṅga* rule *(antarāṅgaṃ balīyo bhavati).*

The *antarāṅga-paribhāṣā* (AP) is reminiscent of cyclic application in generative phonology. Its two versions correspond to two versions of cyclicity, with or without the "Strict Cycle Condition".

The word-integrity principle is a special case of the *antaranga*-principle, but tradition applies the *antaranga*-principle also within words.

4.2.2 A Non-traditional Interpretation

Of the principles in [152], the *para* principle is today generally agreed to be restricted to the *saṃjñā* section (1.4–2.3). Joshi and I (Kiparsky and Joshi 1979, Kiparsky 1982, Joshi in press) have argued at length that the *nitya* principle is subsumed, with the (unstated) master principle that rules apply at any opportunity, under the *siddha*-principle

discussed above in (38). We also argued that Pāṇini did not assume the *antarāṅga*-principle word-internally, only the word-integrity principle. That is, phrasal rule applications are *asiddha* with respect to rule applications inside words, but rule applications to larger constituents of words are not *asiddha* with respect to rule applications to smaller constituents of words. We showed that the wording of his rules invariably presupposes that the word-internal application of rules is governed by the *siddha*-principle and not by the *antarāṅga*-principle.

To this argument I would now like to add two new points. The first new point is that Pāṇini *should* have adopted a form of the *antarāṅga*-principle, i.e. word-internal cyclicity, for it is in fact rather well motivated by phonology/morphology interactions in Sanskrit. The second new point is that Pāṇini *could* not have done for reasons internal to his system.

I shall cite two pieces of phonological evidence that phonology does apply cyclically within words in Sanskrit. The first comes from the accentuation of words with multiple accents. The tradition points out that an accent which is assigned supersedes accents which have been assigned (**satiśiṣṭasvaro balīyān bhavati**, Patañjali on 6.1.158 vt. 8). That is, the last suffix to be added determines the accent of the whole word. This generalization comes for free if rules are applied cyclically from innermost constituents outward.

For example, from the name *Dakṣa*, rule 4.1.95 *ata iñ* yields *Dā́kṣi* 'a descendant of *Dakṣa*' (from *dakṣa+iÑ*), with initial accent by rule 6.1.197 **ñnity ādir nityam**, which accents the initial syllable of a word having a suffix with diacritic Ñ or N. This in turn yields by rule 4.1.101 **yañiñoś ca** the designation of a remote descendant, *Dākṣāyaṇá* 'great-grandson of *Dákṣa*'. Here rule 6.1.165 **kitaḥ** puts the accent on the last syllable, overriding all accents that have been previously assigned in the course of the derivation. As a cyclic derivation would predict, the accent assigned by the last suffix wins.

Consider the derivation of *kurutáḥ* 'they (Du.) make'. If we assume that the order of suffixes matches the derivational sequence in which they are added, then the the cyclic principle predicts the following derivation (with irrelevant steps omitted):

(157)	Tense assignment:	(111) 3.2.123 **vartamāne laṭ**	kṛ+LAṬ
	Root accent:	3.1.91 **dhātoḥ**	kṛ́+LAṬ
	Vikarana placement:	3.1.79 **tanādikṛñbhya uḥ**	kṛ́+u+LAṬ
	Suffix accent:	(12) 3.1.3 **ādyudāttaś ca**	kṛ+ú+LAṬ
	Inflection:	(66) 1.4.108 **śeṣe prathamaḥ**	kṛ+ú+tas
	Suffix accent:	(12) 3.1.3 **ādyudāttaḥ**	kṛ+u+tás

Further rules would then give the correct *kurutáḥ*.

This is, in fact, *not* the Pāṇinian derivation. In his system, for theory-internal reasons, the *vikaraṇas* are added after the person/number endings. In this case, the generalization that the last-added suffix wins (that is, **satiśiṣṭasvaro balīyān bhavati**) predicts the wrong accentuation:

(158)	Tense assignment:	(111) 3.2.123 **vartamāne laṭ**	kṛ+LAT
	Root accent:	3.1.91 **dhātoḥ**	kṛ́+LAT
	Agreement:	(66) 1.4.108 **śeṣe prathamaḥ**	kṛ+tas
	Suffix accent:	(12) 3.1.3 **ādyudāttaś ca**	kṛ+tás
	Vikarana placement:	3.1.79 **tanādikṛñbhya uḥ**	kṛ+u+tás
	Suffix accent:	(12) 3.1.3 **ādyudāttaś ca**	*kṛ+ú+tas

which ultimately gives **kurútaḥ*. Under these assumptions about the morphology, the cyclic principle does not work.

To get the correct form *kurutáḥ,* the traditional interpretation adds an *ad hoc* exception to the general principle that an assigned accent supersedes earlier accents: namely, that *vikaraṇa* accents (such as that on *u* in the above derivation) do not supersede previously assigned accents on personal endings (**satiśiṣṭavikaraṇasvaro lasārvadhātukasvaraṃ na bādhate**, Pat. ad 6.1.158 vt. 10). Pāṇini's treatment of the verb morphology thus complicates the assignment of word accent. If (unlike Pāṇini) we assume that suffixes are always added to the end, so that their linear order in the word matches the derivational order of affixation, then cyclic application of phonological rules gives the right results even in this case.

A second set of cases where Sanskrit shows cyclic application of phonological rules that the grammar does not capture comes from the behavior of roots that have both prefixes and suffixes. The morphology of inflexional suffixes is sensitive to whether the root is prefixed or not. Several suffixes show allomorphic variation based on this, notably the absolutive (gerund) suffix, which makes temporal adverbials with the meaning 'having V-ed', 'after V-ing'. Recall from (147) 7.1.37 **samāse 'ñapūrve ktvo lyap** that it has two basic allomorphs, *-tvā*, which occurs after simple roots, and *-ya*, which occurs after prefixed roots. The latter allomorph gets a *t* added before it if the root is light, in order to make the one-mora root syllable into a minimal foot ((148) 6.1.71 **hrasvasya piti kṛti tuk**). The allomorphy is illustrated by the simple form and a compounded form of the root /bhṛ/ 'carry' in (159).

(159) a. *bhṛ-tvā́* 'having brought' (*-tvā* after a simple root)
b. *saṃ-bhṛ́-tya* 'having brought together' (*-t-ya* after a light prefixed root)

In *bhṛ-tvā́*, the root, being simple, selects the allomorph *-tvā́*. In (159b) *saṃ-bhṛ́-tya*, the prefixed root selects the absolutive allomorph *-(t)ya*. This shows that the absolutive is formed off the prefixed root.[8]

Additional evidence is the special behavior of the negative prefix *a-*. Unlike verbal prefixes, such as *sam-* in (159b), *a-* has no effect on the choice of absolutive allomorph. For example, *á-bhṛ-tvā* in (159c) has the absolutive allomorph that is otherwise selected by simple roots. Why does *a-* differ from the verbal prefixes in this way? The solution to this puzzle is that it is prefixed not to roots but to absolutives. So, if those absolutives are formed from simple roots, they will have

[8] More precisely, it shows it provided we agree that that the right allomorph is selected at the point at which the morphological operation introducing the affix takes place, and that (contrary to Pāṇini) there are no "allomorphy rules" that could, for example, replace *-tvā́* by *-tya* after the prefix has been added.

the allomorph *-tvā*. The reason why *a-* *must* be prefixed to absolutives and not to roots is that *a-* selects nominal and adverbial stems, and the absolutive suffix *-tvā* makes verbs into adverbs (with essentially nominal character). Conversely, verbal prefixes must be added to roots prior to absolutive formation because they select verbal stems, and absolutives, not being verbs, do not satisfy that subcategorization requirement. The allomorphy contrast between (160a) and (160b) reflects this intrinsic difference in derivational history.

(160) a. saṃ-bhṛ → (saṃ) (bhṛ́-tya) (suffixation to a prefixed root)
b. bhṛ-tvā́ → (á) (bhṛ-tvā) (prefixation to a suffixed stem)

The prosodic structure of the words is the same as far as we can tell, as indicated in (160). Specifically, phonology shows that there is a compound boundary between the prefix and the root in both words. Examples like this show that level ordering cannot be simply reduced to the domains defined by prosodic structure. Rather, the morphophonology reveals two different orders of prefixation and suffixation, as determined by the different selectional requirements of the prefixes and suffixes, for what surfaces as the same prosodic structure.

Because Pāṇini does not adopt the cyclicity of word phonology, he has to stipulate in (147) that the negative prefix *a-* does not trigger the absolutive allomorph *-ya* like other compound roots do.

Another argument for the prefix+root constituent is that prefixed roots can be suffixed with the agent suffix *-tṛ*, which otherwise is not allowed in compounds. Nouns in *-tṛ* are subject to the constraint that they are not compounded (2.2.16 **kartari ca**). If prefixation creates compound roots, then they can be inputs to the affixation of *-tṛ*, and prefixes need not be exceptions to the ban on compounding.

Certain phonological rules also apply cyclically to the prefixed root prior to further affixation. After prefixes ending in *-i* and *-u*, a root-initial *s-* becomes retroflexed to *ṣ*. For example, the root *svaj* 'embrace' (as in *svajate* 'embraces') appears as *-ṣvaj* after the prefix *pari-*, as in *pariṣvajati*. Crucially, this happens even if an augment or a reduplication intervenes (8.3.63-64 ff.), as in the imperfect /pari-a-svaj-a-t/ *paryaṣvajat*, and in the perfect /pari-sa-svaj-e/ *pariṣaṣvaje*.

Importantly, it is *not* possible to account for the "overapplication" of retroflexion on the basis of the output form. The rule that effects this retroflexion otherwise requires strict adjacency between the triggering high vowel and the undergoing *s*. The cyclic nature of the effect is shown even more clearly by cases like *abhi-ta-ṣṭhau*. The root *sthā* 'stand' is prefixed and its initial *ṣ-* is retroflexed. The following plosive *th* is not retroflexed at this point because assimilation of retroflexion is postlexical. The cyclic derivation, however, yields the correct output form: *sthā-* → *abhi-ṣthā-* → (formation of perfect stem) *abhi-ta-ṣthā-* → (inflection) *abhi-ta-ṣthau* → (postlexical phonology) *abhi-ta-ṣṭhau*.

Because Pāṇini does not adopt the interleaving of phonology and morphology inside words, this derivation is not available to him. He simply stipulates that the augment and the retroflexion may intervene between the high vowel and the *s*.

Why did Pāṇini not adopt word-internal cyclicity? The most important reason is that he treated allomorphy as replacement. This forced him to prevent

the underlying allomorph from triggering unwanted applications of phonological rules prior to being replaced by the actual derived allomorph.

There are many instances where the *antarañga*-principle, if applied word-internally, would give the wrong result, and where Pāṇini did not intend it to apply. Instead, he relied on the *siddha*-principle, which, in fact, works correctly in these cases. A typical example is the following.

In the derivation of *seduṣas* (Sg.Gen. of *sed-vas*, Nom. *sedivān*) 'having sat', the suffix+root combination *sed-vas* is subject to a rule which inserts the augment *i-* before consonantal endings. The semivowel *v* of the suffix is then vocalized before accented vocalic endings, which bleeds the insertion of the augment. Cyclicity predicts the incorrect form:

(161) sed-vas
sed-ivas 7.2.35 **ārdhadhātukasyeḍ valādeḥ**
sed-ivas-as 2.3.50 **ṣaṣṭhī śeṣe**
sed-iuas-as 6.4.131 **vasoḥ samprasāraṇam**
sed-ius-as 6.1.108 **saṃprasāraṇāc ca**
*sed-yuṣ-as 8.3.59 **ādeśapratyayayoḥ**, (25) 6.1.77 **iko yaṇ aci**

The *siddha*-principle predicts the correct derivation, where 6.4.131 bleeds 7.2.35, as desired:

(162) sed-vas-as
sed-uas-as 6.4.131 **vasoḥ samprasāraṇam**
sed-us-as 6.1.108 **saṃprasāraṇāc ca**
sed-uṣ-as 8.3.59 **ādeśapratyayayoḥ**
— 7.2.35 **ārdhadhātukasyeḍ valādeḥ** (inapplicable)

It is because of such cases, I think, that Pāṇini abandoned the cyclic principle in the word domain favor of exclusive reliance on the *siddha*-principle, at the cost of complications such as those we discussed.

If we look at such examples from the perspective of today's approaches to morphology, we come to the conclusion that they do not involve competition between phonological rules, but competition between a phonological rule and an allomorphy rule. An allomorphy analysis would posit two allomorphs *-ivāns* and *-us*, which would both combine with the root to give two stems {*sed-ivāns-, sed-us-*}. The selection between those two stems would be done by a fairly general constraint which selects the weakest available stem allomorph before a following accented vocalic case suffix. On this account, there is no question of competing processes. Each allomorph is simply subject to the appropriate phonological rules.

To summarize: the fact that Pāṇini did not adopt the principle of cyclic rule application word-internally is deeply connected with his whole approach to the phonology/morphology interface. In fact, it is inevitable once the decision is made to assimilate allomorphy to phonology by treating it by replacement rules (rather than by a selectional mechanism). Within Pāṇini's system, that treatment of allomorphy is very solidly motivated by the need to provide for inheritance of morphological properties between the allomorphs of a morpheme

(as the default case). But the price to be paid for it is that the phonological input representation will always have the underlying form of each morpheme, which may not be the allomorph that appears in the output. Under the cyclic hypothesis embodied in the *antarañga*-principle, it can happen that this "wrong" allomorph triggers unwanted phonological processes in an inner constituent prior to being replaced by the "right" allomorph in an outer constituent. A secondary reason, as explained above, was that his treatment of the *vikaraṇas* as inserted between root and inflectional affix compromised the cyclic explanation for accent dominance.

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