Esa Itkonen

REMARKS ON PĀṆINI'S GRAMMAR (Turku, December 31, 2014)

I) *Kāraka* = Semantic Role?

In contemporary linguistics 'semantic role' is understood as being exemplified by one of those 'things' that participate in a state of affairs expressed by a complete sentence; for instance AG[ent], PAT[ient], REC[ipient], or INS[trument], each of which is expressed by a suitably specified N[oun] or PRO[noun]. Pāṇini's grammar *Aṣṭādhyāyī* ('Eight Chapters') is crucially based on the notion of 'kāraka'. It is generally translated as 'semantic role'. This interpretation is indeed correct with respect to the following four kārakas: REC = *sampradānam* (expressed by DAT[ive]), INS = *karaṇa* (expressed by INSTR[umental]), PLACE = *adhikaraṇa* (expressed by LOC[ative]), and SOURCE = *apādāna* (expressed by ABL[ative]). But it is **not** correct with respect to the remaining two, which also happen to be central from the theoretical point of view, namely *kartṛ* and *karman*. These two terms are generally translated as AG and PAT, respectively, but this interpretation must be rejected. Why?

To answer this question, we must start with two (successive) rule combinations, i.e. 3.4.67/69 and 3.4.77-78:

3.4.67/69 kartari karmaṇi bhāve ca LAḶ
'*kartṛ*, *karman*, and *bhāva* are to be replaced [or expressed] by LAḶ'
A-LOC B-NOM = A → B

3.4.77-78 LASYA TIṄ
'LAḶ is to be replaced by TIṄ'
B-GEN C-NOM = B → C

According to Pinault (1989: 378) rules 3.4.67/69 (given here in a slightly simplified form) are the "pivot" of Panini's grammar; and according to Itkonen (1991: 33), they "put the entire derivational system in motion". (Significantly, Pinault makes use of the same metaphor: "la mise en branle de la formation des phrases et des mots", p. 377.) What is the meaning of 3.4.67/69?

LAḶ is an artificial symbol (= 'conventional label') that collectively designates all finite (= personal) verb endings. The other three terms that occur in 3.4.67/69 stand for the semantic counterparts of the tripartite voice/diathesis system of Sanskrit. The underlying idea can be explained as follows. An action (*kriyā*) is to be conceptualized in three different ways: either as being **done** by someone (*kartṛ*) or as being **undergone** by someone/something (*karman*) or as just **happening** (*bhāva*). These three alternatives are of **semantic** nature, but they anticipate, and have indeed been (in advance, as it were) determined by, the corresponding tripartite voice system, which is of **formal** nature: doing, undergoing, and happening are expressed by the **endings** of, respectively, active/middle (ACT/M), personal passive (P-PASS), and impersonal passive (I-PASS) (to use the Western terminology). These three (types of) endings are summarized as LAḶ.

In asserting that the three subtypes of action (whose designations are in LOC) are to be replaced by LAḶ (which is in NOM[inative]), the rules 3.4.67/69 effectuate the **fundamental transition from meaning to form** (accompanied, to be sure, by a host of similar less important transitions).

We are now in a position to see why *kartṛ* and *karman* cannot be translated, respectively, as AG and PAT. For us, AG and PAT are expressed by suitably specified (pro)nouns. But for Pāṇini, *kartṛ* and *karman* are expressed by, respectively, ACT/M endings and P-PASS

endings (i.e. LAḶ minus I-PASS). Here I just want to establish the difference between these two positions, without trying to adjudicate between them.

The situation is complicated by the fact that *kartṛ* and *karman* are **also** (secondarily) expressed by case endings of (pro)nouns. It is this fact that has given rise to the (erroneous) view that they are simply identical with AG and PAT. Let us clarify the situation by means of two example sentences, ACT and P-PASS, with the meanings '(the) children are leading (a/the) horse' and '(a/the) horse is being led by (the) children'. I shall distinguish between the two types of *kartṛ*/*karman* by numbering them differently; the semantic analysis is placed above the example sentence while the morphological analysis is placed under it:

(1) ACT	child-kartṛ2	horse-karman	lead-kartṛ1
	bāl-āh	*aśv-am*	*naya-nti*
	N-NOM.PL	N-ACC.SG	V-ACT.IND.PRES.3PL
(2) P-PASS	horse-karman2	child-kartṛ	lead-karman1
	aśv-ah	*bāl-aih*	*nī-yate*
	N-NOM.SG	N-INSTR.PL	V-PASS.IND.PRES.3SG

In (1), *kartṛ* is expressed twice, primarily by the personal ending *-nti* (plus the 'normal' ablaut grade *na-*) and secondarily by the NOM ending *-āh*, whereas *karman* is expressed only once, namely by the ACC ending *-am*. In (2), by contrast, *karman* is expressed twice, primarily by the personal ending *-yate* (plus the zero ablaut grade *nī-*) and secondarily by the NOM ending *-ah*, whereas *kartṛ* is expressed only once, namely by the INSTR ending *-aih*. (Etymological note: *nayanti* < **nī-a-nti vs. nīyate* < **nī-ya-te*.)

One way to explain the 'primary vs. secondary' distinction at issue is as follows. The finite endings in (1) and (2) express the fact **that** there is, respectively, an agent and a patient. The nouns in NOM in turn express **which** agent or patient it is. It is interesting to note that an analogous interpretation was known to the medieval grammarians, so-called Modistae. For Boethius de Dacia (d. c. 1280), in the Latin counterpart of (1) the finite verb is understood to contain a *nominativus simpliciter* while the subject of the sentence is identified as a *nominativus nominis aut pronominis* (cf. Itkonen 1991: 323, n. 15).

The description of (1) and (2) proceeds (roughly) in accordance with the following instructions: "If you choose *kartṛ1*, then *kartṛ2* = NOM and *karman* = ACC; and if you choose *karman1*, then *karman2* = NOM and *kartṛ* = INSTR." Thus, there is no derivational relation between ACT/M vs. P-PASS sentences, but their descriptions proceed in parallel.

Let us add one more reason why *kartṛ* and *karman* cannot be interpreted as semantic roles. In 3.4.67/69 they are introduced together with *bhāva*, i.e. what is expressed by the I-PASS constructions (cf. the Latin *itur* = 'it is [being] gone'). But this cannot of course be any kind of semantic role.

The logical continuation of rules 3.4.67/69 is constituted by rules 3.4.77/78, which say that LAḶ is to be replaced by TIṄ. This is a so-called condensation symbol, based on the following principle (cf. 1.1.72): "take the first intended unit and the determinative (= auxiliary symbol) that follows the last intended unit!". The finite verb endings constitute a matrix with 6 columns and 3 rows: the first unit is the ACT.3SG ending *tiP* while the last unit is the M/PASS.1PL ending *mahiṄ*. Thus it is by *ti[…]Ṅ* that all 18 endings are summarized. Rules 3.4.77-78 say that the abstract global symbol *LAḶ* is to be replaced by the list of these 18 concrete alternatives. Let it be added that the same principle is applied to nominal inflection as well: *sU* (= NOM.SG) … *suP* (= LOC.PL) > *SUP* (= 21 case endings). The reader is now in a position to understand Pāṇini's maximally general definition of 'word': *SUP-TIṄ-antam padam* = "a word is that which ends either with *SUP* or with *TIṄ*".

The entire grammar constitutes a ‘movement’ from meaning to form; but there is this all-important distinction that when meanings are replaced by forms, as in 3.4.67/69 (= *kartari … LAḤ*), the rule format is X-LOC Y-NOM, but when abstract forms are gradually replaced by more concrete ones, the rule format is X-GEN Y-NOM. In both cases there is a transition X → Y but it is marked in two distinct ways.

From the ontological point of view, meaning and form are absolutely different. Therefore it is a fundamental mistake (committed e.g. by generative semantics in the late 60’s and early 1970’s) to try to **gradually** convert meaning into form. For Pāṇini, the transition from meaning to form is **abrupt**, as it should be. By contrast, forms (whether abstract or concrete) constitute an ontologically homogeneous domain (or can at least be so conceived), which means that it is fully legitimate to gradually convert abstract forms into less and less abstract ones. In each derivation, hence, there is only one stage of ‘meaning → form’ rules, i.e. A-LOC B-NOM (cf. 3.4.67/69), which is then followed by several ‘descending’ stages of ‘form → form’ rules: B-GEN C-NOM, C-GEN D-NOM, D-GEN E-NOM, … The first such stage is given in 3.4.77/78.

From the **axiomatic** point of view, A-LOC represents the ‘axiom’, while rules exemplifying either X-LOC → Y-NOM or X-GEN → Y-NOM perform the function of ‘inference rules’ (cf. Sect. III). For instance, the description of the verb-form *náyanti* (‘they lead’) assumes the form of a derivation which contains 16 stages and refers (explicitly or implicitly) to no less than 66 rules or definitions (cf. Itkonen 1991: 63-65).

We have already seen that *kartṛ* and *karman* should not be translated as AG and PAT, but rather as DOING and UNDERGOING (to use the terminology of Itkonen 1991). Further clarifications will now be added.

In ontology and in language we have two dichotomies which (iconically) correspond to each other: action vs. thing and verb vs. (pro)noun. Pāṇini’s grammar is based on the centrality of action/verb, and is thus similar to modern predicate logic and to dependency grammar, and dissimilar from Aristotelian subject-predicate logic and from constituent-structure grammar à la NP + VP.

The meaning of *kartṛ* is DOING in its **dual** aspects, both ontologically and linguistically: ontologically, as exemplified both by (one subtype of) the **action** and by the corresponding **thing**, and linguistically, as exemplified by the finite ACT/M endings of the **verb** and by the NOM endings of the **(pro)noun**. Using the same term for both action and thing is a way to emphasize their conceptual **interdependence** (= ‘distinct but inseparable’), which is a clever insight. Linguistically, this interdependence is expressed by **agreement** (in our terminology: verb-subject agreement, given that Sanskrit has no verb-object agreement.) More precisely, it is agreement in **person/number**. At the maximum level of abstraction, the notion of person turns out to be what is **common** to both action and thing. Pronouns, of course, typically represent 1P, 2P, 3P, but nouns too are subsumable under ‘person’: first, nouns typically represent 3P; second, in some languages nouns too inflect in person (à la ‘I-man’, ‘you.SG-man’, ‘he-man’, ‘we-two-men’, etc.); this is true e.g. of the ergative case in Hua (cf. Haiman 1980: 229-231; also Itkonen 2005: 70, 2008: 302).

Exactly the same remarks apply, mutatis mutandis, to *karman*: it means UNDERGOING both in its twin ontological (= action/thing) aspects and in its twin linguistic (= P-PASS endings/NOM endings) aspects.

For completeness, let us mention that the (secondary) ACC-*karman* also assumes the semantic role of GOAL (with DAT as another option). It is indeed difficult to imagine a coherent system of semantic roles which would have both PLACE and SOURCE but not GOAL.

From the grammatical-descriptive point of view, the verb is primary because it **must** always be there whereas both in NOM & ACT/M constructions and in NOM & P-PASS constructions the NOM-(pro)noun **may** be lacking. (To be sure, nominal or copula sentences contain no verb.) As mentioned before, by expressing DOING, ACT/M implies that there must be

some AG, and an overt NOM-(pro)noun 'only' expresses **which** AG it is. The same is true, mutatis mutandis, of P-PASS constructions. And in I-PASS constructions the NOM-(pro)noun **must** be lacking, which means that there can be no agreement (i.e. the 3SG ending expresses the lack of any person; again, cf. the Latin *itur* = 'it is [being] gone').

Although (1) exemplifies the DOING aspect of the abstract notion of *kriyā*, it seems undeniable that (1) must also contain UNDERGOING in some 'subordinate' sense: the children do, the horse undergoes. This result can be generalized insofar as all participants of *kriyā* (embodying distinct semantic roles) can be conceptualized as contributing their own 'subactions' to the overall action (cf. Sharma 1987: 145).

In conclusion, the counterparts of our AG and PAT do exist, even if they are identical neither with *kartr* nor with *karman*. It is uncontroversial to say that in (1)/(2) *bālāh*/*bālaih* is AG and *aśvam*/*aśvah* is PAT.

II) The Shortest Grammatical Rule in the World: *a a*

In Pāṇini's grammar, phonological description is based on the so-called Śiva-sūtras, i.e. 44 sound segments arranged in 14 horizontal rows each of which ends with an auxiliary symbol or 'determinative' (written here in capital letters). The vowels are given in the first four rows:

a	i	u	Ṇ
ṛ	ḷ		K
e	o		Ṅ
ai	au		C

The last or 14th row of the entire matrix ends with *L*. Sound classes needed in phonological description are formed by means of the condensation technique: "take the first intended unit and the determinative following the last intended unit!" Thus, for instance, *aK = {a,i,u,ṛ,ḷ}*, *aC* = all vowels, *aL* = all sounds. There are 292 potential sound classes, but only 41 thereof are actually used.

The Śiva-sūtras ignore such vowel qualities as length (3 alternatives = short, long, extra-long), accent (3 alternatives = high, low, high-low), and nasality (2 alternatives = oral vs. nasal) (by rule 1.1.69). When these are taken into account, each of *a, i, u, ṛ* stands for 18 distinct sounds (while the range of *ḷ* is more restricted); by contrast, each of *e, o, ai, au* stands for 12 distinct sounds (because there are no short variants).

The 'abstract' *a* of the first row is pronounced as short and open, although the usual short *a* is closed. When length has to be indicated, this is done by means of the *T*-determinative (by 1.1.70): *aT* = short vs. ā*T* = long. A consonant followed by -*U* represents 5 homorganic sounds (again by 1.1.69); e.g. *pU = {p, b, ph, bh, m}*, and similarly for *kU, cU, ṭU, tU.*

Some of these techniques are exemplified already in the first three rules of the grammar (cf. Itkonen 1991: 22-23):

1.1.1 *vṛddhirādaic = vṛddhiḥ āT-aiC* = The sounds *ā, ai, au* are called 'vṛddhi'

1.1.2 *adeṅguṇaḥ = aT-eṄ guṇaḥ* = The sounds *a, e, o* are called 'guṇa'

1.1.3 *iko guṇavṛddhī = iK-aḥ* [GEN.SG] *guṇavṛddhī* [NOM.D] = The sounds *i, u, ṛ, ḷ* are replaced by guṇa or vṛddhi (except in the environments specified in 1.1.4–5; i.e.

1.1.4, technically a prohibition, states an (important) exception to 1.1.3, marked with *na* [= 'not'], while 1.1.5 states an extension of 1.1.4, marked with *ca* [= 'also']).

These three rules deal with the synchronic reflex of the Proto-Indo-European quantitative ablaut in Classical Sanskrit insofar as *vṛdhhi*, *guṇa*, and *iK* correspond to its three grades (exemplified by the verb-forms ***nāyayati***, ***naya**ti*, ***nī**yate* and known as *Dehnstufe*, *Vollstufe*, *Schwundstufe*, respectively, in the German-language tradition).

To give another example, one of the most general assimilatory rules is given in 6.1.77: *iko* (GEN) *yaṇ* (NOM) *aci* (LOC), or *iK* → *yṆ*/ __ *aC*; i.e. the vowels *i, u, ṛ, ḷ* are replaced by the semi-vowels *y, v, r, l* before any vowel (except that the vowels *a, i, u, ṛ, ḷ* are replaced by their long counterparts before homorganic vowels [*sa-varṇa*], by 6.1.101: *aK-aḥ savarṇe dīrghaḥ*). In context-sensitive rules of this type the LOC expression indicates the following context (= 'before') while the ABL expression (not exemplified here) indicates the preceding context (= 'after'). Rules 1.1.3, 6.1.77, 6.1.101 exemplify the general structure of substitution rules: abstract forms in GEN are replaced by less abstract forms in NOM (cf. Itkonen 1991: 34, 39).

According to Scharf (2013: 239), Pāṇini's use of determinatives and of conventional labels (such as *L[AḤ]* = finite verb endings) "was unmatched in the technical literature until the comparable use of superscript and subscript indices as markers in modern technical notation, and the explicit introduction of brief technical terms in modern mathematics".

The very last rule of the *Aṣṭādhyāyī* has been with perfect justification called "the shortest grammatical rule in the world" (Coulson 1976: 5): 8.4.68 *a a*. This characterization is not invalidated by the fact that there are other rules too consisting of two sounds only. These are fragments that exemplify rule ellipsis and need to be completed by other rules, whereas 8.4.68 constitutes a self-contained statement.

We know that 8.4.68 is to be pronounced as "*[a] [ə]*". But what does it mean? It was mentioned before that the unspecified *a* of the Śiva-sūtras stands for 18 different variants of the *a* sound. Therefore it represents a very abstract unit, comparable to what Trubetzkoy (1958 [1939]: 70–75) calls *Archiphonem*, i.e. a unit which neutralizes, or abstracts away from, phonological distinctions between homorganic sounds, in particular the distinction between */a/* and */ā/*. Accordingly, we must postulate here (at least) three levels: archiphoneme *{a}*, phoneme */a/*, and the phonetic unit *[a]*. In the normal pronunciation of Classical Sanskrit */ā/* was open and */a/* was closed, most probably pronounced as *[ə]*. In Pāṇini's rules the unspecified *a* is pronounced as short and open, i.e. **not** as *[ə]*, in order to indicate that this non-normal sound *[a]* stands for a **theoretical** entity.

The function of 8.4.68 may be explained as follows. Now that the grammar is completed, the final rule "restores *a* to its normal value" (Cardona 1976: 207). Or more elaborately: "*a a*, i.e. */a/* → *[ə]* = The sound that (for convenience of grammatical statement) we have treated as differing from */ā/* only in length is, in fact, to be realized as [ə]" (Coulson 1976: 5). It should be stated more clearly, however, that 8.4.68 involves **three** descriptive levels, and not just two: the rule descends from *{a}* to *[ə]* via */a/*. Pāṇini must of course recognize a phonological level */a/* between the more abstract *{a}* and the more concrete *[a]* ~ *[ə]*: it is precisely the function of the *T*-determinative to establish the phonological distinction between */a/* and */ā/*, as expressed by *aT* vs. *āT*. It is less

important that some of the other distinctions between the 18 *a*-variants may not qualify as phonological.

With these specifications, it is true to say that, having completed his task of theoretical description, in the final rule Pāṇini 'gives' the real language 'back' to his audience and then leaves the scene: "par un énoncé ultime, le grammarien redonne sa langue à l'auditeur, tout en marquant la distance de son propre point de vue: dès que la simple parole apparaît, il s'écarte" (Pinault 1989: 343). It is quite remarkable that Pāṇini manages to express this complex and profound idea by means of the shortest grammatical rule in the world.

Finally, rule 8.4.68 illustrates the sense in which the written medium distorts the (spoken) nature of the *Aṣṭādhyāyī*. If written, its structure is *X [is] X*, which makes no sense at all. If spoken, its structure is *X ['s nearest spoken equivalent is] Y*, which makes perfect, refined sense.

III) Panini & Axiomatics

This section reproduces and further develops the argument given in Itkonen (1991: 38-44) and (2003: Chap. VI, esp. pp. 69-71).

The goal of axiomatics is intuitively natural: starting from a fixed point, to describe in a controlled way as much as possible by means of as little as possible. The "fixed point" equals a set of one or more axioms, and the "controlled way" refers to a definite set of inference rules (plus definitions). Applying the inference rules to the axioms generates theorems to which (same or different) inference rules may be re-applied again and again, ultimately producing an infinite number of theorems. (Alternatively: theorems are 'derived' from axioms and other theorems.) The overriding value is **simplicity** (or economy) as far as the number of axioms and/or inference rules is concerned (which paradoxically produces results that certainly look far from simple: consider e.g. the 66-rule description of the verb-form *náyanti* in Itkonen 1991: 63-65). It goes without saying that Pāṇini's grammar conforms to the axiomatic ideal so defined: "Almost all technical aspects of the grammatical system are motivated ultimately by the fundamental principle of simplicity (economy, *lāghava*)" (Kiparsky 2002: 6). In fact, Section II gave an example of simplicity/economy that cannot be surpassed. It is significant that for some 2'000 years the higher education both in India and in Europe was based on the idea of axiomatics, represented by Pāṇini's grammar and Euclid's geometry, respectively.

The informal characterization given above applies to all axiomatic **systems**. The most important subclass of such systems is constituted by axiomatic **theories**, which have the additional property that the axioms must be (empirically or logically) **true** and inference rules must be truth-preserving. In this technical sense, Pāṇini's grammar is an axiomatic system, not a theory.

Within axiomatic logic, theorems are proved by being derived from axioms. In formal logic, however, it is also possible to prove theorems without any axioms, i.e. just by means of inference rules. The trick is to take a few inference rules, to assume the premise(s) A to be true, to derive the conclusion B, and then to cancel the assumption of the truth of A, which then leaves just the implication 'if A, then B' (cf. below). This insight is generally attributed to Gerhard Gentzen, who since 1934 made it the basis of what he somewhat misleadingly called "the method of natural deduction".

It is interesting to note that Dummett (1981: 432-434), for instance, strongly prefers the Gentzen-type formalization of logic over the axiomatic approach:

> "The founders of modern mathematical logic, Frege and, after him, Russell, have formalized logical systems on the quite misleading analogy of an axiomatic theory: namely, by reducing to a minimum the rules of inference, and axiomatically stipulating the validity of formulas of certain forms. In such a formalization, attention

is concentrated on the postulation of logical truths and the derivation of further logical truths from them. … The traditional [and correct] answer to the question what is the subject-matter of logic is, however, that it is **not truth**, but inference, or, more properly, the relation of **logical consequence** … The first to correct this distorted perspective, and to abandon the false analogy between a formalization of logic and an axiomatic theory, was Gentzen" (emphasis added).

Even non-experts can agree with Dummett that the Gentzen-type formalization with **no** axioms succeeds in capturing the basic intuition that logic is **hypothetical** in character: it does not say what **is** the case *tout court*, but what is the case **if** something else is the case.

Stegmüller & von Kibéd (1984: 98-99) make the same point as Dummet, and illustrate it in more concrete terms by giving an example that was originally due to Gentzen himself. But first we have to set the stage by adducing two intuitively obvious inference rules:

Rule of Addition $\quad \dfrac{p}{p \vee q}$

Explanation: If you know that John is sick, you are entitled to infer that John is sick or something else is the case, i.e. in moving from the premise A to the conclusion B, you are entitled to **decrease** the information contained in A (cf. 'If x is 3 meters long, x is at least 1 meter long').

Rule of Simplification $\quad \dfrac{p \,\&\, q}{p} \qquad \dfrac{p \,\&\, q}{q}$

Explanation: If you know that John is sick and Mary is healthy, you are entitled to infer two things: first, that John is sick; second, that Mary is healthy. Again, the amount of information decreases in going from the premise A to the conclusion B, because B is literally contained in A.

Now let us suppose that we have to prove that the following implication ('if A, then B') is valid (= logically true):

$$[p \vee (q \,\&\, r)] \rightarrow [(p \vee q) \,\&\, (p \vee r)]$$

This is how we proceed in reality. We first assume *p* to be true and derive both *(p ∨ q)* and *(p ∨ r)*, by applying twice the Rule of Addition; and then we assume *(q & r)* to be true and derive both *(p ∨ q)* and *(p ∨ r)*, by first applying the Rule of Simplification followed by the rule of Addition and then repeating this once more. This means that *[(p ∨ q) & (p ∨ r)]* can be derived either from *p* or from *(q & r)* or from both, which in turn means that we have proved the validity of the implication. After this we **cancel** the assumptions concerning the truth of *p* and of *(q & r)*. The important thing is that during this whole process of proving the validity of our implication, we never appealed to any (unproved) axioms, but solely relied on the two rules of inference. Therefore the axiomatic method is indeed replaced by 'natural deduction'.

It is incontestable that if we want to find out whether a given formula is valid or not, we practically **never** apply the axiomatic method. This is a strong argument against axiomatics, but not a devastating one. On reflection, the justification of axiomatics lies elsewhere, namely in its capacity to give us – metaphorically speaking – the **mastery** over an infinite domain. Moreover, even granting that Dummett is right in claiming logical consequence to be the **primary** consideration for logic, certainly the **secondary** consideration is truth, i.e. logical truth (= validity). If we deny this, we are prevented from grasping the **analogy** between validity and

grammaticalness/correctness and, in consequence, also the methodologically crucial analogy between logical descriptions and grammatical descriptions (cf. Itkonen 1975, 1978: Chap. X). Contrary to what Dummett seems to be saying in the above quotation, this is **not** a false analogy.

Therefore – as my references to Pāṇini and Euclid already indicated – I continue to share Frege's view about the ('philosophical') importance of axiomatics. It is **important** to understand that the axiomatic ideal (of "describing as much as possible with as little as possible") applies to such seemingly disparate domains of research as geometry, linguistics, Newtonian mechanics, and – yes — logic, and even reappears in different cultures as the very origin and epitome of systematic thinking. In stating this fact, I achieve a **significant generalization** about the nature of human thought.

Let it be added that the history of Western linguistics is characterized by a constant **tension** between two distinct, and occasionally even opposite, descriptive ideals: on the one hand, axiomatics (cf. Itkonen 1978); on the other, causal explanation (cf. Itkonen 1983). A bird's-eye view is given in Itkonen (2013). This kind of tension is absent from the Indian tradition, which is dominated by Pāṇini's non-causal (= non-psychological) approach.

IV) The Real Importance of Pāṇini's Grammar

It is not only the case that the *Aṣṭādhyāyī* was originally composed and transmitted orally, i.e. without the aid of written language. It is also the case that literacy did not exist in India at the time (c. 500 BC) when Pāṇini composed his grammar. There are no written records of either Sanskrit or its descendant Prakrit before the edicts of the emperor Aśoka (c. 250 BC). By comparison, the language of the Indus Valley civilization (c. 2200-1800 BC), which in Pāṇini's lifetime had been extinct for much more than one thousand years, has been preserved until the present day in numerous (albeit brief) documents carved on stone, metal, or bone. "It is unheard-of that any people having a script never use it on hard materials" (Masica 1991: 134). It follows that Pāṇini had no written medium at his disposal, a view confirmed by a visiting Greek, who flatly stated c. 280 BC that the Indians have no knowledge of written letters (p. 135).

"Modern linguistics acknowledges [Pāṇini's grammar] as the most complete generative grammar of any language yet written, and continues to adopt technical ideas from it" (Kiparsky 1993: 2912). It represents the **only** case where the oldest extant description has remained – for 2'500 years – the best in its own scientific field. This fact alone suffices to make it the paramount intellectual achievement in the annals of human thought. But since it, in addition, came into being without the aid of literacy, we seem to be in the presence of a "miracle" (*Wunderwerk*), to quote the opinion that Georg von der Gabelentz expressed in 1891 (cf. Itkonen 1991: 69). Miracles do not exist, however. Therefore Pāṇini must be taken to have shown that the human mind is capable of much more than all of us have been led to believe. This is one of the most important lessons that any science can teach; and linguists should consider themselves fortunate that they, and they alone, are qualified to impart it.

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