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TWO MODELS OF GRAMMATICAL DESCRIPTION

CHARLES F. HOCKETT

I. INTRODUCTION

1.1. By a 'model of grammatical description' is meant a frame of reference within which an analyst approaches the grammatical phase of a language and states the results of his investigations. In one sense, there are as many models as there are different descriptions ('grammars' in the sense of monographs). But in another, and very important, sense, most grammatical descriptions seem to cluster about a relatively small number of relatively distinct models; it is with these archetypical frames of reference that we are concerned here.

The bulk of the present paper was written between 1949 and 1951; at that time, the writer was under the erroneous impression that there were principally just two archetypes to be dealt with. If we confine our attention to monographs produced in the United States in the past half-century, this impression is not grossly inaccurate. One of the 'two models' which is well represented within those spatial and temporal limits is what we shall call ITEM AND PROCESS, or IP for short; the other we shall call ITEM AND ARRANGEMENT, or IA. In most of what follows we shall have occasion to mention only these two.

But that limitation constitutes a defect in the paper—a defect which was recognized by the writer in 1951, and because of which the paper was long held unpublished. Quite apart from minor variants of IP or IA, or models that might be invented tomorrow, there is one model which is clearly distinct from either IA or IP, and which is older and more respectable than either. This is the WORD AND PARADIGM (WP) model, the traditional framework for the discussion of Latin, Greek, Sanskrit, and a good many more modern familiar languages. It will not do to shrug this frame of reference off with the comment that it is obviously insufficiently general, incapable of organizing efficiently the facts of a language like Chinese. As yet we have NO completely adequate model: WP deserves the same consideration here given to IP and IA. The writer offers his apologies for not having worked such consideration of WP into the present paper. However, lack of time prevented this, and the discussion as it stands may nevertheless be of some value.

1.2. As between IP and IA, the former is older. The key term in IP is 'process', as is evident from the following characterization by Harris (1944, p. 199):[1] "The difference between two partially similar forms is frequently described . . . as a process which yields one form out of the other. Thus, when bases or themes have several vocalic forms, the various forms are said to be the result of vowel-change processes operating upon the base or theme. The difference between a base and a base-plus-suffix is described as a result of the process of suffixation. This is a traditional manner of speaking, especially in American Indian grammar.

[1] Reference is made by author and year of publication to the bibliography at the end of the article.

It has, of course, nothing to do with historical change or process through time: it is merely process through the configuration, moving from one to another or larger part of the pattern."

Rigorous work with historical linguistics, as everyone knows, preceded almost all rigorous descriptive work; the carry-over of 'process' terminology from historical discussion is natural enough. In this country Boas (1911, pp. 27f.) established IP, and Sapir (1921, esp. ch. 4) elaborated it; the descriptive chapters of Sapir's *Language* are cast entirely in this mold. Grammars written largely under Sapir's aegis, such as Newman's Yokuts (1944; the specific aim of Harris's remarks quoted above), still stand as examples of IP in action.

1.3. As a further example of IP, consider the following paragraph from Haas's shorter treatment of Tunica (1946):

> The Tunica language is mildly synthetic in structure. In its technique of synthesis it is for the most part agglutinative, but it also employs a limited amount of fusion. The morphological processes used are juxtaposition, affixation (prefixation, infixation, and suffixation), reduplication, and suppletion. Of these, prefixation and suffixation, particularly the latter, are exploited to a greater extent than are the other processes.

There is no question about the meaningfulness of this characterization. Whether it is particularly relevant, either to a description of Tunica or to a proper placing of Tunica in the gamut of linguistic types, and whether, relevant or not, it is effectively phrased, are other matters.

1.4. The younger model, IA, has been formulated at least in part because of a feeling of dissatisfaction with the 'moving-part' or 'historical' analogy implicit in IP. At the very least, those analogies seem to imply the necessity of making certain decisions in a possibly arbitrary way. Critics of IP would prefer to circumvent such decisions altogether.

For example (cf. Hockett 1947a, pp. 282–3), if it be said that the English past-tense form *baked* is 'formed' from *bake* by a 'process' of 'suffixation', then no matter what disclaimer of historicity is made, it is impossible not to conclude that some kind of priority is being assigned to *bake*, as against either *baked* or the suffix. And if this priority is not historical, what is it?[2] Supporters of IP have not answered that question satisfactorily.

Another objection which might be raised to IP as exemplified in the above quotation from Haas is that the wording tends towards personalization and teleology. The Tunica language 'uses' or 'employs' various techniques; it 'exploits' some of those more than others. The use of 'the Tunica language' as a subject with such verbs is personalization; the use of such verbs seems to imply teleology—the language has a purpose to accomplish, and it makes use of such-and-such means to the end. If any entity 'uses' the techniques, it is the speakers, not the language. This objection is pointless unless it can be shown that such a way of speaking leads its users into errors of fact. So long as it is

[2] The possible criteria are examined by Pittman, 1948. But Pittman's discussion is cast in IA, and affords no obvious support for the IP approach.

merely a 'way of speaking', easier than some other way because English is an Indo-European language, we cannot object.

1.5. The essence of IA is to talk simply of things and the arrangements in which those things occur (Harris 1944, section 5, esp. end of page 203; Bloch 1947, introductory remarks; Harris 1945b; Harris 1942). One assumes that any utterance in a given language consists wholly of a certain number of minimum grammatically relevant elements, called morphemes, in a certain arrangement relative to each other. The structure of the utterance is specified by stating the morphemes and the arrangement. The pattern of the language is described if we list the morphemes and the arrangements in which they occur relative to each other in utterances—appending statements to cover the phonemic shapes which appear in any occurrent combination.[3]

The matter is not quite so simple as that. Some of the complexities will concern us later. Here it must be noted that there is some indeterminacy even in the apparently trivial matter of deciding what to subsume as 'item' and what to call 'arrangement'. In English, intonation phonemes can be taken as comprising parts of morphemes just as do vowels and consonants. There is then a set of morphemes composed entirely of intonation phonemes, and such intonation morphemes occur, not before or after other kinds of morphemes, but simultaneously with them. In *Come here!*, the segmental form and the /(2)31/ intonation morpheme occur at the same time. But this is not the only way to handle the matter. An alternative is to consider pitch as a second dimension in which (segmental) forms can be arranged, there being four possible positions along this dimension, in contrast to the infinite number along the time axis. For purposes of demonstration, we could then write

(4)
(3) *h*
(2) *come* *e*
(1) *re*

—where the numbers specify the pitch-levels. There would then be no intonation morphemes, but rather a two-dimensional space in which other types of morphemes are arranged relative to each other.[4] The four stress levels of English

[3] Floyd Lounsbury has suggested (private conversation) that we can profitably speak of the 'structure' of a word or utterance but of the 'pattern' of a language. This suggestion is followed here. (The contrast, of course, parallels one of those designated by the terms 'parole' and 'langue'.)

[4] The problem of dimensionality is confusing. Recognizing intonation morphemes, we have to accept simultaneity as one arrangement of morphemes relative to each other. This, in turn, suggests that there is a second dimension of arrangement in addition to time; but there are no contrasts between different 'arrangements' in this second dimension—the term 'superfix' is no more apt than 'subfix', and (the bad Latin) 'simulfix' might be even better. A dimension in which arrangements are not in contrast is rather thin. Lounsbury has suggested (private conversation) that it is better to speak of just one dimension, with simultaneity as one possible arrangement within it. If we treat intonations (or stresses) as features of arrangement instead of as morphemes, then clearly we have more than the one dimension time; but in this case, although two items can occur at dif-

could be handled in the same way, giving three dimensions of arrangement. Bloomfield (1933, p. 163) chooses this alternative when he speaks of taxemes of 'modulation'.

IA is present implicitly, though not with complete clarity, in Bloomfield's chapters on grammar; where traces of IP survive, he is sometimes a bit apologetic (1933, p. 213 top; cf. Wells, 1949, p. 102). It is certainly Bloomfield's systematization which has served as the main point of departure for the train of investigators who have been trying to develop IA—Harris and his students, Bloch, Wells, lately Nida, and others (see bibliography passim under these names, Nida only in 1948, 1949. Nida 1946 is cast essentially in IP). There are few full grammatical descriptions which illustrate IA in its purest form; Bloch's discussions of Japanese are probably the closest (1946; even more—work done under Bloch's direction —Gardner 1950, Yokoyama 1950).

1.6. There is partial translatability between IP and IA, but the results of translation are apt to seem somewhat strange. By way of demonstration, here is the passage from Haas's Tunica, recast in IA:

> The average number of morphemes per word in Tunica stands about midway between the highest and lowest averages known from various languages. The morphemes within a single word are for the most part relatively invariant in shape, but there are some cases of more alternations. Tunica morphemes fall into several position-classes: stems, prefixes, infixes, and suffixes; at least one affix [we are not told which kind or how many] is morphophonemically a chameleon. A single word may contain more than one stem. Suffixes are more numerous, both as a class and as regards the average number per word, than prefixes, and the latter in turn more numerous than infixes. In a few cases, morphophonemic alternations are between totally dissimilar forms.

The original, in all seeming, imparts relevant general information about Tunica. The translation given above has little or no such impact—at least on this reader; it has the appearance, rather, of an assembly of prosaic facts, which have no particular reason for being given in the sequence in which they are here found, or, indeed, even for being given all at one place.

If this be true, then there must be more difference between the IP and the IA models than has yet been touched on; there must be major differences as to what features of a language are regarded as worthy of prominent mention and what features are prosaic—even if necessarily included somewhere in a reasonably complete description.

This last comment is offered not as a forerunner of greater elaboration to follow, but in lieu thereof. There are differences between IP and IA which will have to be ignored within the fairly formal framework that will shortly be built, and it would be wrong to ignore them altogether.

1.7. It seems to me that the current general preference for IA rather than IP —and such a prejudice is certainly observable—stems at least in part not

ferent times on the same intonation level, two items cannot occur at the same time on different intonation levels. There is still something rather queer about the added dimensions.

from any great excess of merit of IA over IP, but rather from the following: (1) We like, nowadays, to be as formal as possible. (2) IA has been formalized, and IP has not. It is unfair to compare a formalized IA with an informal IP and conclude that the former is better just because it is formalized. If it could be shown that IA is capable of formalization but that IP is not, that would be another matter. But in what follows, I hope to demonstrate that no such claim can be made.

To do this, it is of course necessary to devise a formalized version of IP. This will be almost our last step. It will be preceded by: a general outline of IA, in broad enough terms to cover most, if not all, of its current varieties; a survey of some of the problems implicit in IA (in two parts: tactical and morphophonemic); an excursion into certain elementary notions of mathematics, seeking analogs for IA and other possibly useful analogs. Our formal version of IA will be derived from such an analog. We will then be in the position to assess the relative merits and defects of IA and IP.

II. Item and Arrangement

2.0. The following outline of IA might be called 'semiformal'—not so formal as to qualify as 'postulates', but succinct rather than discursive. The model is familiar, so all but the most essential examples are eschewed.

2.1. A linguistic form is either SIMPLE or COMPOSITE.[5]

2.2. A simple form is a MORPHEME.

2.3. A composite form consists of two or more IMMEDIATE CONSTITUENTS standing in a CONSTRUCTION and forming a CONSTITUTE. Constituents and construction recur in other composite forms (save for an occasional unique constituent). Each IC (=immediate constituent) occupies a certain POSITION in the construction; each is the PARTNER of the other(s).[6]

2.4. Occasionally it is convenient to regard a morpheme not as participating in any construction, but rather as a MARKER of the construction in which nearby forms stand.

Any such concession necessitates a statement of the conditions under which the interpretation is to be accepted. Three such statements of conditions occur to me, the first being the trivial (but not unimportant) one of excluding the interpretation altogether.

The second is to allow the interpretation only where the marker indicates the boundary between partners in a construction, and nothing more. By this, the Peiping Chinese junctural morphemes /;/ and /,/ are allowable as markers, since in such an utterance as /ue^3 lai^2, ni^3 zieu^4 cy^4./ 'When I come, you go right away', the /,/ tells us that the segmental sequence before it and that after it are partners in a construction—that is, that this division of the whole sequence,

[5] The term 'linguistic form' is here to be regarded as being defined by the other terms at least as much as they are by it. The outline assumes, without explicit statement, a certain amount of our linguistic common sense.

[6] The only new term is 'partner', which I venture to suggest to fill a hole in our terminology in which I have stumbled more than once.

rather than any other, is the correct one—but it does not tell us what construction is involved (Hockett 1950, section 2).

This limitation, however, would not allow us to interpret *men and women* as a bipartite construction with marker *and*, since *and* quite obviously gives us more information than the maximum amount specified. A set of conditions which would allow the interpretation in this case would have to be along the following lines: there is a form ABC consisting of three smaller forms, where (1) one of the smaller forms, say B (it would not have to be the one in the middle) is a single morpheme; (2) the remaining two, A and C, are structurally similar to each other (in some appropriate sense) but not to B; (3) there is no evidence forcing either an interpretation as A|BC or as AB|C.[7]

Even more liberal sets of conditions might be formulated. Our reason for including the present discussion will appear in the sequel.

2.5. The TACTICAL PATTERN of a language is completely covered by a set of statements of the following form (or by any set of statements which can be transformed mechanically into this form):[8]

(1) A list of the constructions.
(2) Under each construction as heading,
  (2.1) Enumeration of the positions in that construction.
  (2.2) Specification of any marker for that construction.
  (2.3) For each position,
    (2.31) A list of the morphemes which occur there, and
    (2.32) A list of the constructions, composite forms belonging to which occur there.

2.6. A morpheme may appear in more than a single phonemic shape. A single shape of a morpheme is a MORPH; the various morphs which are the shapes or REPRESENTATIONS of one and the same morpheme are its ALLOMORPHS.

2.7. The alternations in shape of a morpheme are predictable in terms of the environments in which it occurs (plus, of course, the morphophonemic statements which one makes).

This necessitates a definition of 'environment': the environment of a morpheme-occurrence is the setting of that occurrence, insofar as that setting can be described in purely structural (i.e., nonsemantic) terms. Narrower definitions are possible; ours is intentionally wide.

2.8. All the phonemic material in an utterance is accountable for in terms of

[7] This incorporates Wells's specification of the conditions under which one resorts to a tripartite instead of a bipartite construction (Wells 1947, pp. 103f.).

[8] Many different arrangements of descriptive statements are convertible into this form. In particular there is the contrast between beginning with the most inclusive constructions and working down the scale (large-to-small), which is perhaps the traditional way at least for syntax (exemplified, e.g., by the arrangement of the grammatical chapters in Bloomfield 1933), and beginning with the least inclusive constructions and working up the scale (small-to-large), the procedure proposed by Harris, 1946. These two ways have in common—despite Harris's disclaimer in section 3.7 and fn. 8—the recognition of IC or hierarchical structure, though Harris's procedure discovers that structure step by step, whereas the alternative seems to imply discovering it in advance.

the morphemes which compose the utterance and the arrangement in which they occur relative to each other (plus, once again, one's morphophonemic statements).

2.9. Subject to the conditions just stated (2.6–8), it is possible to allow such devices as the following where they prove convenient:

(1) We may recognize phonemic zero as a possible morph shape. This requires carefully formulated supplementary criteria. At least two apparently consistent limitations have been proposed:

(1.1) A morpheme does not appear everywhere as zero (Bloch, 1947, section 2.3, (3)).

(1.2) A morpheme may appear everywhere as zero, providing it is a member of a tactically relevant class (under some suitable definition), other members of which are not (or are not always) represented by zero (Nida 1948, 1949; the criterion is there by implication, though not overtly stated).

(2) We may recognize a morph which belongs to no morpheme (Hockett 1947b, p. 333). Or, instead of this, we may simply classify some of the phonemic material in some utterances as NONMORPHEMIC (Hockett 1950, fn. 8).

(3) We may recognize a morph which belongs simultaneously to two (or more) morphemes in a fixed arrangement (whether partners in a construction or not). If the morphemes involved appear, in other environments, in separable shapes, then the morph in question is a PORTMANTEAU representation of the morpheme-group (Hockett 1947b, p. 333). If the morphemes involved appear only in such portmanteau representations, the usual terminology is a little different: the representations themselves are called 'morphemes', and the separate entities represented are called 'morphemic components' (Harris 1948, more extensively in 1951). This more usual, but deviant, terminology will not be used in the present discussion.

(4) We may allow a particular phoneme or sequence of phonemes to belong at one and the same time both to a morph which includes some preceding phonemes (and represents one morpheme) and to a morph which includes some following phonemes (and represents another morpheme)—LINKED MORPHS, the shared phoneme(s) being a LINK (Wells 1949, fn. 29, with credit to Lounsbury). Trivially different is the case in which one of the morphs, instead of both, contains phonemic material which is not part of the other.

2.10. The statement of shapes, alternations, and conditions of alternation describes the MORPHOPHONEMIC pattern of the language.

2.11. Morphophonemic and tactical pattern taken together constitute GRAMMATICAL PATTERN. This, paired with PHONOLOGICAL PATTERN, completes the synchronic pattern of a language. The cleavage between phonology and grammar is thought by some (including myself) to be more fundamental than that, within grammar, between morphophonemics and tactics, even though, for some purposes, other stratifications are possible. For example, it is sometimes convenient to class morphophonemic and phonological facts together, say as 'mechanics', in collective contrast to tactics (Hockett 1948, p. 185). Or, if the

distinction between automatic and non-automatic morphophonemics is made (we have not taken the trouble to work it into the above outline), it also makes a good deal of sense to class automatic morphophonemic facts with phonology, non-automatic with tactics; I have no labels to propose for the resulting two divisions (this is the stratification which seems to be implied by certain of Sapir's discussions: 1933, 1930). In any case, there are indeed problems about the exact location of the lines of demarcation between levels, but we need not concern ourselves with them here because the formal version of IP to be presented later will solve them neither more nor less than does IA.

III. Tactical Difficulties With IA

3.0. A grammatical description built according to the plan outlined in II sets forth principles by which one can generate any number of utterances in the language; in this sense, it is operationally comparable to the structure of that portion of a human being which enables him to produce utterances in a language; i.e., to speak. It is also comparable to a cookbook. From the lists in the tactical description, choose any set of compatible ingredients. Put them together, two by two or few by few (ICs), until all have been tentatively assembled; then treat in accordance with the morphophonemic statements (in cooking, 'cream', 'blend', 'broil', etc.); remove traces of these operations (clean and put away the cooking utensils); and one has an utterance in the language. In cooking, a difference in the sequence in which ingredients are put together can make a difference in the end-product; if this were not so, manufacturers of processed foods would not announce, as they sometimes do on packages, both ingredients and proportions. But there can also be differences of sequence in cooking operations which make no discernible difference in the end-product. For the moment this second fact is of primary relevance for the analogy. There is, in linguistics, no guarantee that different sequences of operations, performed on the same ultimate constituents, may not produce the same, or what is ostensibly the same, end-product.

In fact, we can specify the conditions under which this will be the case. The conditions involve the constructions recognized in the tactical description and the forms listed under the various positions for the various constructions. Let there be four constructions, C_1, C_2, C_3, and C_4 (some of which may be the same). Let there be three forms F_1, F_2, and F_3. Suppose that F_1 and F_2 occur in that order in C_1; F_2 and F_3 in that order in C_2. Suppose that forms conforming to C_1 (hence F_1F_2) occur in the first position of C_3, and that F_3 occurs in the second position of C_3. Finally, suppose that forms conforming to C_2 (hence F_2F_3) occur in the second position of C_4, and that F_1 occurs in the first position of C_4. Under just these conditions, the composite form $F_1F_2F_3$ will be a case in point.

We may illustrate with English. C_1 and C_4 are the construction of adjective-attribute and nominal-head. F_1 is *old*, F_2 is *men*. C_2 and C_3 are the marked construction *X and Y*; F_3 is *women*. Consequently we may build the composite form *old men and women* by either of two procedural sequences: putting *old* and

men together by C_1, and then joining the result to *women* by C_2; or putting *men* and *women* together by C_2, and then putting *old* together with the result of C_2 in accordance with C_1.[9]

The converse of the cookbook nature of a grammatical description is that, when presented with an utterance in a language the pattern of which has been determined, the analyst should be able to state its structure. Now it is clear that in any such case as that of *old men and women*, the analyst will be able to determine the ultimate constituents and the (linear) order of those constituents, but he will not necessarily be able to tell the order of association, the IC-structure or HIERARCHICAL STRUCTURE, of the utterance. The fact that his description supplies more than a single procedural sequence which will build the composite form implies that when presented with the whole form the analyst cannot determine which procedural sequence was involved in its production.

We therefore have to make a decision. It was mentioned above that a grammatical description is an operational parallel to part of a speaker's internal apparatus. If we believe that this parallel extends to the matter of order of association, so that ambiguities in the description are matched (at least in some cases) by distinct internal chains of activity which produce identical linear sequences of morphemes, then we can regard the matter of hierarchical structure as an integral part of the structure of utterances even in ambiguous cases. But if we do not so believe, or if we feel that such a conclusion ought not to influence our development of analytical techniques, then we are forced to conclude that hierarchical structure is at most a convenient shorthand for description—not anything essential about the grammar of a language, but simple a way to make our description of a whole language less cumbersome—an intrusive artifact, like the dye on a bacteriologist's slide. For, obviously, it would be possible (save for lack of time) to specify all arrangements of ultimate constituents in utterances without resort to any intermediate groupings.

The IA picture is therefore potentially somewhat more complex than our original emphasis on the two notions ('item' and 'arrangement') would imply. There are more potentially independent factors than those two. Specifically, there are (1) forms, (2) (linear) order, (3) constructions, and (4) IC or hierarchical structure. We must investigate the status of these factors relative to each other. Are they all 'primitives' in the system, or are some derivable from others?

The independence of forms and order is clear almost without demonstration. Such a trivial example as *John hit Bill* versus *John hit Dick* demonstrates the independence of form from order; the former versus *Bill hit John* demonstrates the independence of order from form, since these two could be said to differ

[9] Wells 1947, p. 93. Since normal English orthography leaves out certain grammatically relevant features of utterances (e.g., intonations), any single English notation, such as *'old men and women'*, subsumes ambiguously a family of linguistic forms. Some members of this family are marked clearly as having one IC structure; some are marked equally clearly as having the other. But, at least for my own speech, there are also members of the family that are not marked in either way. In the context, it is of course one of the latter with which we are dealing; here, and in similar situations later, the reader must assume that this is the case.

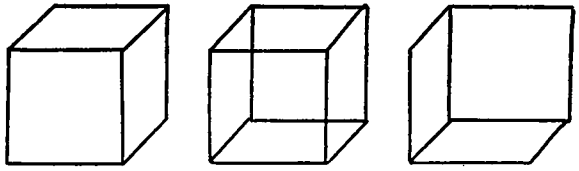
only as to order of ultimate constituents. But the status of constructions and of hierarchical structure needs further discussion.

3.1. Beginning with hierarchical structure, let us consider again Wells's case of hierarchical ambiguity, this time embedded in a longer utterance: *The old men and women stayed at home.* It is quite possible that if I say this to an audience, some hearers may conclude that I have referred to old males and all females, others may believe that I have spoken of all old people of both sexes; still others may believe that I am consciously being ambiguous (as I am!) or may simply be unable to decide the matter.

Wells adopts a very simple solution. He assumes that *old men and women* has one or the other hierarchical structure depending on the meaning. Since there are cases in which the hearer cannot tell what the meaning is, this must revert to a consideration of something like 'speaker's intention', which means that the step mentioned earlier is indeed being taken. Before we resort to such a drastic measure, let us look for further evidence.

We might apply the same technique by which we separate homophonous morphemes. *Old men and women* can be substituted for, say, *old people*, in one large set of environments (for example, *old people belong at home* and *old men and women belong at home* are both good English sentences); it can be substituted for *women and old men* in another, partly different, set of environments (*The women and old men stayed at home while the young men went to war; The old men and women . . .*). But *old people* and *women and old men* are not so freely interchangeable. It is by just this procedure that we would, in the first instance, separate *The sun's rays meet* and *The sons raise meat.* Having separated either pair of homophones, we can seek for correlated internal structural differences. In the latter pair, the differences lie in the ultimate constituents; in the former, the only difference is in the hierarchical organization.

But there is a deeper consideration. The hearer, confronted with *The old men and women stayed at home*, is in much the same position as the observer who sees a picture of a hollow cube and can, almost at will, see first one corner and then another as closer to him. There is a third way to see the picture: as an assemblage of straight lines on a flat surface, without depth. This third way is difficult without the special training which artists, whose task it is to produce such visual representations, have to get. The ordinary individual, looking at the three figures A, B, and C, can easily enough see that B is different from both A and C, but he will also see B now as more like A, now as more like C. Since most of our visual experience is with depth perception, we 'read' depth into many two-dimensional portrayals.



A B C

B, then, is ambiguous. An ambiguity cannot exist in the abstract; it must be between things. The alternatives in the visual case are not A and C; they are B's BEING LIKE A or C respectively. 'Being like A' and 'being like C' are two distinct and mutually exclusive matters: B cannot at one and the same time be taken both as like A and as like C.

The same argument holds for hierarchical ambiguity. Our B is *The old men and women stayed at home.* For A and C, we can select respectively *The women and old men stayed at home* and *The old men and old women stayed at home.* B's 'being like' A is one hierarchical structure; B's 'being like' C is another. A hierarchical structure is a class of forms which are alike in a certain way; so is a construction. A single sequence of morphemes cannot be like two mutually exclusive other sequences at one and the same moment for a single hearer, but in some cases it may fluctuate between the two directions of likeness. Interpreting *old men and women* as merely a linear sequence of morphemes is highly unnatural; the linguist, for his special purposes, may have to develop the ability to do so, just as the artist has to develop the ability to see things without depth in order to represent them in such a way that others will report the presence of depth.

Our conclusion, then, is that hierarchical structure is a 'primitive' just as are forms and order. The demonstration turns necessarily on two considerations: (1) there must be many utterances in which the hierarchical structure is unambiguous, to afford a frame of reference; (2) there must be also at least a few in which the hierarchical structure is ambiguous, since otherwise the hierarchical structure would in every case be determined by forms and order, and hence not a 'primitive'.

3.2. One recently proposed type of morphemic analysis turns on the 'primitive' status of hierarchical structure in a way which has never been made clear. This is the utilization of discontinuous morphemes (Harris 1945a). For those to whom this type of analysis appeals, this dependence, to be demonstrated in a moment, may add weight to the desirability of recognizing IC-structure as a 'primitive'. But since there is no situation in which the analyst is actually forced to use discontinuous morphemes, its dependence on IC-structure cannot count in any sense as evidence for the status of the latter.

Consider the following two Latin sentences: (a) *pater bonus filium amat*; (b) *pater bonum filium amat.* The latter, though unusual, was certainly possible; it is easier to handle than more complex and more realistic examples that could be found.

According to the more customary procedure—rejecting discontinuous morphemes—the ultimate constituents of (a) include two occurrences of a morpheme that we may call {nominative} and one occurrence of {accusative}, while those of (b) include one of {nominative} and two of {accusative}.[10] The distribution of the two occurrences of nominative in (a) marks *pater* and *bonus* as going together as partners in a construction, while the distribution of the two

[10] These morphemes, treated as discontinuous or not, are what Harris has called morphemic components, a fact which does not disturb the present argument (see 2.9 (3) of this paper).

occurrences of {accusative} in (b) mark *bonum* and *filium* in the same way. The hierarchical structure in each case is partly marked by the nature and location of these morpheme-occurrences. There is no need, in these examples, for hierarchical structure to be an independent primitive.

Using discontinuous morphemes, the results are different. The ultimate constituents of (a) in this case include ONE occurrence each of {nominative} and of {accusative}—and in (b) there will be found, also, just one occurrence of each of these morphemes. In (a), the one occurrence of {nominative} is an occurrence in discontinuous form, the separated representations coming at the ends of two successive words; in (b) similarly for the {accusative} morpheme.

Now when discontinuous morphemes are recognized, it is necessary not only for the particular shape of each representation of such a morpheme, but also for the number of representations involved in any one occurrence and the precise location of those representations, to be predictable on the morphophonemic level. It is not enough that we be able to predict that if the stem *patr-* and the nominative morpheme co-occur, the total form will be *pater*; we must also be able to predict that if the stem-sequence *patr-* . . . *bon-* . . . and {nominative} co-occur, the total form will be *pater bonus*. Now assume that we have the partial *patr-* . . . *bon-* . . . *fili-* . . . *amat* and one occurrence each of {nominative} and {accusative}. There is absolutely no way of knowing that the total form will be *pater bonus filium amat*, or *pater bonum filium amat*, or possibly something else, unless among the environmentally relevant facts it is given that *patr-* and *bon-* are partners, rather than *bon-* and *fili-*. The distribution of represensations of discontinuous morphemes is not predictable in Latin unless hierarchical structure is allowed to count as part of morphophonemically relevant environment. When we make use of discontinuous morphemes, then Latin sentences (a) and (b), despite overt phonemic differences, are structurally the same as the two English phrases of shape *old men and women*.

The requirement of 2.7 was intentionally phrased broadly enough to allow this. However, it has not been customary to count IC-structure as relevant environment, and it may be that the necessary added complication will be enough to turn some against the whole notion of discontinuous morphemes.

3.3. Next in line is the status of constructions.

Given verb-stem *bake* and the past-tense morpheme, with instructions that they are to go together, the only thing one can do is to put them together as *baked*. There is no problem of hierarchical structure since each constituent is ultimate. Linear order is determined.

Given *John* and *saw* to be put together, the result can be either *John saw* or *saw John* (either of which, partnered by an intonation, might occur as an utterance). Here there is a choice of procedure. If to *John* and *saw* we add a specification as to linear order, then there is no longer any choice between constructions: only *John saw*, which is the actor-action construction, is possible with one order specification, and only *saw John* (action-goal construction) is possible with the other. But instead of approaching the matter in this way, we can equally well regard the order as determined by the construction: *John*, *saw*,

and subject-predicate construction result necessarily in one linear order, the same forms and action-goal construction result necessarily in the other. Whichever course we follow, it is clear that we are confronted with one more variable than the maximum number which can be regarded as independent: forms to be partners, order, and construction cannot in such a case all be independent of each other.

The nearest example to complete independence of these three matters that I have so far discovered is in Chinese. Given *chau*^{3} 'to fry' and *fan*^{4} 'rice', and the specification that the first is to precede the second, there is still a choice of construction—though it does not manifest itself in any overt way within the sequence itself. One possible construction is verb-object, giving *chau*^{3} *fan*^{4} 'to fry rice, fry rice'; the other is attribute-head, giving *chau*^{3} *fan*^{4} 'fried rice'. These are really different: the first is also the construction of *chr*^{1} *fan*^{4} 'to eat rice, eat rice', unambiguously verb-object; the second is also the construction of *hau*^{3} *fan*^{4} 'good rice', which is unambiguously attribute-head.

From here on our argument about *old men and women* applies pari passu to *chau*^{3} *fan*^{4}, and need not be repeated in detail. There are, of course, some larger contexts in which *chau*^{3} *fan*^{4} is marked unambiguously as one or the other construction, just as there are larger environments in which the hierarchical structure of *old men and women* is not ambiguous. But there are also larger contexts in which the ambiguity remains. The construction, then, cannot be derived from the forms and the order. The reverse is possible: given forms and construction, the order can be regarded as determined—it just so happens that either of two constructions, with the same two constituents, results in the same order.

The conclusion to which we are forced is that, at least in some cases in some languages, choice of construction is a primitive.

3.4. If a particular version of IA allows the recognition of marked constructions, then the question as to the primitive or derived status of constructions becomes trivial: at least such constructions which have markers must have primitive status. Consider *John and Bill*, a bipartite construction with marker *and*. This form contrasts with *Bill and John* only as to order, with *John and Mary* (or *Tom and Mary*) only as to form, and with *John or Bill* only as to construction—since *or* is the marker of a different construction. In this case, all three factors are independent. It immediately follows that in *old men and women* all four factors are independent, since in addition to the *X and Y* construction there is also the matter of hierarchical structure, already demonstrably independent of the other factors.

3.5. So the four factors, the status of which we set out to survey, all have to be recognized as potentially independent, and therefore as primitives. If there is a possible exception, it is, surprisingly enough, linear order—one of the two factors (the other being forms) which would seem so obviously primary. The only situation discussed above in which linear order had to accepted as independent of all other factors was in the case of marked constructions like *John and Bill*, and it is possible to proscribe marked constructions altogether.

The survey also shows, however, that in the bulk of cases not all of this machinery is needed. In most cases, a determination of two or three of the factors leaves no choice for the remainder. It is this fact which gives rise to the most embarrassing tactical trouble inherent in IA: machinery which has to be in our workshop for use in certain marginal cases tends to obtrude itself where it isn't wanted.

Thus Bloch writes as follows (1947, p. 400): "the preterit form *waited* . . . can be described as follows. It consists of two morphemes, /weyt/ and /ed/, occurring in that order. The meaning of the first morpheme is a particular action that we need not specifically define here; that of the second is 'past time' or the like. The constructional meaning of the order in which the two morphemes occur is approximately 'perform a certain action at a certain time'." Bloch has cut down on the total amount of machinery by identifying 'construction' and 'order' (which, as we have seen, is in general questionable). But, still, entities are multiplied beyond necessity. Given the morphemes /weyt/ and /ed/ to be put together, actually nothing further need be said at all on the tactical level. There is no possible linear order save that of /weyt/ first and /ed/ second. Nor—if we separate order and construction—is there any choice of construction. Semantically, it is quite pointless to break down the meaning of the whole form *waited* into THREE parts: structurally, there are two and only two independent variables, and the only valid procedure is to assign, as the meaning of the second variable, everything which differentiates the meaning of *waited* from that of *wait*.

IV. Morphophonemic Troubles With IA

4.1. Most morphophonemic problems find simple answers in IA, for there is available a wide variety of morphophonemic techniques all well within the bounds of the IA model. However, there is a refractory residue, troublesome not because no solution can be found, but either because a multiplicity of solutions present themselves, no one seeming much better than another, or because the intuitively best solution is clearly in violation of the fundamental orientation of IA. This residue includes such cases as *took*, *put* (past tense), *children*, French *bon* and *bonne*, Chinese *lya*^{3} and *lyang*^{3} 'two'. We need deal in detail only with one of these, and *took* will do.

4.2. The following morphophonemic solutions have been proposed (or might be proposed) for *took* (we here follow, in the main, Bloch 1947, pp. 400–1):

(1) *took* is a single morpheme, so that there is no morphophonemic problem.

(2) *took* is a portmanteau representation of the two-morpheme sequence *take* and /ed/.

(3) *took* is an allomorph of the morpheme which appears elsewhere as *take*, plus a zero allomorph of /ed/.

(4) *took* is a discontinuous allomorph /t . . . k/ of *take*, and an infixed allomorph /u/ of /ed/.

(5) *took* is *take* plus a REPLACIVE MORPH /u/ ← /ey/ (read '/u/ replaces /ey/').

Let us consider these one by one.

(1) is unacceptable because it controverts the tactical parallelism between *took* and *baked* and many other obviously composite forms.

(2) is the most general solution, since it avoids, in a sense, the problem of identification of partial similarity in shape. But this very avoidance is arbitrary: *took* and *take* are partly similar in phonemic shape just as are *baked* and *bake*, and similar in meaning also in the same way; the fact should not be obscured.

(3) is arbitrary because it assigns to something that isn't there phonemically —something that is 'there' only in the fact that it calls for a phonemically distinct allomorph of the accompanying morpheme—a meaning which would more naturally be assigned to some location within the overt form *took*. The same solution for the past tense *put* (or the plural *sheep*) is even more strained since there is not even this phonemic effect on the accompanying morpheme. Within the same special rules that allow (3), it would also be possible to propose that *took* be interpreted as an allomorph of /ed/ accompanied by a zero allomorph of *take*. I see no reason why (3) should be considered any more or less seriously than this alternative. (3), in effect, gains nothing at all over (2).

(4) is in some ways the most attractive (with some manipulation, this proposed solution can be derived from Nida's discussions in 1948, 1949; his 'replacive' terminology tends to obscure the matter). It meets the objections so far raised to the other alternatives, as well as that which will shortly be raised to (5). The most serious criticism so far offered is that we might be led to interpret *take*, also, as an allomorph /t . . . k/ plus an infixed allomorph /ey/; this is not justified because *take*, like *bake*, *rake*, *catch*, and so on, acts tactically like a single morpheme. This is not a very serious criticism, since we need not be so submissive to the proposed analogy. Within the IA framework, (4) is probably the best answer.

(5) is not valid within IA. It calls an 'allomorph' something which is not in conformity with the general definition of the term. A morph is composed wholly of phonemic material or (as the limiting case) of no phonemic material at all. A 'replacive', like '/u/ ← /ey/', is not by any stretch of the imagination composed of phonemic material.

The same comment applies to 'subtractives', which happen not to apply in the case of *take*. It is tactically convenient to regard French *bon* as more complex than *bonne*, Chinese *lya*^{3} 'two' as more complex than *lyang*^{3} 'two'.[11] *Bon* is then, it is proposed, to be taken as *bonne* plus a 'subtractive' morph consisting of loss of final consonant (and nasalization of the vowel); *lya*^{3} is to be taken as *lyang*^{3} plus a terminal 'subtractive'. A subtraction is no more composed of phonemic material than is a replacement.

4.3. Why should so much emphasis be placed on this? Could we not modify our definition of 'morph' in such a way as to allow subtractives and replacives in those circumstances where they seem so clearly convenient? Of course we

[11] This comment on 'replacives' and 'subtractives' is given by Bloch in fn. 3 of Nida 1948. The error discussed here crops up also in Hockett 1947b, pp. 339–40; Hockett 1950, p. 82–3; Harris 1942, p. 170–1.

can do so. But such action seems to be equivalent—perhaps rather unexpectedly—of removing the keystone of the whole IA arch; the model begins to collapse. All the criteria which have been so laboriously established as a basis for the selection of one morphophonemic treatment or another have to be supplemented by new clauses. Even the tactical picture tends to be modified. When we pick up the pieces and try to fit them together again—without restoring the keystone—we find that we are no longer dealing with anything that looks like IA; we have a new model on our hands. After a short intermission this new model will be put on exhibit.

V. Mathematical Interlude

5.1. Mathematics is a good place to turn to for analogs of structures, since mathematicians and mathematical logicians have as their business the construction of structures of the greatest variety and generality. For our purposes, we shall only have to venture into the most elementary phases of their activity (see the more elementary and readable portions of Quine 1940, Birkhoff and MacLane 1944).

A good many MATHEMATICAL SYSTEMS are characterizable wholly or primarily as consisting of a set of ELEMENTS for which certain RELATIONS are defined. One such system has as elements all the positive integers, and as one elementary relation, the relation of 'greater than': two is greater than one, five is greater than two, and so on. A relation ties together pairs of elements, or, in some cases (for example, the relation 'is between . . . and . . .'), more than two elements. A relation is also quite satisfactorily definable as a CLASS OF ORDERED PAIRS (or of ordered n-ads with n greater than 2) OF ELEMENTS. In this sense, the number-pairs (3, 2), (5, 1), (2, 1) are said to be members of the relation 'greater than', while the number-pair (1, 3) or (1, 1) is not. The two approaches to relations are equivalent: we can begin with some property such as 'greater than' and observe that some pairs of numbers bear this relation, or we can begin with any set of ordered pairs of numbers—selected, it may be, quite randomly—and define a relation simply by listing the ordered pairs that belong to it.

Now it is easy to show that a construction, in the linguistic sense (within IA), is a relation (this proposal has not been made in print, to my knowledge; Wells has incorporated it in an as yet unpublished report on linguistics and semantics). The constituents of a constitute are elements; they are in a particular arrangement (linear order). A construction, then, is a class of ordered n-ads of constituents, whereupon a construction is a relation.

There is one point at which this characterization seems (wrongly) to fall down. Two and three are numbers; 'three is greater than two' is not a number, nor is (3, 2) a number. *Black* and *cat* are forms; and *black cat* is a form too. It makes sense to say that *black cat* participates, as a whole, as an element in larger constructions; it certainly does not make sense to say that (3, 2) is greater than something or less than something. This apparent discrepancy is due to the perhaps overly simple nature of the particular mathematical system we have chosen. It is hardly possible to say that (3, 2) can be greater than some

number, but it is perfectly possible to define—in the arbitrary way mentioned above—a relation which has as members not only ordered pairs of numbers such as (3, 2) and (3, 1) but also ordered pairs of elements one or both of which are in turn ordered pairs of numbers—such as ((3, 2), 1) or (3, (2, 1)), or even ((3, 2), (3, 1)). Most such invented relations would be trivial and uninteresting, but some might be fruitful, and all are perfectly acceptable logically. So there is nothing to keep us from recognizing a relation in linguistics which has as members both such ordered pairs as *black cat* and also such as *big* | *black cat*.

5.2. Another great class of mathematical systems are characterizable as consisting of a set of elements for which certain OPERATIONS are defined. One such system has, as did our exemplification of a system with relations, the positive integers as its elements, and has, as one elementary operation, that of ADDITION. Addition applies in the first instance to pairs of positive integers, and is therefore a BINARY operation: two plus two is four, three plus four is seven, and so on. Addition has certain further properties. For instance, it is COMMUTATIVE: we get the same result adding two and three whether we start with the two or with the three. There are operations which are not commutative; e.g., subtraction defined over the same set of elements, since five minus seven is not only not the same as seven minus five, but actually meaningless. Addition is also ASSOCIATIVE: $(2 + 3) + 6$ and $2 + (3 + 6)$ add up to the same total. By virtue of this property, parentheses can be dropped and the operation takes on the appearance of not being binary at all, but of applying to any number of terms, two or more. Fundamentally, however, it is convenient to regard addition as binary.

It can be shown that operations are reducible to relations, so far as their logical status is concerned. Thus the binary operation of addition, by which $2 + 3 = 5$, can also be interpreted as a ternary relation holding between the ordered triad of numbers (2, 3, 5) and between any ordered triad of numbers (a, b, c) for which it is true that $a + b = c$. In general, any n-ary operation is logically reducible to an appropriate $(n + 1)$-ary relation.

Psychologically, however, this replacement leaves something out. Relations seem static, whereas operations seem dynamic—seem to generate something which we perhaps did not know was there. One use of mathematical systems is in computing; that is, in discovering implications of assumptions that are not known, or not obvious, to the computer until the computation has been performed. Computing makes use of systems involving operations, not those characterized purely by relations, underscoring the importance of the dynamic or generative nature of operations. Logical identifications are always achieved by leaving something out; the mathematical logician is willing to leave out this psychological difference between relations and operations, but the ordinary mathematician is not. For our purposes, we shall follow the inclination of the ordinary mathematician.

5.3. There are two features of operations which may render them useful to us in linguistics, in place of relations—despite the logical substitutability which has been demonstrated.

One of these is the fact that the result of applying an operation to a pair (or set) of elements, or to a single element, is also an element. 'Two is greater than one', whatever it may be, is certainly not the same kind of element as are two and one. But two plus three is the same kind of element as are two and three; indeed, it is specifically that element, another name for which is 'five'. So if we say that *black* and *cat* are joined by an operation, instead of by a relation, we shall be more comfortable about calling *black cat* a form too.

The other is the fact that there are singulary operations, but no singulary relations (not 'unitary', 'uninary', or 'unary'; see Quine 1940, 13, fn. 1). We see this from the logical substitutability of operations and relations. An n-ary operation is equivalent to an $(n + 1)$-ary relation, so that the obvious existence of binary relations guarantees equally obvious singulary operations; but it there were singulary relations there would have to be nullary operations, and the one is as meaningless as the other.[12]

An example of a singulary operation in mathematics is 'reciprocal of' or 'negative of'. The latter is undefined for positive integers, but is defined for the set of all integers, positive, negative, and zero: the negative of three is minus three; the negative of minus four is four; the negative of zero is zero. For that matter, given a binary operation, any number of singulary operations can be devised. If addition is a binary operation, then addition of two to, addition of three to, and so on, are all singulary operations.

The utility of a singulary operation for linguistic analysis can be demonstrated with a form like *waited* where, as we saw in 3.5, it is pointless to isolate more than two factors. It may be advantageous to interpret *waited* as the result of a singulary operation applied to *wait*, at least in that this gives us just two separate factors.

5.4. If 'relation' is our closest analog to 'construction', then certainly the linguistic analog to 'operation' is 'process'. A grammatical model constructed in terms of this analogy ought to differ from IA just as operations differ from relations: it should be dynamic instead of static. It was pointed out in 1.2–4 that this was one of the chief characteristics of the older unformalized IP model, and we shall see that it is retained in the formal version about to be presented.

VI. Item and Process

6.0. The statements which follow parallel, as much as possible, those of II, and are abbreviated where reference to II can easily serve to fill them in; examples are left for VII.

6.1. A linguistic form is either SIMPLE or DERIVED.

6.2. A simple form is a ROOT.[13]

6.3. A derived form consists of one or more UNDERLYING FORMS to which a

[12] Since a relation is a class of ordered n-ads, the singulary analog is a class of ordered monads; i.e., simply a class. What a nullary operation would be still escapes me entirely.

[13] The choice of terminology is difficult here; I do not recommend continued use of 'root' and terms stemming from it. 'Morpheme' would be preferable, but is avoided here in order better to contrast the two models.

PROCESS has been applied. The underlying forms and the process all recur (save for occasional uniquenesses) in other forms. The underlying form or forms is (or are) the IMMEDIATE CONSTITUENT(S) of the derived form, which is also called a CONSTITUTE; each underlying form is said to occupy a given POSITION; each, if there are more than one, is the PARTNER of the rest.

6.4. Some of the phonemic material in a derived form may be, not part of any underlying form, but rather a REPRESENTATION or MARKER of the process. (Such markers are not roots.)

As in the parallel statement for IA (2.4), this necessitates a statement of conditions; we defer this to VII.

6.5. The TACTICAL PATTERN of a language is completely covered by a set of statements of the following form:

(1) A list of the processes.
(2) Under each process as heading,
  (2.1) Enumeration of the position or positions involved.
  (2.2) For each position,
    (2.21) A list of the roots which occur in that position, and
    (2.22) A list of the processes which produce forms which occur in that position.

There is here no analog to statement (2.2) of section 2.5.

6.6. A root may appear in more than a single phonemic shape. A single shape of a root is a ROOT-ALTERNANT.

A process may have more than one representation. A single representation of a process is a marker. A marker consists of the difference between the phonemic shape of a derived form and the phonemic shape(s) of the underlying form or forms. That is, a marker may consist of phonemic material in some specific position relative to the phonemic material which is identical with that of the underlying form, or it may consist of something present in the derived form in place of something else present in the underlying form, etc.

6.7. The alternations in shape of roots, and the choice in a particular instance of one or another marker of a process, are predictable in terms of the environments in which they occur (plus, of course, one's morphophonemic statements).

'Environment' is definable as in 2.7.

6.8. All the phonemic material in an utterance is accountable for in terms of the roots which occur in the utterance and the processes to which they have been subjected.

6.9. Empty root-alternants, portmanteau root-alternants, and links are definable and allowable as in IA, should there be any need for them. Zero alternant roots and zero markers of processes are likewise allowable, under similar limitations.

6.10. The statement of shapes, alternations, and conditions of alternation describes the morphophonemic pattern of the language; further considerations remain as in IA (2.11).

VII. Comparisons

7.1. First we give examples of IP treatment.

(1) *Baked* is a derived form, with a single immediate constituent *bake*, which happens to be a root, subjected to a singulary process which we can simply label PAST-TENSE FORMATION. This process has various markers; when applied to *bake*, the marker is a /t/ which follows the phonemes of the underlying form.

(2) *Took* is tactically like *baked*, with underlying form *take*. The morphophonemic difference is that here the singulary process in question has a marker consisting of replacement of the stem vowel /ey/ of the underlying form by /u/.

(3) *John* and *saw*, subjected to the binary process of PREDICATION, give *John saw*, necessarily with that order, and with zero marker unless the order be taken as a marker. The same forms, subjected to the binary process of RESOLUTION, give *saw John*, again with order determined and zero marker. As with IA, we could alternatively take the order as primary and the process as determined. In support of the first alternative, we can present comparable cases in mathematics. If we are concerned with the positive integers only, then the operation of subtraction, if it is to apply to seven and three, necessarily requires the order $7-3$, since $3-7$ is undefined.

(4) Chinese *chau*^{3} and *fan*^{4}, subjected to either the binary process of resolution or the binary process of MODIFICATION, give *chau*^{3} *fan*^{4}, respectively 'fry rice' and 'fried rice'. The difference in positions of occurrence in larger forms, and the difference in meaning, correlate with the difference in process.

(5) *John and Bill* is (perhaps) underlying forms *John* and *Bill*, subjected to the process of ADDITION, for which the only marker is *and*. *Bill and John* is a different derived form, involving the same underlying forms and the same process, but a different order—order in this case being separable from process. Note that this process, here called 'addition', does not have the properties of the mathematical operation of the same name; grammatical addition is not commutative. Indeed, probably no grammatical processes will be found to be commutative.[14]

7.2. Our IP model differs, at least superficially, from anything to be found in the writings of Sapir.

This is partly because we have tried to incorporate into the more formalized version of IP some of the results of recent investigations carried on within the

[14] The inventors of mathematics, as speaking humans, distill mathematical notions out of the raw-material of everyday language. Their notions are derived by leaving something out of the nearest everyday-language analogs. A linguist analyzing English must assume that *two plus three* and *three plus two* are different forms. The mathematician chooses to ignore everything which differentiates the meanings of these two forms, and by so doing, he renders his 'addition' commutative. It may seem strange that we who are concerned with the total complexity of language should turn to mathematics for help, considering the ultimate source of mathematics. But the circle is not in fact closed: the mathematician derives his notions by abstraction from language, whereas we are deriving, not language itself, but a WAY OF HANDLING language, from mathematics.

IA framework. Mainly this means the contrast between tactics and morphophonemics, which does not emerge at all clearly either in Sapir's writings or in Bloomfield's 1933 discussion. It would be a loss of ground to expunge this contrast during the reconstruction of IP.

But its retention leads us to use the term 'process' in a way different from Sapir's use. For Sapir, such matters as vowel-change, suffixation, reduplication, and the like, were 'processes'. For us, 'vowel-change' refers to one possible canonical form of marker, a canonical form represented both in *men*, from *man*, and in *took*, from *take*, though the markers in *men* and *took* represent tactically different processes in our sense of the word; the marker in *took* and the marker in *baked*, representing the same process in our sense, are of different canonical forms and thus would be different 'processes' in the Sapir sense. Nida's (1946) earlier contrast (derived closely from Sapir) between 'phonological process' and 'morphological process' approaches closely our contrast between canonical forms of markers, on the one hand, and tactically relevant processes on the other.

All of this would be easier to say, and at the same time perhaps less necessary, had we abandoned the term 'process' and simply imported 'operation' from mathematics, or had we used such a pair of terms as 'processeme' (tactical) and 'alloprocess' (morphophonemic), as a direct splitting-up of Sapir's more nebulous notion of 'process' in the light of recent developments.

7.3. The examples of 7.1 show that, by and large, grammatical descriptions cast in IP will run parallel to those cast in IA. There will be slight differences in terminology, and the wording certainly gives a 'dynamic' rather than a 'static' feel to the statements. Apart from these matters, the main differences will be marginal—though perhaps crucial.

IP obviates the major tactical and the major morphophonemic difficulty of IA. We are not confronted with superfluous machinery in the case of *baked* or *took*: the process involved is singulary, so that the only factors are the respective underlying forms and the process. The morphophonemic difficulty which IA gets into with *took* is obviated, since the whole frame of reference is one in which the difference between *took* and *take* is just as acceptable a process-marker as that between *baked* and *bake*.

On the other hand, IP makes for certain difficulties avoided by IA.

In the first place, a 'pure' IA approach (which bars the interpretation of any morphemes as markers of constructions) is clearly much more homogeneous than either a less pure IA, or IP. This homogeneity is not as simple as has been thought; 'items', true enough, are either morphemes or sequences of morphemes, but still one has to contend with the independent status of order, constructions, and hierarchical structure. Even so, there is a clear difference between taking some phonemic material as 'root' (=item) and some as 'marker' of processes, as IP requires, and the simple procedure of taking all phonemic material as either morphemic or else morphemically irrelevant and morphophonemically predictable.

The problem of priority, evaded by IA, comes back into the picture. How are we to tell under what conditions to interpret a derived form as involving

two or more underlying forms and a binary or higher-order process, and under what conditions to interpret it as involving a single underlying form and a singulary process? In one sense, of course, this is an extension to the case of two versus one of a problem found in IA: when do we recognize three ICs rather than two, or, in general, n rather than $n-1$?

The answer probably lies partly in the cases which are solved more easily by IP than by IA. *Baked* and *took* are interpreted in terms of a singulary process because to do otherwise leads to tactical and semantic trouble in both cases, and to morphophonemic trouble in the second. Obviously cases will be found more difficult than these, and a full elaboration of the necessary criteria is not to be expected overnight. In this very connection, IP is sure to encounter its refractory residue, different in content from, but similar in implications to, that of IA.

7.4. Another contrast between IA and IP turns on the number of constructions one has to recognize for a language under IA, versus the number of processes necessary for the same language under IP. The criterion of economy seems never to be evoked in IA so far as number of morphemes is concerned: there are in any case a great many morphemes, and a few more or less hardly matters. But economy enters the picture in reducing the number of classes of morphemes, or the number of major form-classes, or constructions, as much as possible. This is why, when confronted with the doublet plurals *brothers* and *brethren*, we are willing either to recognize two homophonous stem-morphemes *brother* requiring different allomorphs of the noun-plural morpheme (Hockett 1947b, p. 330), or, if needs be, to recognize that the plural element in *brethren* is, after all, a different morpheme from that in *brothers* (Ibid., and Nida 1948, p. 415, by implication). It hardly occurs to us to suspect that the constituents are the same but the construction different.

The same tendency also manifests itself in the effort sometimes made to reduce, if not the total number of constructions, at least the total number of CONSTRUCTION-TYPES—that is, classes of constructions which manifest some similarity of behavior. Thus in Chinese there is no way in which one can call *hau*^{3} *fan*^{4} 'good food' (stative verb followed by noun) and *ye*^{3} *lai*^{2} 'also come' (adverb followed by verb) instances of a single construction; their privileges of occurrence in larger stretches of speech are quite different. But one can say that the two constructions exemplified by these forms are, in their turn, instances of a single construction-type, sharing the features of endocentricity and of head second rather than first. Without much bother, one can establish a classification of all the constructions in Chinese into eight construction-types. To do so is esthetically satisfying, probably just because of the psychological impact of the criterion of economy; in addition, it affords a useful basis for the organization of tactical statements about Chinese.

Perhaps it does not matter, but if we follow IP we are going to have to sacrifice some of this partly covert drive towards one form of 'economy'. The number of processes in a language, under IP, will probably in general be greater than the number of constructions in the same language under IA. For *brothers* and *breth-*

ren, the interpretation of two homophonous underlying forms is still open to us, but loses much of its attractiveness. There is only one alternative: a single underlying form (*brother*) with two different singulary processes. And while the singulary process involved in *brothers* (normal noun-plural formation) is one which recurs widely, that in *brethren*, since it contrasts with that in *brothers*, is presumably also different from the one in *boys*, *men*, *taxes*, and so on; it is as forlorn as a process as the first IC (under either IA or IP) of *cranberry* is forlorn as an item. Uniquenesses under IP, in other words, may be unique constituents or unique processes. The only possible way to appease our parsimoniousness is to devise PROCESS-TYPES on the cross-model analogy of construction-types.

7.5. Whether a grammatical description of a language is satisfactory or not depends in part on the use we want to make of it. Quite apart from esthetic or stylistic considerations, which can and do vary from one reader of grammars to another, and setting aside such matters as application to language pedagogy, there remain a number of properties which a grammatical description must have if it is to satisfy us for any scientific purpose. These properties have already been hinted at (particularly in 3.0). A grammatical description must be a guidebook for the analysis of material in the language—both material examined by the analyst before the description was formulated, and material observed after that. Lexically the coverage need not be complete, since new morphemes can turn up as one continues to record the language. Otherwise it must be complete in the sense just described. The description must also be prescriptive, not of course in the Fidditch sense, but in the sense that by following the statements one must be able to generate any number of utterances in the language, above and beyond those observed in advance by the analyst—new utterances most, if not all, of which will pass the test of casual acceptance by a native speaker.

If these are criteria for the evaluation of a grammatical description, what we need for the evaluation of models is a set of appropriately related metacriteria. The following list is perhaps not complete, and I am hesitant about the fifth, but no set would be complete which did not include the first four:

(1) A model must be GENERAL: it must be applicable to any language, not just to languages of certain types.

(2) A model must be SPECIFIC: when applied to a given language, the results must be determined wholly by the nature of the model and the nature of the language, not at all by the whim of the analyst. It is not lack of specificity if the model requires us to subsume certain facts more than once, from different angles; it would be a lack of specificity if the model ALLOWED us to take our choice in such cases, instead of FORCING one choice or other or their joint option.

(3) A model must be INCLUSIVE: when applied to a given language, the results must cover all the observed data and, by implication, at least a very high percentage of all the not-yet-observed data. This is the analog of the 'guidebook' criterion (not metacriterion) mentioned earlier.

(4) A model must be PRODUCTIVE: when applied to a given language, the

results must make possible the creation of an indefinite number of valid new utterances. This is the analog of the 'prescriptive' criterion for descriptions.

(5) A model must be EFFICIENT: its application to any given language should achieve the necessary results with a minimum of machinery.

If we were confronted with two models, one of which fulfilled all the above requirements while the other did not, choice would be easy. If we were confronted with two, both of which fulfilled all the requirements, we would have to conclude that they differed only stylistically. Neither of these situations, of course, is at present the case. Neither any existing version of IA nor any existing version of IP meets all the metacriteria. Insofar as such matters can be felt quantitatively, it seems to me that IP, as constructed here, comes at least as close to satisfying the requirements as does IA, though perhaps no closer. In other words, what we have is two main types of model, neither completely satisfactory. Our course in this case is also clear. We must have more experimentation, as much with one model as with the other—and with the devising of further models too, for that matter—looking towards an eventual reintegration into a single more nearly satisfactory model, but not forcing that reintegration until we are really ready for it.

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