THE PHONEMIC CONCEPT OF DISTINCTIVE FEATURES

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The international discussion of the ultimate phonemic units, which was inaugurated by the Ghent Congress of Phonetic Sciences, is still developing. The place of this concept in linguistic theory, the use of DISTINCTIVE FEATURES on the various levels of speech analysis, their role in descriptive and historical linguistics, and finally their significance for phonemic typology – all these questions are closely watched and studied.

The analysis into distinctive features has since been applied to a considerable number of linguistic patterns. Thus, for instance, such an inquiry was made for the following Indo-European languages: English by N. Chomsky and M. Halle,[1] German by G. Heike,[2] Swedish by B. Malmberg,[3] and by C. -Ch. Elert,[4] Norwegian by C. Hj. Borgstrøm,[5] Icelandic by H. Benediktsson;[6] a Donegal dialect by A. Sommerfelt,[7] Portuguese by J. Mattoso Camara,[8] Spanish and Catalan by E. Alarcos Llorach,[9] French by R. Jakobson and J. Lotz,[10] Italian dialects by Soffietti[11] and by L. Heilmann,[12] Rumanian by E. Petrovici,[13] Albanian dialects by E. Hamp,[14] Latvian by M. Halle and V. J. Zeps,[15] Slavic languages all together by E. Stankiewicz,[16] and separately – Old Church Slavonic by H. Lunt,[17] Bulgarian dialects and standard

[1] *The Sound Pattern of English* (to appear); cf. R. Jakobson, C. G. M. Fant and M. Halle, *Preliminaries to Speech Analysis*, p. 43 ff.
[2] *Phonetica*, VI (1961), p. 162 ff., and *Zeitschr. f. Phonetik, Sprachwissenschaft u. Kommunikationsforschung*, XIV (1961), p. 1 ff; cf. M. Halle, *Word*, X (1954), p. 197 ff.
[3] *For Roman Jakobson* (The Hague, 1956), p. 316 ff.
[4] *Årbog for Nordisk Sommeruniversitet 1954* (København, 1955), p. 140 ff.; *Arkiv for Nordisk Filologi*, LXXII (1957), p. 35 ff.
[5] *Norsk Tidsskrift for Sprogvedenskap*, XVII (1954), p. 549 ff.
[6] *Word*, XV (1959), p. 282 ff.
[7] *Celtica*, V (1961), p. 107 ff.
[8] *Para o Estudo da fonêmica Portuguêsa* (Rio, 1953).
[9] *Fonología Española*, 3rd ed. (Madrid, 1961); *Archivum*, III (Oviedo, 1953), p. 135 ff.
[10] *Word*, V (1949), p. 151 ff.; cf. R. Gsell's paper at the Fourth Congress of Phonetic Sciences.
[11] *Phonemic Analysis of the Word in Turinese* (New York, 1949).
[12] *La Parlata di Moena* (Bologna, 1955), p. 241 ff. — *The Phonology of Contemporary Italian* by Ž.Muljačić is to appear in *Manualia Universitatis Studiorum Zagrabiensis*.
[13] *For Roman Jakobson* (The Hague, 1956), p.382 ff., and *Mélanges linguistiques* (Bucarest,1957), p.81 ff.
[14] *Vaccariczo Albanese Phonology: The Sound-System of a Calabro-Albanian Dialect* (PhD. dissertation, Harvard University, 1954).
[15] *Latvian Inflection* (to appear in the *Indiana University Publications*).
[16] *American Contributions to the Fourth Int. Congress of Slavicists* (The Hague, 1958), p. 301 ff.
[17] *Old Church Slavonic Grammar* (The Hague, 1955), p. 24 ff.

language by H. L. Klagstad,[18] Macedonian by H. Lunt,[19] Serbocroatian by R. Jakobson,[20] Czech by H. Kučera,[21] Slovak by Pauliny,[21a] Low Sorbian by J. H. Cheek,[22] Polish by S. K. Shaumjan[23] and by Stankiewicz,[24] Russian by E. C. Cherry, M. Halle and R. Jakobson,[25] and especially by M. Halle,[26] Sanskrit by V. V. Ivanov and V. N. Toporov,[27] Bengali by Ch. A. Ferguson and M. Chowdhury,[28] and Hindi by T. Ja. Elizarenkova.[29]

Two substantial problems brought up by developing phonological research have prompted attempts at reducing the multiple of phonemes to the subset of their elementary constituents. Distributional analysis, which has been applied so fruitfully to the SYNTAGMATIC relations within language and to its phonemic structure in particular, but had been confined originally to sequential concatenation, demanded extension to the other dimension of the verbal sign, i.e., to the superposition of its simultaneous constituents. Henceforth questions of context embrace not only antecedent and subsequent but also concurrent factors.

On the other hand, the fundamental role assigned by Ferdinand de Saussure to the concept of OPPOSITION in phonology and grammar called for a further specification and more precise definition. Shortly after the Ghent Congress, the prominent Dutch theoretician of language, H. J. Pos, published his illuminating comments on the principles and prospects of structural linguistics. He pointed out that OPPOSITION is in essence a logical operation. The presence of one term of this binary relation necessarily implies the other, opposite term ("à l'idée du blanc, il n'y a que celle du noir qui soit opposée, à l'idée du beau celle du laid"). On the contrary, in a contingent duality neither of the two members "carries any predicting information about the other".[30] While we read in the Genevan *Cours de linguistique générale* that "phonemes are above all else oppositive, relative, and negative entities," it has become still more obvious that a phoneme has no single, predictable opposite. Thus, one does not know what the opposite of the Turkish /u/ is until it is broken up into its distinctive features. Analysis into features shows that /u/ is a narrow (diffuse), back (grave), rounded (flat) vowel. Each of the distinctive features which constitute this phoneme (and every phoneme whatever) belongs to a single "dualité d'opposition" within the

[18] *American Contributions to the Fourth Int. Congress of Slavicists* (The Hague, 1958), p. 157 ff; *The Slavic and East European Journal*, XVI (1958), p. 42 ff.
[19] *Grammar of the Macedonian Literary Language* (Skopje, 1952), p. 9 ff.
[20] *Selected Writings*, I (The Hague, 1962), p. 421 f. - P. Ivić's *Phonemics* is in preparation.
[21] *The Phonology of Czech* (The Hague, 1961).
[21a] *Fonológia spisovnej slovenčiny* (Bratislava, 1961).
[22] *A distinctive Feature Phonematic Analysis of Lower Sorbian* (PhD. dissertation, Harvard University, 1959).
[23] *Istorija sistemy differencial'nyx èlementov v pol'skom jazyke* (Moscow, 1959).
[24] *For Roman Jakobson* (The Hague, 1956), p. 518 ff.
[25] *Language*, XXIX (1953), p. 34 ff.
[26] *The Sound Pattern of Russian* (The Hague, 1959).
[27] *Sanskrit* (Moscow, 1960), p. 51 ff.
[28] *Language*, XXXVI (1960), p. 51 ff.
[29] *Voprozy jazykoznanija*, X, No. 5 (1961), p. 22 ff.
[30] *TCLP*, VIII (1939), p. 71 ff.

given language, and any one of these constituents implies the coexistence of its opposite in the same phonemic system: diffuseness is opposed to compactness, gravity to acuteness, and flatness to non-flatness. Our conclusion, that the oppositive value should be transferred from the phoneme to the distinctive feature, does not contradict the views of Ferdinand de Saussure himself, because, here as often elsewhere, the editors of the *Cours* have deviated from his authentic teaching. In the original records of Saussure's lectures, we find that it is not the phonemes but their ELEMENTS that take "une valeur purement oppositive, relative, négative".[31]

The need which Saussure descried – to assign a purely relative and oppositive definition to the differential elements – has become the basis for any consistent 'featural analysis'. The idea that "differences of properties actually are discrete" and that their differential aspect "is really the fundamental concept"[32] permeates various fields of modern science. The topological approach – "it is not things that matter, but the relations between them"[33] – is equally decisive for phonological methodology. One cannot determine the French phoneme /p/ without reference to other phonemes – for instance, to the rest of the voiceless obstruents. The habitual statement, "/p/ will be defined as labial by opposition to /t/ and to others," is deceptive: there is no opposition between /p/ and the other obstruents, for the presence of /p/ neither implies nor predicts these other obstruents. Moreover, the relation between /p/ and any of the other voiceless obstruents is quite different. The 'relational gaps'[34] between /p/ and /t/, /p/ and /k/, or /p/ and /f/ are totally unlike, and each of these pairs offers its own discriminative clue for speech perception.

All other features being equal in both of its members, the pair /p/ – /t/ carries the opposition grave(low-pitch)/acute(high-pitch), according to Grammont's perceptual nomenclature. Some disputants have rashly rejected the perceptual level, which they claim to be subjective, impressionistic acoustics, but in verbal communication the subjective impression of the listener plays a decisive role, and correspondingly for speech analysis the perceptual stage of the speech event is of paramount importance. It is from sound attributes as discriminated and interpreted by the listener that one must proceed when seeking their correlates on both the physical and physiological levels. Specifically, to the opposition of low (grave) and high (acute) pitch in the pair /p/ – /t/ there corresponds a physical difference between *relatively* low and *relatively* high resonances (as illustrated perfectly, e.g., in experiments carried out by Eli Fischer-Jørgensen in the Haskins Laboratories).[35] While such

[31]   See R. Godel, *Les sources manuscrites du Cours de linguistique générale de F. de Saussure* (Genève, 1957), pp. 269, 272.
[32]   E. Schrödinger, *What is Life?* (Cambridge-New York, 1947), p. 28 f.
[33]   E. T. Bell, *The Development of Mathematics* (New York-London, 1945), p. 466 f.
[34]   E. Sapir, *Language*, I (1925), p. 37 ff. A noteworthy analogue: "It needed great scientific imagination to realize that it is not the charges nor the particles but the field in the space between the charges and the particles which is essential for the description of physical phenomena" (A. Einstein and L. Infeld, *The Evolution of Physics*, New York, 1942, p. 259).
[35]   *Miscellanea Phonetica*, II (1954), p. 58 f.

lower resonances are produced by an ampler and less compartmented mouth cavity, the opposite, higher resonances are due to a smaller and more divided cavity.

In agreement with current perceptual nomenclature for sound attributes, the determining clue in the discrimination between /k/ and /p/ is relative 'compactness', or 'density', as opposed to relative 'diffuseness'.[36] On the physical level, as Gunnar Fant has recently restated it, "within stops and fricatives the degree of spectral concentration is the main characteristic of compactness".[37] First and foremost, a "strong concentration of explosion" distinguishes /k/ from /p/ and /t/, according to E. Fischer-Jørgensen's comparison of her detailed acoustic analysis with experiments in the perception of synthetic stops (*l.c.*). Consequently, both /p/ and /t/ are opposed to /k/ in the same way, i.e. as diffuse *vs.* compact, and to each other as grave *vs.* acute. Compact consonants are articulated in the velopalatal area of the mouth cavity, and diffuse consonants – dentals and labials – in front of this area. To the vain phonological attempts to define /t/ and /k/ irrespective of each other, featural analysis opposes a strictly relational definition. While phonemes for the most part coincide in some of their features and thus bear to each other a relation of mutual overlapping ('relation d'empiétement', in Cantineau's term),[38] all distinctive features are based on the principle of true dichotomous oppositions.

It is not possible to confine phonemic analysis to syntagmatic relations only. Attempts to identify a phonemic category on the basis of distributional rules alone unavoidably result in an impasse. One cannot, for instance, cite as the primary phonemic definition of Polish voiced obstruents the fact that they are limited to non-final positions, any more than one could define a dining car as the car which in a train is never found between two freight cars. In order to state that diners or voiced obstruents do not appear in a given position, we must first and foremost know how to identify diners and distinguish them from freight cars, coaches, and Pullmans, or voiced from voiceless obstruents.

Some observers have been prone to believe that, without any recourse to the "sound substance", the analysis of such a series of Russian words as /z,át,/ 'son-in-law', /z,áp,/ 'ploughland', /z,áp/ 'shivered', /v,ás,/ 'ligature', /v,ás/ 'elm', /v,ál/ 'languid', /dán,/ 'tribute', /dán/ 'given', /bás/ 'bass', /páx/ 'groin', /pál/ 'bollard', would yield a distinction between /a/ as 'central' or, simply, vowel phoneme, and the other elements of this series as 'marginal', consonant phonemes. These observers declare the entity /a/ to be central, for it may appear alone in a text, while the marginal phonemes never stand by themselves. Such reasoning, however, is based on a preassumed sameness of all the /a/'s which figure in the series. In fact, as D. Jones has noticed, these specimens present at least five fairly distinguishable varieties, beginning with a front sound close to [ɛ] and ending with a very wide back vowel;[39] moreover, several inter-

[36]   On tonal density as a phenomenal dimension see Stevens, *J. Exper. Psychol.*, XVII (1934), p. 585 ff.
[37]   *Acoustic Theory of Speech Production* (The Hague, 1960), p. 217 f.
[38]   *Word*, XII (1955), p. 1 ff.
[39]   D. Jones, *The Phoneme: Its Nature and Use* (Cambridge, 1950), p. 26.

mediate shades may be detected by the ear. Phonemics admits no operations "with unnamed entities". The identifying act is indispensable, and there are only two possible courses. Either the identification is made by resort to an unavoidably vague notion of phonetic resemblance, which is an uncontrolled infiltration of gross phonetic matter smuggled into phonology, or phonemic analysis deliberately considers and processes the physical matter in order to elicit the strictly relative, oppositive values superimposed on the "phonetic premises" by the coding rules of language. It is in the latter way that phonemic study of paradigmatic relations overcomes the gross phonetic contingencies and discloses the consistent dichotomy of the distinctive features, which is basically the same LOGICAL PRINCIPLE that underlies the grammatical structure of language.

Mutatis mutandis, the analysis into distinctive features employs devices analogous to those that have been used in the elicitation of phonemes. Both consecutive procedures – namely, the tabulation of 'micro-phonemes' and the subsequent elicitation of 'macro-phonemes', as described by W. T. Twaddell,[40] find an exact equivalent in the featural analysis that proceeds, so to say, from 'micro-feature' ("the term of any minimum phonological difference)" to 'macro-feature'. Twaddell is right to insist that the inference from micro-phonemes (and, let us add, *a fortiori* from micro-features to macro-features) cannot be based on any constant positive characteristic of the units themselves, but solely on "a constant qualitative relation" between the micro-phonemes (and likewise micro-features) of different classes. The determining criterion is a one-to-one, isomorphic relation between these classes. Thus, in a language which before back vowels presents [p], [t], and [k], but before front vowels [p,] [t,], and the hushing affricate [ʃ̂] (or fricative [ʃ]), [p] and [p,] belong to one labial macro-phoneme (briefly, phoneme) – grave in contradistinction to the dental phoneme implemented by the variants [t] and [t,], and both of these phonemes are diffuse as against the compact, velopalatal phoneme represented by the contextual variants [k] and [ʃ̂] (or [ʃ]). Equally, in a language where [k] occurs before back vowels but [ʃ̂] before front vowels, and [p] and [t] before both back and front vowels, the oppositions compact/diffuse and grave/acute remain valid for the two classes of microphonemes: *p-t-k* and *p-t-ʃ̂*. Here again we assign [k] and [ʃ̂] to one and the same velopalatal phoneme, which is opposed by its compactness to both diffuse phonemes, the grave /p/ and the acute /t/.

Featural analysis follows the same procedure. The French system of consonants, which has excited perhaps the most lively discussion in this regard, offers a cogent example. Among the stops in this pattern, the fortis /p/ and the lenis /b/ are opposed by their gravity to the acuteness of the fortis /t/ and of the lenis /d/, and all of these stops are diffuse as opposed to the compact stops, the fortis /k/ and the lenis /g/. Correspondingly, in the class of continuants the fortis /v/ and the lenis /f/ are opposed

[40]   On Defining the Phoneme – *Language Monographs*, XVI (Baltimore, 1935).

as grave, to the fortis /s/ and to the lenis /z/ as acute, and all these continuants oppose diffuseness to the compactness of the fortis /ʃ/ and lenis /ʒ/. Finally, in the class of nasals the diffuseness of the grave /m/ and of the acute /n/ stands in opposition to the compactness of /ɲ/. The isomorphism that underlies all three classes of the fifteen French consonants – stops, continuants, and nasals – is quite evident: within each of these three classes, only the diffuse phonemes are subdivided into grave and acute. This "triangular" pattern of consonants (and of vowels as well) is widespread among the languages of the world, since diffuse phonemes, in comparison with the compact ones, are naturally more susceptible of being split into graves and acutes.

In the system of French consonants, the feature of compactness presents three contextual variants, each of which depends on a concurrent feature: compact consonants are implemented as velar when plosive, as palatal when nasal, and as postalveolar when continuant. In terms of speech synthesis, the transformation of French compact consonants from stops into nasals or fricatives converts the velar region of articulation into palatal or postalveolar respectively, while their relative compactness remains invariant. The limits between palatal and velar contextual variants seem to vacillate: /ɲ/ occurs as an optional substitute for /ɲ/, and, according to Marguerite Durand's observations, there exists at present in Parisian speech "a marked tendency" toward a palatal articulation of /k/ and /g/.[41]

Numerous Slavic dialects have a prevocalic [v] and a postvocalic [w]. In an intervocalic position, some of these dialects have [v], others [w]. Both the labiodental [v] and the bilabial [w] are here contextual variants of one and the same voiced labial phoneme. On the level of features, we observe here the same relation of 'mutual exclusion' (in other terms, 'complementary distribution') that is exemplified by the French labial (i.e. grave diffuse) obstruents, which are implemented as bilabial when plosive and as labiodental when continuant.

If none of the French continuants has exactly the same point of articulation as do the stops, this difference evidently depends on the fact that in the optimum continuants the friction and turbulence are noticeably stronger than in the optimum plosives, so that the opposition of plosive and continuant obstruents merges with the opposition strident/mellow, and, following A. W. de Groot's suggestion, the term *composite* (I would say *syncretic*) *feature* might be applied to such a merger.[42] The more intensive noise of the strident obstruents requires a supplementary rough-edged barrier. Therefore, beside the lips, which constitute the sole impediment employed in the production of bilabials, the labiodentals involve also the teeth, while the sibilants employ also the lower teeth in addition to the obstacles utilized in the corresponding mellow consonants. Thus, among the grave diffuse (labial) obstruents, the fricative /f/ and /v/ are the strident correspondents of the mellow stops /p/ and /b/; in the acute diffuse (dental) series, /s/ and /z/ are the strident opposites of /t/ and

[41]   *Conférences de l'Institut de linguistique de l'Université de Paris*, XI (1954), p. 89.
[42]   *Word*, IX (1953), p. 62.

/d/; and when the compact obstruents present no opposition grave/acute, the stops /k/ and /g/ find their strident counterpart in the compact sibilants /ʃ/ and /ʒ/.

In French, all three types of strident continuants use the teeth for building the supplementary obstruction. Another, much rarer implementation of stridency in the compact apex of a triangular consonant pattern is presented by the uvular obstruents.

The localizational difference between the French stops and the corresponding continunants is an appropriate warning against the oversimplified view of a phoneme as a mechanical aggregate of materially invariable components. Every combination of distinctive features into simultaneous bundles results in a specific contextual variation. In view of incessant misunderstandings, it is necessary to reemphasize that any distinctive feature exists only "as a term of relation". The definition of such a phonemic invariant cannot be made in absolute terms – it cannot refer to a metric resemblance but must be based solely on relational equivalence. For instance, in the Bulgarian or Goldic (Nanaian) vowel pattern, each of the three tonality classes – acute (front), grave flat (back rounded), and grave non-flat (back unrounded) – is represented by a pair compact (wider) – diffuse (narrower) – namely, /e/–/i/, /o/–/u/, /a/–/ə/. The physico-motor propinquity between /ə/ the diffuse phoneme of the last pair, and the compact phonemes of the other two pairs, /e/ and /o/, has no phonemic pertinence, for the same opposition underlies all three pairs: /a/ is to /ə/ as /e/ is to /i/ and as /o/ to /u/. The wider articulation of /a/ and /ə/ as compared to both other pairs is a contextual variation associated with the concurrence of grave with non-flat (velarity with unroundedness), but the purely topological relations remain unchanged in all three pairs. Here we are dealing with phenomenal forms whose specific properties are, in Ehrenfel's classic expression, transponible: such properties are not affected by a modification of the absolute data upon which they rest.

Of course, there may be cases when both terms of a phonemic opposition, in particular contradictories, are identifiable through absolute cues also, such as voicing and voicelessness or nasality and its absence (pure orality). Each of these properties, however, functions as one of two conjugate opposites and exists in language primarily as a term of a logical RELATION. Besides, even in the cited cases, variations may considerably limit the applicability of absolute cues to the detection of phonemic invariants. For example, in certain positions where oral vowels or voiceless consonants undergo a partial assimilation to their nasal or voiced environment, the difference between the presence and absence of nasality or voicing may change into a discrimination between a maximum and minimum of nasalization or voicing (thus contradictories become contraries); furthermore, the "various degrees of compromise between full voice and whisper"[43] may preserve a distinction between voiceless and voiced consonants, though the role of the vocal bands happens to be substantially reduced and altered, so that the murmured variants of the voiced phonemes are sometimes nearer to the normal production of the voiceless phonemes.

[43] See R. M. S. Heffner, *General Phonetics* (Madison, 1949), p. 85 ff.

As a matter of fact, the dichotomous principle was latently implied in the traditional linguistic classification of consonants into such conjugate series as plosives – continuants, fortes – lenes, aspirated – non-aspirated, glottalized – non-glottalized, voiced – voiceless, pharyngealized – non-pharyngealized, rounded – unrounded, palatalized – non-palatalized, nasalized – non-nasalized; and each of these pairs presented a clear-cut *differentia specifica*, both in motor and physical terms. The next urgent task was to recognize that the customary alignment of consonants according to their point of articulation was insufficient for plotting the phonemic topology of the consonants, which, as Sapir clearly foresaw, has nothing to do with mere "place of articulation" (*l.c.*). Three distinct factors had to be singled out: the relative volume and shape of the resonance chamber (ampler and less divided *vs.* smaller and more divided), the relation between the volume of the resonance chamber and the position of the narrowest stricture (outward-flanged *vs.* inward-flanged horn), and the relation between the air flow and the obstruction (stronger *vs.* weaker turbulence).

As soon as the crude row of articulation points had been resolved into these three binary oppositions, it became obvious that a consistent rule of dichotomy was shared by both consonantism and vocalism. Occam's razor has impelled us to unify the two patterns into a single system. The early attempts in this direction go back to the Old Indic grammarians, who looked for correspondences between vowels and consonants and, in particular, connected the *k*-series with *a* under the common label *kaṇṭhya*, and the *p*-series with *u*, under the label *oṣṭhya*. It would show an anti-empiric and arbitrary bias to disregard the one-to-one correspondence between the relation of the labial stops and continuants to the analogous dentals, on the one hand, and the relation of back to front vowels on the other. A quick perusal of *Visible Speech* by Potter, Kopp, and Green (1947) suffices to disclose that "the main hub of each of the front vowels" is significantly higher than "the main hub" of the back vowels, and that the "hub" of /t/, /d/, /s/, and /z/ is high above the "hub" of /p/, /b/, /f/, and /v/. Here we are faced with two contextual variants, two different expressions of one and the same opposition grave/acute. The genetic correlate of this opposition is a more peripheral place of stricture, which determines the production of the grave consonants and vowels, in contradistinction to the relatively medial place of stricture typical of the corresponding acute phonemes.

We observe, moreover, that in both vocalism and consonantism, phonemes with a conspicuously lower concentration of energy in the spectrum and with a mouth cavity configuration "closer to that of an inward-flanged horn" are opposed to CORRESPONDING phonemes with a higher concentration of energy and with a vocal tract closer to an outward-flanged horn (Fant, *l.c.*). This 'one-to-oneness' permits us to interpret the opposition diffuse/compact as a common property of the vowel and consonant patterns and then to match both the "triangular" and "quadrangular" vowel systems with the equivalent systems of consonants. Reformatskij's suggestion that the dichotomous principle could hardly be applied to a triangular pattern, "since the relations of all three elements are mutually proportional, namely $a{:}i = i{:}u = u{:}a$"[44]

is mistaken, because $a{:}i=a{:}u=$ compact: diffuse, whereas $i{:}u=$ acute: grave.

The aims we tried to achieve in selecting "the simplest set of new elements identifying and supplanting the phonemes" were pithily summed up by Z. S. Harris: componential analysis is to be "carried out for all the phonemes of a language" and to be based "not on absolute phonetic categories ... but on relative categories determined by the differences among the phonemes of that language". Since "every phoneme can be differentiated from every other one in terms of the combination of components which it equals", the analyst is "interested primarily in ... binary oppositions".[45] We must wholly agree with André Martinet that "the present-day binarism may be very well interpreted as a consistent extension of correlative connections" and that two terms are actually correlative if "the existence of any one of them makes it necessary to suppose the existence of the other".[46] There is no logical consistency, however, in the author's application of this criterion to his own examples. He claims that "the words *father* and *son* are correlative, because a father supposes the existence of a son and vice versa", but in fact the concept of father necessarily implies only the concept of a child but not specifically of a son. Further, if he states that phonemes with distinctive voicing necessarily imply the existence of phonemes with distinctive voicelessness, there are no grounds whatever for his denial of a similar relation between the French /k/ and /t/. In a language possessing these two phonemes, they are endowed with two opposite attributes compact/diffuse, and the existence of one of these distinctive properties necessarily implies the existence of the counterpart. On the other hand, in a consonant pattern which has no distinctive opposition of compactness and diffuseness, the presence of /t/ obviously cannot imply the existence of /k/. For instance, in Tahitian the stop /t/ possesses only the feature of acuteness as opposed to the grave /p/, whereas in the Oneida language, deprived of labial consonants, /t/ plays no part in the opposition grave/acute ($/a{:}/{:}/e/{=}/o/{:}/i/{=}/w/{:}/j/$) but displays the feature of diffuseness only ($/t/{:}/k/{=}/i/{:}/e/{=}/o/{:}/a/{=}/ŭ/{:}/ã/$.[47]) Thus featural analysis reveals the cardinal constitutional difference between the Oneida /t/ and the Tahitian /t/, in spite of their material similarity.

The transition from the phoneme level to the feature level of speech analysis requires that the two sets be rigorously distinguished, and that such promiscuous medleys as "prosodic phonemes" (instead of *prosodic features*) or phonemes allegedly "undecomposable" into features be studiously avoided. A total resolution of higher linguistic units into distinctive features as their ultimate components is not only quite feasible but even indispensable. It gives us the key to the structural laws of the phonemic system. Without an explicit, or at least an implicit featural analysis, the phonemes of a language cannot even be properly listed. The

[44]   *Voprosy teorii jazyka v sovremennoj zarubežnoj lingvistike* (Moscow, 1961), p. 117.
[45]   *Methods in Structural Linguistics* (Chicago, 1951), p. 146.
[46]   *BSL*, LIII (1958), p. 77 ff.
[47]   See F. G. Lounsberry, *Oneida Verb Morphology* (New Haven, 1953), p. 27 ff.

Russian palatalized [b,] is followed by advanced vowels, and the non-palatalized, velarized [b$_x$] by retracted vowels: [gub,á] 'ruining' – [gub$_x$á] 'lip'; [gub,i] imp. 'ruin' – [gub$_x$ú] gen. 'of the lip'; [gr,ib,ót] 3 pers. sg. 'rows' – [gr,ib$_x$ók] 'fungus'; [b,ús$_x$t$_x$] 'bust' – [b$_x$us$_x$w] 'beads'. How is one to determine which of these two successive differences is the phonemic one: /b,/ – /b/ or /a/ –/ɑ/, /i/–/ɯ/, /ö/–/o/, /ü/–/u/? It is true that the final labial stop is voiced when closely followed by an initial voiced obstruent – thus [r,æp,] 'ripple' and [r,áp$_x$] 'pitted' are distinguished before the particle *že* as [r,æb,ӡɯ] – [r,áb$_x$ӡɯ], but in this position there is no phonemic difference between voiced and voiceless stops. Furthermore, in many Russian dialects all final labials have lost their palatalization, so that the distinction of palatalized *vs.* non-palatalized labials is confined to the prevocalic position: [p,it$_x$át,] 'to nourish'– [p$_x$w$_x$át,] 'to torture'. We infer from these facts that a phonemic value is to be assigned in Russian to the palatalized and non-palatalized labials and not to the following advanced and retracted vowels, because in this language there exists an autonomous discrimination between the presence and absence of consonantal palatalization, while there is no autonomous distinction between advanced and retracted vowels.

Consistent featural analysis destroys survivals of the amateurish quibble "that there remain no good reasons for the distinction between *distinctive* and *redundant* among the features,"[48] which incidentally repeats arguments that were raised half a century ago against phonemics in its very inception. Thus in 1913 A. Thomson objected to L. Ščerba that in the Russian pair [ad,ét,] 'to dress' – [ad,ét$_x$] 'dressed', not only the difference of [t,] and [t$_x$] but also that of [e] and [ɛ] "could be recognized as a carrier of the difference in meaning."[49] At present, however, it is clear that in this case, instead of one single consonantal opposition (the presence or absence of palatalization), we would face manifold phonemic differences between more advanced or more retracted vowels and between more closed or more open vowels, in addition to the difference between palatalized and non-palatalized consonants: cf. Rus. [vóʃt,] 'leader' – [kóʃt$_x$] 'maintenance costs'; [s,él,t,] 'herring' – [k,él,t$_x$] 'Celt'; [s$_x$kórp,] 'sorrow' – [s$_x$kár$_x$p$_x$] 'chattels'; [l,gót$_x$ə] 'advantage' – [l$_x$gùt$_x$] 'they lie'.

The embarrassing problem of the so-called "neutralized" phonemes and their assignment disappears on the level of distinctive features. Russian vocables such as *devki* 'girls' occur in three optional or dialectal variants: [d,éf,k,i], with an assimilatory palatalization of the labial before [k,] and with a close [e] before the palatalized consonant; [d,ɛf$_x$k,i] with a velarization of [f$_x$], typical of the non-sharp consonants (called 'hard' in Russian schoolbook tradition), and with the usual openness of the preceding [ɛ]; and [d,éfk,i], with a partial assimilation of the labial to [k,]: namely [f], without becoming palatalized, loses its normal velarization, and before a non-velarized consonant [ɛ] moves toward [e]. Whatever the implementation of the labial continuant in this position, the phoneme differs here from the final labial continuants

[48]   *Word*, XIII (1957), p. 328.
[49]   *Archiv f. slav. Philologie*, XXXIV (1913), p. 560 ff.

– the sharp one in $[k_xr_x\acute{o}f,]$ 'blood', and the non-sharp in $[k_xr_x\acute{o}f_x]$ 'shelter' – by the absence of the binary feature sharp/non-sharp. While the distribution of features is unambiguously clear, the question of how many different phonemes are represented by these three labials remains controversial. If we presume that there are two phonemes, the assignment of the labial in *devki*, with its three optional variants $[f,]$, $[f_x]$ and $[f]$, either to the sharp or to the non-sharp phoneme would be quite artificial. In its turn the answer "three" is likewise objectionable, since there is no context where the simultaneous lack of velarization and palatalization could be distinctively commuted with the presence of one of these properties. In three other Russian examples – *petli* $[p,\acute{e}tl,i]$ 'loops', *pet' li* $[p,\acute{e}t,l,i]$ 'whether to sing', and *pet li* $[p,\acute{e}t_xl,i]$ 'whether sung' – the internal dental stop of the first instance does not take part in the phonemic opposition sharp/non-sharp, whereas the corresponding final phoneme is distinctively sharp in the second instance – $/p,\acute{e}t,/$ 'to sing' – and distinctively non-sharp in the third instance – $/p,\acute{e}t/$ 'sung'.

The interrelation of distinctive, configurative (especially demarcative), expressive, and redundant features requires precise comparative scrutiny. Such inquiry must particularly avoid any confusion between all these essentially heterogeneous sets of features and any effacement of the actual limits between their divergent functions. Equally distorting is a prejudiced request to confine phonological investigation to the distinctive features alone, which are then arbitrarily made out as the only relevant and pertinent ones. Their discreteness, which sets them apart specifically from the gradual gamut of expressive features, does not entitle the linguist to dismiss the latter.

Among problems that are controversial on the plane of phonemes but unequivocally solvable when we move over to the level of features, one could cite the frequent hesitations between a biphonematic and a monophonematic interpretation. For instance, the Bengali aspirates, discussed by Ch. A. Ferguson and M. Chowdhury (*l.c.*), stand both essentially and distributionally in the same opposition to the corresponding unaspirated consonants as /h/ to zero. Such aspirates as /bh/, when viewed as clusters, yield the following tabulation of distinctive features:

	b	h
Grave	+	
Compact	−	
Nasal	−	
Voiced	+	
Tense		+

This would mean that the second phoneme of the supposed cluster has no opposition in common with the first phoneme and takes part in but one opposition tense/lax, displayed exclusively by the pair /h/-zero. Hence instead of treating /bh/ or other aspirates of Bengali as a juxtaposition of phonemes, we are prompted to admit here a mere superposition of features:

	bʿ
Grave	+
Compact	−
Nasal	−
Voiced	+
Tense	+

Actually it is the latter way of analysis which "drastically reduces the number of phonemes" in the sequences and duly simplifies "the statements of distribution".

Not only in the linguistic discussion of distinctive features but also in their confrontation with mathematical logic[50] and with communication theory[51], it was made quite clear that the dichotomous scale points the most profitable and economical way to describe phonemic data. Moreover, it provides an appropriate matrix for the typological comparison of languages.

Far from being a mere aid to research, a mere model imposed by the analyst on the linguistic matter, the bivariant features are, as is revealed by the study of verbal behavior, discriminative clues indispensable for speech perception. The listener is actually confronted by "a number of decisions between alternatives." Psychologists have told us that the capacity to identify stimuli in an absolute way is poorly developed in the human listener, so that "the auditory system must respond to relations;"[52] and the reduction of the range of our expectations to a few two-choice decisions affords the optimum fulfillment of this task.[53] The perceptual identifications of native "subjects uninstructed in linguistics" are directed by their knowledge of the extant distinctive features and of their superpositional and sequential probabilities, and, correspondingly, as the experiments of R. W. Brown and C. Hildrum suggest, "most errors involve only one phoneme and most changes of one phoneme involve only one distinctive feature (e.g. /p/ to /t/, /k/, /b/, or /f/)."[54] It is not a conscious awareness which acts in the speech community, but, as noted by Sapir, "a very delicately nuanced feeling of subtle relations, both experienced and possible."[55] There is a striking correspondence between what is becoming ever more apparent in the use of the phonemic pattern by native adults and the gradual acquisition of language by the child, as examined in its psychological and intrinsically linguistic aspects. The emi-

[50] Cf. G. Ungeheuer, *Studia Linguistica* (1960), p. 69 ff.

[51] Cf. E. C. Cherry, *For Roman Jakobson*, p. 60 ff; D. Gabor, *Lectures on Communication Theory* (M.I.T., 1951); W. Meyer-Eppler, *Grundlagen und Anwendungen der Informationstheorie* (Berlin-Göttingen-Heidelberg, 1959), p. 319 ff.

[52] J. C. R. Licklider and G. Miller, *Handbook of Experimental Psychology* (New York and London, 1951), p. 1069 ff.

[53] Cf. I. Pollack and L. Ficks, *J. of the Acoust. Soc. of Am.*, XXVI (1954), p. 155 ff; P. C. Wason, *British J. of Psychology*, LII (1961), p. 133 ff.; N. I. Žinkin, *Int. J. of Slav. Linguistics and Poetics*, I-II (1959), p. 79 ff.

[54] *Language*, XXXII (1956), p. 417 ff.

[55] *The Unconscious, A Symposium* (New York, 1928), p. 123.

nent French expert in children's psychology, Henri Wallon, offers particularly illu-
minating views on the initial stages of thought and speech:

La pensée n'existe que par les structures qu'elle introduit dans les choses. ... Ce qu'il est
possible de constater à l'origine c'est l'existence d'éléments couplés. L'élément de pensée est
cette structure binaire, non les éléments qui la constituent. ... Le couple, ou la paire, sont
antérieurs à l'élément isolé. ... Sans ce rapport initial qu'est le couple tout l'édifice ultérieur
des rapports serait impossible. ... Il n'y a pas de pensée ponctiforme, mais dès l'origine
dualisme ou dédoublement. ... En règle générale toute expression, toute notion est intime-
ment unie à son contraire, de telle sorte qu'elle ne peut être pensée sans lui. ... La délimi-
tation la plus simple, la plus saisissante est l'opposition. C'est par son contraire qu'une idée
se définit d'abord et le plus facilement. La liaison devient comme automatique entre oui-non,
blanc-noir, père-mère, de telle sorte qu'ils semblent parfois venir en même temps aux lèvres
et qu'il faut comme faire un choix et réprimer celui des deux termes qui ne convient pas...
Le couple est à la fois identification et différenciation.[56]

This psychological testimony has been thoroughly confirmed by new linguistic
observations drawn from among children of various ethnic groups. Such studies have
exhibited the progressive dichotomous scissions in the phonemic build-up of language.

In positions of 'neutralization' the phonemes reduce the number of their distinctive
components, whereas on the level of features every distinctive opposition is endowed
with a perceptual constancy; and as far as the features are properly defined in purely
relational terms, no overlapping can arise. The relational invariant of each oppo-
sitional pair is *per definitionem* actualized in any context where the given feature
occurs, unless this feature is omitted in an elliptic variety of speech. Any such variety,
however, may be translated in case of need by the speaker or listener into a more
explicit subcode of the same language. The slipshod forms are judged precisely as
reduced, slurring, slovenly, and each request for repetition and every danger of mis-
understanding prompt the restoration of the distinction omitted. The existence of
optimum explicitness both on a phonemic and on a grammatical level is a *sine qua non*
of all ellipsis; otherwise an historically elliptic sequence is no longer elliptic from a
synchronic viewpoint; the optional omission of a feature has changed into its compul-
sory absence. The explicit phonemic subcode is an inward resource of spoken lan-
guage, quite different from those extrinsic auxiliaries used by speakers to decipher
homonyms, such as an *ad hoc* contrived spelling-pronunciation or a recourse to the
spelling names of the letters, or simply to their writing.

Any suggestion to dismiss the problem of translation from one subcode into an-
other[57] is to be rejected, like all endeavors to rob linguistics of some of the vitla
properties pertaining to language. The elliptic subcode has its own structural laws,
and its coexistence with the explicit subcode is the indispensable synchronic phase of
every phonemic merger since in general the start and finish of a phonemic change are

[56]   *Les origines de la pensée chez l'enfant*, I (Paris, 1945), pp. 41, 44, 67, 115; cf. my *Selected Writings*,
I, pp. 317–401.
[57]   C. L. Ebeling, *Linguistic Units* (The Hague, 1960), p. 39.

first conceived as belonging to two coexistent subcodes. This synchronic approach to
linguistic changes abolishes the customary identification of synchrony with statics
on the one hand and of dynamics with diachrony on the other and provides us with
a suppler insight into the convertible code of language.

The tentative list of distinctive features so far encountered in the languages of the
world[58] is intended just as a preliminary draft, open to additions and rectifications.
Its further, revised and specified version will undoubtedly bring more precise defini-
tions for the correlates of single distinctive features at the different stages of the speech
event. As to the number of existing features, no more have yet been added to our
matrix by the critics. Passing from the intralingual to the interlingual aspect of
featural analysis, one must still consistently apply the same rules of one-to-one rela-
tion and mutual exclusion. Those seemingly different features which never co-occur
within a language in an identical phonemic environment and which are distinguished
from all other features by a common relational property must be interpreted as two
variant implementations of one and the same distinctive feature. Hence the question
of P. S. Kuznecov – whether the opposition of implosives and explosives that occurs
in some African languages should not be added to our inventory of distinctive
features[59] – receives a negative answer. With the valuable assistance of the expert
Africanist J. Greenberg, I may state that in a language with the distinction of implo-
sives and explosives, either there is no oppostion glottalized/non-glottalized, or the
voiced glottalized stops are in free variation with the voiced implosives,[60] or, finally,
the opposition glottalized/non-glottalized is displayed by the voiceless stops and the
opposition implosive/explosive by the voiced stops. Each of these two isomorphic
pairs exhibits the same relation of a reduced *vs.* non-reduced portion of air, and also
on the acoustic level there appears essentially one and the same difference.

The strictly relativistic foundations of featural analysis also underlie and corro-
borate both the typological studies and the quest for the universal (or near-universal)
implicational laws which determine the structure of phonemic patterns. This research
may proceed only from the principle of equivalence. An ever deeper probing into the
taxonomy of languages reveals, moreover, features common to all or nearly all the
languages of the world, like the oppositions vocalic/non-vocalic, consonantal/non-
consonantal (with the ubiquitous stops as the optimal or sole consonants), compact/
diffuse (universally displayed in vocalism, at least), grave/acute (in consonantism and/
or in vocalism, in the former near-universal), and nasal/non-nasal (near-universal in
consonantism); finally, cross-language analysis uncovers universal phonemic com-
binations, such as the syllables consisting of a vowel preceded by a consonant.

The progress of featural analysis demands a realistic approach to language and
linguistic inquiry. Thus, for instance, the frequent endeavors to refrain from discrimi-

[58]   *Preliminaries to Speech Analysis*, p. 18 ff; *Selected Writings*, I, pp. 477 ff., 550 ff.
[59]   *Voprosy jazykoznanija*, VII, No. 1 (1958), p. 58.
[60]   Cf. D. Westermann and Ida C. Ward, *Practical Phonetics for Students of African Languages*
(London, 1933), Chapter XVIII.

nating such binary vocalic oppositions as grave/acute (back/front) and flat/non-flat (rounded/unrounded), or diffuse/compact (narrow/wide) and tense/lax, disregard the significant clues provided by the languages themselves. In particular, so-called 'vowel-harmony' lays bare the dichotomous structure of all vocalic attributes and displays their operational autonomy with maximal clarity. Thus the vowels of a word must be either all diffuse (narrow) or all compact (wide) in Manchu-Tungus languages,[61] and either all grave (back) or all acute (front) in diverse Turkic, Mongolian, and Finno-Ugric languages. Beside such a 'palatal attraction', there appears in some of these languages a separate 'labial attraction'. In every synharmonic Turkic language, words with a non-flat (unrounded) vowel in their initial syllable cannot contain flat (rounded) vowels in the other syllables, and a sequence of narrow vowels within a word is either rounded throughout or unrounded throughout; in all their further rules of labial harmony the Turkic languages differ from each other.[62] Several African languages cannot combine tense and lax vowels within one word; in Ibo vowel harmony is based on an interplay between two autonomous oppositions – tense/lax and diffuse/compact.[63] In Hindustani and some other Indic languages, words contain either nasal or oral vowels only.[64] Two levels of patterning are frequently confused and must be carefully noticed and distinguished: the dichotomous features and their enchainments within the phonemic system, as for instance the interrelationship of different tonality features or the coupling of the opposition continuant/discontinuous with strident/mellow, and of lax/tense with checked/unchecked.

Per definitionem every distinctive opposition is binary, and the elicitation of its correlates must yield a distinct, unambiguous answer, whatever phase of the speech event is approached by the unbiased searcher of invariants.

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DISCUSSION

It is always stimulating, and sometimes provoking, to listen to Roman Jakobson. The search for the invariant may indeed be vain, if the invariant is phonetic; I agree however that it is not phonetic, but phonological, the relation of the term to the other terms in the system. This must imply a polysystemic approach, taking into account the place in structure for which the system is established. On Jakobson's insistence on the importance of binary systems, however, I would emphatically disagree. There are many instances that come to mind where more than two terms are set up for a system;

[61]   Cf. V. Avrorin, *Doklady i soobščenija Instituta jazykoznanija AN SSSR*, XI (1958), p. 140 ff.
[62]   Cf. M. Čerkasskij, *Voprosy jazykoznanija*, X, No. 5 (1961), p. 94, ff. For the delimitation of both oppositions in Finnish see *Preliminaries to Speech Analysis*, p. 41.
[63]   See *Selected Writings*, I, p. 556.
[64]   See Hoenigswald, *J. Am. Orient. Soc.*, LXVIII (1948), p. 143 ff.

a three term system of tones for the Yoruba verb, for example, in sentences like *O wa* "he came", *O lc* "he went", and *O bc* "he returned": or the three term prosodic system of ₀/h/v for Hausa CV syllables where the C is plosive or sibilant. I suspect that it is the harnessing of machines to linguistic problems that has led to exaggeration of the binary opposition. Yet there is no great difficulty in inventing a programme to enable the machines to deal in binary fashion with systems of more than two terms.

J. Carnochan

Once again, let's recall the TWO-CHOICE selection in Lewis Carroll's pointed dialogue: "Did you say *pig* or *fig*?" – "I said *pig*." To recognize whether it's *pig* or *fig* if the decision is not prompted by the context, the listener needs to grasp the cue which opposes /p/ to /f/. In the words *pig* and *big*, the first segments form another, different binary opposition, and a third one occurs in *pig* and *tig* 'a two-handled cup'. The BINARY opposition underlying the minimal phonemic distinction of TWO words is either identical, as is the case in *pig-fig* and *dig-sig* 'urine', or unlike, as in *pig-fig*, and *pig-big* or *tig-dig*. While the mellowness in the initial stop of *tig* is nondistinctive, and both *tig-sig* and *tig-thig* 'beg' display the same opposition discontinuous/continuant, the words of the PAIR *sig-thig* are differentiated through the opposition strident (sharp-edged)/mellow (smooth-edged). Minimal distinctions are based either on equivalent or on divergent DIADS, and *tertium non datur*. Two clear-cut BINARY oppositions underlie the Yoruba registers: 1. lowest (conducive to low falling) *vs.* non-lowest; 2. highest (conducive to high rising) *vs.* non-highest. The Yoruba even "mid-tone" (/tu./ 'spit') is simultaneously non-lowest in opposition to lowest (/tu./ 'ease') and non-highest in opposition to highest (/tu·/ 'untie'). The familiar relationship between mean and extremes does not at all invalidate the DICHOTOMOUS principle. From their right observation of correspondences between our languages and Old Indic some Romantics drew an emphatic but nonetheless erroneous conclusion which made Sanscrit the alleged ancestor of all those languages, but this distortion should not be paralleled. If there are certain analogues between "the harnessing of machines to linguistic problems" and the language patterning which we observe, they are not due to the hypnotic influence of machines on our judgment but to the simple fact that BINARY DIGITS offer by far the most advantageous way of coding not only for machines but likewise for any verbal behavior and thereby for the phonemic and grammatical structure of language.

R. Jakobson