symbolism with little knowledge of linguistics itself. Unfortunately the essays of most modern writers in this field suffer from this lack of apprenticeship training. To strive at higher mathematical formulas for linguistic meaning while knowing nothing correctly of the shirt-sleeve rudiments of language is to court disaster. Physics does not begin with atomic structures and cosmic rays, but with motions of ordinary gross physical objects and symbolic (mathematical) expressions for these movements. Linguistics likewise does not begin with meaning nor with the structure of logical propositions, but with the obligatory patterns made by the gross audible sounds of a given language and with certain symbolic expressions of its own for these patterns. Out of these relatively simple terms dealing with gross sound patterning are evolved the higher analytical procedures of the science, just as out of the simple experiments and mathematics concerning falling and sliding blocks of wood is evolved all the higher mathematics of physics up into quantum theory. Even the facts of sound patterning are none too simple. But they illustrate the unconscious, obligatory, background phenomena of talking as nothing else can.

For instance, the structural formula for words of one syllable in the English language (Fig. 12) looks rather complicated; yet for a linguistic pattern it is rather simple. In the English-speaking world, every child between the ages of two and five is engaged in learning the pattern expressed by this formula, among many other formulas. By the time the child is six, the formula has become ingrained and automatic; even
the little nonsense words the child makes up conform to it, exploring its possibilities but venturing not a jot beyond them. At an early age the formula becomes for the child what it is for the adult; no sequence of sounds that deviates from it can even be articulated without the greatest difficulty. New words like "blurb," nonsense words like Lewis

![A.](image)

\[ y = C + \sin x \]

(FUNCTION OF VARIABLES)

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suf. \( \sqrt{-s} = 1(C_{sib})-iz ; 2(S)-z ; 3(C-S)-s ; 4(f#V)-z. \)

(PATTERN OF ALTERNANTS)

Figure 13. Variables and alternants: A shows by graph and by mathematical formula (equation) an interrelation of variables. B illustrates by extensible examples and by a pattern formula an interrelation of alternants. The formula means that the English suffix which is theoretically ("by root," \( \sqrt{V} \)) a final 's' is actualized in any given case by one of four alternants: after a sibilant-ending consonant, by '-iz'; after any sonant (vowel or consonant), by '-z,' after any voiceless (nonsonant) consonant by 'os'; except that, after the special alternant 'f#,' it is actualized by '-z,' the 'f#' alternating to 'v.'

Carroll's "mome raths," combinations intended to suggest languages of savages or animal cries, like "glub" and "squonk"—all come out of the mold of this formula. When the youth begins to learn a foreign language, he unconsciously tries to construct the syllables according to this formula. Of course it won't work; the foreign words are built to a formula of their own. Usually the student has a terrible time. Not even knowing that a formula is back of all the trouble, he thinks his difficulty is his own fault. The frustrations and inhibitions thus set up at the start constantly block his attempts to use foreign tongues. Or
else he even hears by the formula, so that the English combinations
that he makes sound to him like real French, for instance. Then he
suffers less inhibition and may become what is called a "fluent" speaker
of French—bad French!

If, however, he is so fortunate as to have his elementary French taught
by a theoretic linguist, he first has the patterns of the English formula
explained in such a way that they become semiconscious, with the result
that they lose the binding power over him which custom has given them,
though they remain automatic as far as English is concerned. Then he
acquires the French patterns without inner opposition, and the time for
attaining command of the language is cut to a fraction (see Fig. 14).
To be sure, probably no elementary French is ever taught in this way—at least not in public institutions. Years of time and millions of dollars' worth of wasted educational effort could be saved by the adoption of such methods, but men with the grounding in theoretic linguistics are as yet far too few and are chiefly in the higher institutions.

Let us examine the formula for the English monosyllabic word (Fig. 12). It looks mathematical, but it isn't. It is an expression of pattern symbolics, an analytical method that grows out of linguistics and bears to linguistics a relation not unlike that of higher mathematics to physics. With such pattern formulas, various operations can be performed, just as mathematical expressions can be added, multiplied, and otherwise operated with; only the operations here are not addition, multiplication, and so on, but are meanings that apply to linguistic contexts. From these operations, conclusions can be drawn and experimental attacks directed intelligently at the really crucial points in the welter of data presented by the language under investigation. Usually the linguist does not need to manipulate the formulas on paper but simply performs the symbolic operations in his mind and then says: "The paradigm of class A verbs can't have been reported right by the previous investigator"; or "Well, well, this language must have alternating stresses, though I couldn't hear them at first"; or "Funny, but d and l must be variants of the same sound in this language," and so on. Then he investigates by experimenting on a native informant and finds that the conclusion is justified. Pattern-symbolic expressions are exact, as mathematics is, but are not quantitative. They do not refer ultimately to number and dimension, as mathematics does, but to pattern and structure. Nor are they to be confused with theory of groups or with symbolic logic, though they may be in some ways akin.

Returning to the formula, the simplest part of it is the eighth term (the terms are numbered underneath), consisting of a V between plus signs. This means that every English word contains a vowel (not true of all languages). As the V is unqualified by other symbols, any one of the English vowels can occur in the monosyllabic word (not true of all syllables of the polysyllabic English word). Next we turn to the first term, which is a zero and which means that the vowel may be preceded by nothing; the word may begin with a vowel—a structure impossible in many languages. The commas between the terms mean "or." The second term is C minus a long-tailed n. This means that a word can
begin with any single English consonant except one—the one linguists
designate by a long-tailed n, which is the sound we commonly write ng,
as in “hang.” This ng sound is common at the ends of English words
but never occurs at the beginnings. In many languages, such as Hopi,
Eskimo, or Samoan, it is a common beginning for a word. Our patterns
set up a terrific resistance to articulation of these foreign words begin­
ning with ng, but as soon as the mechanism of producing ng has been
explained and we learn that our inability has been due to a habitual
pattern, we can place the ng wherever we will and can pronounce these
words with the greatest of ease. The letters in the formula thus are not
always equivalent to the letters by which we express our words in or­
dinary spelling but are unequivocal symbols such as a linguist would
assign to the sounds in a regular and scientific system of spelling.

According to the third term, which consists of two columns, the word
can begin with any consonant of the first column followed by r, or with
g, k, f, or b followed by l. The s with a wedge over it means sh. Thus
we have ‘shred,’ but not shled. The formula represents the fact that
shled is un-English, that it will suggest a Chinese pronunciation of
‘shred’ or a German’s of ‘sled’ (sl is permitted by term 7). The Greek
theta means th; so we have ‘thread’ but not thled, which latter suggests
either a Chinese saying ‘thread’ or a child lisping ‘sled.’ But why aren’t
tr, pr, and pl in this third term? Because they can be preceded by s and
so belong in term 6. The fourth term similarly means that the word
can begin with a consonant of the first column followed by w. Hw does
not occur in all dialects of English; in ordinary spelling it is written back­
wards, wh. If the dialect does not have hw, it pronounces the spelled
wh simply as w. Thw occurs in a few words, like ‘thwack’ and ‘thwart,’
and gw, oddly enough, only in proper names, like ‘Gwen’ or ‘Gwynn.’
Kw, ordinarily spelled qu, can have s before it and therefore belongs in
term 6.

The fifth term indicates that the word may begin with one of the first­
column consonants followed by y, but only when the vowel of the word
is u; thus we have words like ‘hue’ (hyuw), ‘cue, few, muse.’ Some dia­
lects have also tyu, dyu, and nuy (e.g., in ‘tune,’ ‘due,’ and ‘new’), but I
have set up the formula for the typical dialects of the northern United
States, which have simple tu, du, nu in these words. The sixth term
indicates pairs that can commence a word either alone or preceded by
s, that is, k, t, or p followed by r, also kw and pl (think of ‘train, strain;
crew, screw; quash, squash; play, splay'). The seventh term, which means the word can begin with s followed by any one of the consonants of the second column, completes the parts of the word that can precede its vowel.

The terms beyond the eighth show what comes after the vowel. This portion is rather more complex than the beginning of the word, and it would take too long to explain everything in detail. The general principles of the symbolism will be clear from the preceding explanations. The ninth term, with its zero, denotes that a vowel can end the word if the vowel is a—which means (1) the vowel of the article 'a' and the exclamation 'huh?' and (2) the vowel of 'pa, ma,' and the exclamations 'ah!' and 'bahl!'—or the vowel can end the word if it is the aw sound, as in 'paw, thaw.' In some dialects (eastern New England, southern United States, South British) the vowel ending occurs in words which are spelled with ar, like 'car, star' (ka, sta, in these dialects), but in most of the United States dialects and in those of Ireland and Scotland these words end in an actual r. In eastern New England and South British dialects, but not in southern United States, these words cause a linking r to appear before a vowel beginning a following word. Thus for 'far off' your Southerner says fa of; your Bostonian and your Britisher say fa rof, with a liquid initial r; but most of the United States says far of, with a rolled-back r. For some dialects, term 9 would be different, showing another possible final vowel, namely, the peculiar sound which the Middle Westerner may notice in the Bostonian's pronunciation of 'fur, cur' (fa, ka) and no doubt may find very queer. This funny sound is common in Welsh, Gaelic, Turkish, Ute, and Hopi, but I am sure Boston did not get it from any of these sources.

Can one-syllable words end in e, i, o, or u? No, not in English. The words so spelled end in a consonant sound, y or w. Thus, 'I,' when expressed in formula pattern, is ay, 'we' is wiy, 'you' is yuw, 'how' is haw, and so on. A comparison of the Spanish no with the English 'No!' shows that, whereas the Spanish word actually ends with its o sound trailing in the air, the English equivalent closes upon a w sound. The patterns to which we are habituated compel us to close upon a consonant after most vowels. Hence when we learn Spanish, instead of saying como no, we are apt to say kowmow now; instead of si, we say our own word 'see' (siy). In French, instead of si beau, we are apt to say 'see bow.'

Term 10 means that r, w, or y may be interpolated at this point
except when the interpolation would result in joining w and y with each other. Term 11 means that the word may end in any single English consonant except h; this exception is most unlike some languages, e.g., Sanskrit, Arabic, Navaho, and Maya, in which many words end in h. The reader can figure out terms 12, 13, and 14 if he has stuck so far. A small c means ch as in ‘child’; j is as in ‘joy.’ Term 13, which contains these letters, expresses the possibility of words like ‘gulch, bulge, lunch, lounge.’ Term 14 represents the pattern of words like ‘health, width, eighth’ (eytθ), ‘sixth, xth’ (eksθ). Although we can say ‘nth’ power or ‘fth’ power, it takes effort to say the unpermitted ‘sth’ power or ‘hth’ power. ‘Hth’ would be symbolized *eycθ, the star meaning that the form does not occur. Term 14, however, allows both mθ and mpθ, the latter in words like ‘humph’ or the recent ‘oomph’ (umpθ). The elements of term 15 may be added after anything—the t and s forms after voiceless sounds, the d and z after voiced sounds. Thus, ‘towns’ is tawnz, with wnz attained by term 10 plus 11 plus 15; whereas ‘bounce’ is bawns, with wns by 10 plus 12. Some of the combinations resulting in this way are common; others are very rare but still are possible English forms. If Charlie McCarthy should pipe up in his coy way, “Thou oomphst, dost thou not?”; or a Shakespearean actor should thunder out, “Thou triumphst!” the reason would be that the formula yields that weird sputter mpfst by term 14 plus term 15. Neither Mr. Bergen nor Mr. Shakespeare has any power to vary the formula.

The overriding factor applicable to the whole expression is a prohibition of doubling. Notwithstanding whatever the formula says, the same two consonants cannot be juxtaposed. While by term 15 we can add t to ‘flip’ and get ‘flipt (flipped),’ we can’t add t to ‘hit’ and get hitt. Instead, at the point in the patterns where hitt might be expected, we find simply ‘hit (I hit it yesterday, I flipt it yesterday).’ Some languages, such as Arabic, have words like hitt, fadd, and so on, with both paired consonants distinct. The Creek Indian language permits three, e.g. nnn.

The way the patterns summarized in this formula control the forms of English words is really extraordinary. A new monosyllable turned out, say, by Walter Winchell or by a plugging adman concocting a name for a new breakfast mush, is struck from this mold as surely as if I pulled the lever and the stamp came down on his brain. Thus linguistics, like the physical sciences, confers the power of prediction. I can predict, within limits, what Winchell will or won’t do. He may coin a word
But he will not coin a word _srub_, for the formula cannot produce a _sr_. A different formula indicates that, if Winchell invents any word beginning with _th_, like _thell_ or _therg_, the _th_ will have the sound it has in ‘thin,’ not the sound it has in ‘this’ or ‘there.’ Winchell will not invent a word beginning with this latter sound.

We can wheeze forth the harshest successions of consonants if they are only according to the patterns producing the formula. We easily say ‘thirds’ and ‘sixths,’ though ‘sixths’ has the very rough sequence of four consonants, _ksØ₇s_. But the simpler _sixths_ is against the patterns and so is harder to say. ‘Glimpst (glimpsed)’ has _gl_ by term 3, _i_ by 8, _mpst_ by 12 plus 15. But _dlinpfk_ is eliminated on several counts: Term 3 allows for no _dl_, and by no possible combination of terms can one get _npfk_. Yet the linguist can say _dlinpfk_ as easily as he can say ‘glimpsed.’ The formula allows for no final _mb_; so we do not say ‘lamb’ as it is spelled, but as _lam_. ‘Land,’ quite parallel but allowed by the formula, trips off our tongues as spelled. It is not hard to see why the “explanation,” still found in some serious textbooks, that a language does this or that “for the sake of euphony” is on a par with nature’s reputed abhorrence of a vacuum.

The exactness of this formula, typical of hundreds of others, shows that, while linguistic formulations are not those of mathematics, they are nevertheless precise. We might bear in mind that this formula, compared with the formulation of some of the English (or other) grammatical patterns that deal with meaning, would appear like a simple sum in addition compared with a page of calculus. It is usually more convenient to treat very complex patterns by successive paragraphs of precise sentences and simpler formulas, so arranged that each additional paragraph presupposes the previous ones, than to try to embrace all in one very complex formula.

Linguistics is also an experimental science. Its data result from long series of observations under controlled conditions, which, as they are systematically altered, call out definite, different responses. The experiments are directed by the theoretic body of knowledge, just as with physics or chemistry. They usually do not require mechanical apparatus. In place of apparatus, linguistics uses and develops techniques. Experimental need not mean quantitative. Measuring, weighing, and pointer-reading devices are seldom needed in linguistics, for quantity and number play little part in the realm of pattern, where there are no