How can one word, no matter what the word is, be made to generate another word? That is the problem treated in this report, and a solution will be described.

One way in which one word can generate another is by permuting the letters. There are many very interesting transpositions of all lengths—and ten times as many uninteresting ones (such as HASHER and REHASH), but, even so, the great majority of words are untransposable. Persons interested in collecting transpositions can get a good start from the following list. Where they all ultimately came from cannot readily be ascertained by the authors at the present time, the same having obtained them through the grapevine. It is certain that many of them were originated by the members of The National Puzzlers League, of which ENIGMA is the official organ; and we are deterred from saying nearly all only because there have been other active leagues such as The Eastern Puzzlers League.

HELLENIC, CHENILLE
SERAHEC, PARCHESI
LOATHELY, TALLYHO
ADMIRER, MARRIED
CREDENTIAL, INTERLACED
REFURBISH, BRUSH-FIRE
LIONESSES, NOISELESS
HISTRIONICS, TRICHINOSIS
DIALECT, CITADEL
SUNLIGHT, HUSTLING
OCEAN, CANOE
APPRAISED, DISAPPEAR
POETASTER, OPERETTAS
SVENGALI, LEAVINGS
PRETTINESS, PERSISTENT
SMITHEREENS, INTERMESHES
CLIMAKES, EXCLAIMS
APHRODITE, ATROPHIED
LOATHING, PROVIDES
SEESAWED, SEAWEEDS
DISPROVE, PROVIDES
IMPEDE, PERMEATING
PERSISTENT, SMITHEREENS
EPITAPHS, HAPPIEST
NINETIES, EINSTEIN
PALESTINE, PENALTIES
SCHUBERT, BUTCHERS
FIENDISH, FINISHED
LAMENTING, ALIGNMENT
COTERIES, ESOTERIC
INITIATED, DIETITIAN
CONTINUED, UNNOTICED
EYELIDS, SEEDILY
DISCOVER, DIVORCES
POLEMIC, COMPILE
PREDATORY, PORTRAYED
CATECHISM, SCHEMATIC
SENTENCES, SENESCENT
TANGIBLE, BLEATING
ARTISTS, STRAITS

Word Ways

ALICE GORKI and DIMITRI MILLER
Although there are many more transpositions, and although even some of the above words can be further transposed into still other words, it is nevertheless obvious that if the object is to find a way in which any word whatever can be made to generate another word, transpositions, however interesting, cannot take us very far.

Another way in which a word can sometimes be made to generate another word is by means of the word-shift, but word-shifts are far rarer than transpositions. The cream of the word-shift crop, excluding words less than five letters, can be found in Language on Vacation, by Dmitri Borgmann, published by Charles Scribner’s Sons. One word-shift which you will not find published either in that book or elsewhere, may be used here to illustrate the word-shift idea:

\[
\begin{array}{cccc}
  Z & O & R & B \\
  I & A & P & S \\
  C & J & B & Q \\
  T & D & X & C \\
  R & U & E & L
\end{array}
\]

Here we have the name of the science-fictioneer, Zorbi, whose mad scientists all deal in such unlikely and obscure sciences as nidology and logology. We see that, when it is shifted three places down the alphabet, it produces his first name, Cruel.

If every shift of a word is regarded as a possible scrambled word, the possibilities of generating words by shifting are considerably augmented. If every shift is
regarded as a possible scrambled egg, the possibilities are greatly reduced. An example will make this clear:

MUSIC
NVZJD
OWUKE
PXVLF
QYWNG
RZKNH
SAYUI
TBZPJ
UCAQK

"QUACK!" They say in the news that hens lay better to music; why not ducks? At any rate, MUSIC, when shifted eight places, produces everything that is needed for the word QUACK. But a quack is not an egg, it be noted; so be on your guard.

A short investigation produced a tidy little crop of these "shiftgrams", as we came to call them—though we found none over seven letters. A few shiftgram phrases which turned up are also included here for their interest. Two triples were found: EIGHT, PACED, STREP, and WHORLS, TAXIED, POLITE.

ENTER, JAPAN, CRAZY, PRONG, PIANO, TERMS, WEIRD, BONGS
MAGIC, Mousy, WORDS, PLATO, GRIEF, APRON
ALONE, SPIRE, PROUD, MOLAR, LARGE, ENTRY
SIGHT, COPED, LIGHT, STREW, SYLPH, NERVI
DITCH, JUDIE, BEARD, VIRUS, ALICE, GORKI
THORN, PIous, CLUED, VENOM, LAUGH, TOPIC
MENDS, OFTEN, HOLDS, WHALE, WEIGHT, POLAND
TIRED, BONDS, LUNCH, TRAIN, WAFTED, TULIPS
PETALS, DEWLAP, TOURED, BEYOND, WATERS, PLIGHT
COMETS, JUICES, FLIMSY, SORELY, ADULTS, FLOWED
HARMED, FAVORS, MANGLE, COPING, RAVAGE, INTERN
DESERT, TIGHTS, PENURY, RACHEL, PERHAPS, LOWLAND
PHONES, TWIRLS, CRAVER, REPINE, BATHING, MYRTLES
PLIGHTS, STRAWED, RIBANDS, OBJECTS, TINGED, POETRY
MAYBE, FILTH, FLING, VASTY, MATING, SAFELY
WEEDS, CONGO, VITAL, LANDS, SEQUIN, COAXES
TIGHT, TREES, EMBER, TILLY, DUCATS, FONDLE
AGENT, GRANT, FROZEN, AMBERS, ANGELIC, PECKING

Another phrase we found was "honeysuckle, GI POW lyrics."

It is not easy to imagine any single operation which, when applied to any given word, invariably causes that word to generate some other word. Possibly only a combined method will enable us to approach our goal at all nearly. But nothing
new can be produced by combining transposing and shifting. If PETSALS is first transposed to PASTEL, STAPLE, PLEATS or PLATES, its shiftgram will still be DEWLAP.

There is another way in which a completely different set of letters can be derived from the letters of any given word, although it involves quite a bit of work. The letters of the alphabet are first set into correspondence with the whole numbers from zero to twenty-five, and also with the prime numbers from 2 to 101.

We demonstrate the process with the word GOD. The letters of this word correspond to the primes 7, 17, and 47. The first step is to multiply these together. The product is 5593. The next step is to divide this number repeatedly by 26, recording the remainder after each division, until we obtain a quotient of zero. The remainders will range from zero to twenty-five, and will correspond to letters.

As with shiftgrams, we regard the resulting letters as a possible scrambled word, and so GOD, far from being dead, is merely HID. In the same way BOY produces BUG. Mathematicians call the division part of our process "translating to base 26," but we have dubbed the entire process "transfiguration," trusting that the pun will not be lost on you.

Transfigurations and shifts may be combined, and it is probably possible for any word to generate another word by combining and repeating these operations. Let us show how LOGOLOGY can lead to another word. Looking over the shifts of LOGOLOGY (none of which appears to be a shiftgram—a shift which is a scrambled word), we find one combination of letters, FIAIFIAS, which can be transfigured without too much labor. Since A corresponds to 2, and F to 13, we may divide this combination twice by 26 to obtain two zero remainders corresponding to AA. After the F's and A's are thus disposed of, the remaining letters correspond to factors whose product is 815189.

Looking over the shifts of AALXJUB, we find RRCOALS! So, LOGOLOGY has generated CORRALS.
We leave these inhospitable realms to be harvested by some more intrepid explorer, and turn our attention to a more simple and usual way of associating letters with numbers.

The letters are usually thought of as the irreducible atoms, for they are, in fact, the orthographic units out of which the words are built. However, the letters have an assigned order—they have the numerical property of succession (A is first, B is second, ...), and, therefore, letters (being so amiable) can easily take on all the other coloring of numbers—which means that some letters are factorable into others, and some are products of others. In general, if the letters are thought of as orthographic atoms, then it must also be recognized that they have their subatomic realm. The nonfactorable letters are A B C E G K M Q S W; they correspond to the primes 1, 2, 5, 7, 11, 13, 17, 19, 23. The number “one” is, of course, a special case; but it is simplest to treat it as a prime—though a prime which cannot be a factor.) Let us once more place the letters in correspondence with the numbers, but this time in factored form:

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>(2 x 2)</td>
<td>5</td>
<td>(2 x 3)</td>
<td>7</td>
<td>(2 x 2 x 2)</td>
<td>(3 x 3)</td>
<td>(2 x 5)</td>
<td>11</td>
<td>(2 x 2 x 3)</td>
</tr>
</tbody>
</table>

Consider a very simple transposition. NO transposes to ON. But NO = (2 x 7) (3 x 5), and these factors can be rearranged to (2) (3 x 5) (7) which equals BOG. What is this? It is a subtransposition. NO subtransposes to BOG.

Take another example: TO = (2 x 2 x 5) (3 x 5). These factors can be rearranged in several ways; TO can be subtransposed to at least seven other words:

(5) (5) (2 x 2 x 3) = EEL, which transposes to LEE.
(3 x 5) (2 x 2) (5) = ODE, which transposes to DOE.
(2 x 5) (3 x 5) (2) = JOB.
(3) (5) (2 x 2) (3) = CEDE.
(2) (5) (5) (2 x 3) = BEEF.

Listed below are a few simple subtranspositions. It appears evident that, although subtransposition of long words may be hard to find, there are many more subtranspositions than ordinary transpositions.

AND, HAG
THE, HEED, BEEP, DEBT
TOO, JEER
ONE, BUY
WORD, WOLF, FLOW

FIVE, LOCK
ARMED, ZEBRA
GOD, DUE
BOY, FELY, JOE
RED, BIT

WORD WAYS
id except letters

It must not be supposed that all small words will subtranspose. A little experience will soon rout that notion. But, even so, the obvious potential we have here is gratifying and heartening. It should be noticed that the letters corresponding to primes fall into two classes. If a word contains B, C, E, K, or M, it is possible (sometimes) to subtranspose that letter away, as happened with the M in ARMED, above. But if a word contains an A, S, Q or W, any subtransposition of that word must have that letter too. An example of a small word that can neither be transposed nor subtransposed is SQUAWS.

Clearly, we need another operation which may be applied to words in combination with subtransposition if we hope to find a way to make any word whatever generate another word.

The letters, numbered from one to twenty-six, may form thirteen complementary pairs, each totaling twenty-seven:

\[
\begin{array}{cccccc}
A & B & C & D & E & F \\
G & H & I & J & K & L \\
M & N & O & P & Q & R \\
S & T & U & V & W & X \\
Y & Z & \_ & \_ & \_ & \_
\end{array}
\]

A very few words can be made to generate other words by inversion—that is, by substituting for each letter in the word the complementary letter. Thus, GIRL inverted is TRIO. Now, suppose that a certain word proves impossible to subtranspose. The intractable word may be inverted, and one may then attempt to subtranspose that letter away. If this fails, the inversion may be subtransposed and inverted again. Subtransposition and inversion could be alternated as long as necessary in order for the word in question to generate another word. There could hardly be a question of a word being refractory to this treatment. One could only ask, does it take one step, two steps, three steps—or, in general, what is the least number of alternate subtranspositions and inversions necessary in order to make this word generate another word? Suppose MUSIC is a word we have tried and failed to subtranspose: MUSIC inverted is NFHRX, and this subtransposed is HGLRX, and this inverted is STOIC.

It is such words as these, which arise from other words by alternate subtranspositions and inversions (where either subtransposition or inversion may be the first step), and in which not less than two such steps are involved, that we have christened sea-changed words.

Full fathom five thy father lies.
Of his bones are coral made.
Those are pearls that were his eyes.
Nothing of him that doth fade,
But doth suffer a sea-change
Into something rich and strange.
Sea-nymphs hourly ring his knell,
Ding dong,
Hark, now I hear them, ding dong bell.
William Shakespeare

Who shall sea-change, word for word, this whole poem, and weave the sea-changed words together in such a manner as to make an utterly different—a sea-changed poem; who shall take such a step toward drawing the great literature of our English tongue into the compass of logology?

In closing, we draw attention to the letters which are factorable entirely into B’s and C’s (2’s and 3’s): D, F, H, I, L, P, R, and X. If to these we add the A, B and C, we may say that these eleven letters are reducible to A’s, B’s and C’s. Let us celebrate the advent of sea-changed words by chanting a lipogrammatical litany using only these eleven letters:

Hail, Allah afar!
I had a hill, a rill.
I did affix a lilac.
A bird did chirp.
Fair hair did I braid,
I—a ruffian lad, ill-clad!

Who knows what the Deity’s thundrous (or silent?) response must be, using only the other fifteen letters?

* * *

THE DEADLIEST SIN

The worst error that a dictionary can possibly make is to misspell one of the words entered in it. Yet, this deadly sin has been committed by the finest dictionaries ever published.

Webster’s Second Edition, the “Supreme Authority” from 1934 to 1961, misspelled SUPERSEPTUAGENARIAN as SUPERSEPTUAGINARIAN for the entire 27-year period. For the first 23 of those 27 years, it also misspelled EXOCELAR as EXCOELAR. It was replaced, in 1961, by Webster’s Third Edition, which misspells BONIFICATION as BONIFICATION. For shame!

Along a similar line, we are fascinated by an entry in the 1965 Edition of The Times Index-Gazetteer of the World. Given for KALAE, a cape at the southern tip of Hawaii, are a latitude of 18.58 North and a longitude of 155.24 East. There are three separate errors in this one entry, for the actual latitude figure is 18.54, the actual longitude figure is 155.41, and the correct longitude direction is West, not East. If you doubt us, examine any atlas, or look up the information in a recent edition of The Columbia Lippincott Gazetteer of the World.

WORD WAYS