SHIFTGRAMS

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Take a word (for example, MUSIC), shift each letter n steps along the alphabet arranged in a circle with A following Z (for example, M eight steps to U, U eight steps to C, S eight steps to A, I eight steps to Q, C eight steps to K), and rearrange the resulting letters to form another word (for example, UCAQK to QUACK). Howard Bergerson, writing under a pseudonym, christened QUACK a shiftgram of MUSIC in "Sea-Changed Words" in the February 1969 Word Ways. (MUSIC is, of course, a shiftgram of QUACK, achieved by shifting 26 - 8 = 18 spaces.) Multiple shiftgrams are possible (the earlier article exhibited the triple WHORLS, TAXIED, POLITE); however, the theoretical maximum of 26 shiftgrams of a word is impossible to achieve for words of four or fewer letters because of the paucity of vowels (AEIOUY used four times apiece takes care of at most 24 words), and equally impossible for words of five or more letters because of the sparseness of words. Transpositions are special cases of shiftgrams when the number n of steps equals zero, and alphabetic letter shifts (for example, CHEER to JOLL Y) are special cases of shiftgrams when the final arrangement of letters is unnecessary (for details on these, see the editor’s article in the November 1979 Word Ways).

It is rather surprising that no articles on shiftgrams have appeared in Word Ways since their introduction by Bergerson. This note presents the results of my investigation of the problem, based on boldface entries in Webster’s New International Dictionary, Second or Third Edition. First, I exhibit shiftgrams for nine-letter words starting with each letter of the alphabet in turn (can the examples for Q and X be improved?):

areophane + 4 = silverite
becoiffed + 3 = highflier
cablegram + 2 = decocting
deplaster + 15 = spaghetti
enrupture + 13 = rechanger
Fabrikoid + 3 = ungrilled
gasometry + 20 = amusingly
harvestry + 13 = refueling
inhumanly + 6 = tetragons
jackshaft + 8 = skipbrain
Kellaways + 8 = mitigates
lingberry + 13 = elevatory
metatatic + 11 = expellent

nervature + 13 = rehearing
outweapon + 14 = dobchicks
plexiform + 18 = thinkable
quadrants + 26 = squadron
ransacked + 4 = overweigh
straphead + 11 = scalloped
tegulated + 7 = banksholl
uncharly + 6 = exorating
viperfish + 22 = bandoleer
wanhoyly + 4 = particles
xerones + 26 = exornates
yaghourta + 20 = olbanums
Zephaniah + 4 = delimiter

Shifting gears, is it possible to find examples of each step size, from 1 through 26:

waternmen
flasking +
bookable +
partaker +
ampogna
quisling +
begotten +
folkways +
figurize +
quibbled +
Dedanite +
wishbone +
bangster +

This list can
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both a 2-shi
shift are not

Can one
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t than either (
with no entr

amhran +
became +
Cabiri + 3
daekon +
dendive + 5
c faucal +
gambit +
hallah + 8
infers + 9
jaderly + 1
Khatti + 1
loggia + 1
morgan +
ziarat + 1
yercum +
xeroma +
wachna +
viddvy + 5
Uchean +
Tabeal + 1
saddhu + 6
recule + 9
Quiche +
packet + 1
oafish + 1
nafta + 1
steps along the line, M ergerson, of MUSIC (MUSIC is, of course, 18 spa­ces away from the edge of the page).

We have appeared in The Times of London, under the heading "The Problem of the Eight Steps". The problem asks for a list of eight-letter words exhibiting both alphabetic and step variation in synchrony. Two constraints together are more difficult to satisfy than either one alone; I was able to achieve it for six-letter words, but with no entries for either X or Y:

\[ \begin{align*}
\text{amhran} + 1 & = \text{bobins} \\
\text{became} + 2 & = \text{cogged} \\
\text{daekon} + 3 & = \text{fulled} \\
\text{endive} + 4 & = \text{jinjas} \\
\text{faucal} + 5 & = \text{riggals} \\
\text{gambit} + 6 & = \text{hatpin} \\
\text{infers} + 7 & = \text{wabron} \\
\text{jadery} + 8 & = \text{kinbot} \\
\text{Khatti} + 9 & = \text{sveste} \\
\text{loggia} + 10 & = \text{saxsum} \\
\text{morgan} + 11 & = \text{tanzeb} \\
\text{ziarat} + 12 & = \text{jubbas} \\
\text{yercum} + 13 & = \text{towage} \\
\text{xeroma} + 14 & = \text{purdah} \\
\text{wachna} + 15 & = \text{regale} \\
\text{vidduy} + 16 & = \text{dizain} \\
\text{Uchean} + 17 & = \text{taking} \\
\text{Tabeal} + 18 & = \text{Shilha} \\
\text{sadani} + 19 & = \text{capill} \\
\text{recule} + 20 & = \text{unland} \\
\text{Quiche} + 21 & = \text{somare} \\
\text{packet} + 22 & = \text{Plevna} \\
\text{oafish} + 23 & = \text{mature} \\
\text{naftha} + 24 & = \text{sugann} \\
\text{Quiche} + 10 & = \text{stoma} \\
\text{takna} + 11 & = \text{parian} \\
\text{kobird} + 12 & = \text{hearty} \\
\text{Jaakan} + 13 & = \text{barrer} \\
\text{ilativ} + 14 & = \text{sandal} \\
\text{hafynl} + 15 & = \text{gyrate} \\
\text{giggit} + 16 & = \text{Cacana} \\
\text{ritful} + 17 & = \text{papoga} \\
\text{deflux} + 18 & = \text{brucia} \\
\text{ciscut} + 19 & = \text{grampa} \\
\text{bibil} + 20 & = \text{dasher} \\
\text{alerce} + 21 & = \text{cereal}
\end{align*} \]

This list can immediately be reduced to only 14 examples because the first entry is both a 1-shift and a 25-shift, the second entry is both a 2-shift and a 24-shift, etc. (note that the 13-shift and the 26-shift are not paired).

Can one generate a list exhibiting both alphabetic and step variation in synchrony? Two constraints together are more difficult to satisfy than either one alone; I was able to achieve it for six-letter words, but with no entries for either X or Y:

\[ \begin{align*}
\text{watermen} + 1 & = \text{snuffbox} \\
\text{flasking} + 2 & = \text{chipmunk} \\
\text{bookable} + 3 & = \text{deerhorn} \\
\text{partaker} + 4 & = \text{excotive} \\
\text{zampogna} + 5 & = \text{truffles} \\
\text{Quipling} + 6 & = \text{motorway} \\
\text{begotten} + 7 & = \text{alluvian} \\
\text{folkways} + 8 & = \text{sweating} \\
\text{figurize} + 9 & = \text{raindrop} \\
\text{quibbled} + 10 & = \text{novellas} \\
\text{Dedanite} + 11 & = \text{polytope} \\
\text{wishbone} + 12 & = \text{quantize} \\
\text{banger} + 13 & = \text{frontage}
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Curiously, a complete list of six-letter words was possible by reversing
the alphabet with respect to step size.

If one insists on both words beginning with the same alphabetical
letter, the following nearly-complete list of six-letter words results:

| Abiner + 13 = avenor | nather + 13 = nauger |
| baktun + 7 = Brahui | oarlop + 3 = ordurs |
| calden + 17 = curvet | pacing + 2 = picker |
| Danize + 4 = dirhem | quarte + 26 = quatre |
| eggcup + 24 = encase | ratchet + 13 = repugn |
| faured + 14 = fortie | sachem + 6 = skyng |
| Gabdes + 14 = groups | tangib + 11 = tryme |
| hagbut + 13 = hognut | ugsome + 6 = umyaks |
| Icerya + 10 = imbosk | vailer + 13 = vinery |
| jarfly + 9 = Joshua | wailer + 22 = washen |
| kernos + 22 = kojang | yercum + 22 = Yanqui |
| lampit + 18 = lashed | Zareah + 8 = Ziphim |
| mabuti + 18 = metals |

A curiosity noted in passing was TANGER + 13 = TANGER, an identity
shiftgram, possible only for shiftgrams of step size 13. Note that Q
employs a step size of 26, so that the two words are transpositions; it
is desirable to avoid this special case if possible.

Suppose that one considers alphabetic letter shifts only. It is possible
to find an alphabetical list of six-letter examples for all letters but Q
and Y (and the inferred reformed spelling 'arizer' to match J):

| aphtha + 19 = Tiamat | Napean + 4 = retier |
| banian + 4 = fermer | orphan + 13 = becuna |
| caddaw + 8 = killie | pyrryl + 24 = rattan |
| dionym + 6 = joutes | reefer + 9 = annona |
| elated + 15 = tapits | sappan + 4 = wetter |
| farrel + 13 = sneery | Tillim + 6 = zorros |
| gedder + 22 = cazzan | Urrijah + 17 = lizary |
| Hadith + 11 = slotes | verver + 9 = enaena |
| iddats + 11 = tooled | wiggin + 6 = commot |
| jarina + 17 = arizer | xister + 22 = teopan |
| kernel + 23 = ganjah | zanana + 4 = derere |
| ledder + 22 = hazzan | |
| manful + 7 = thumbs |

Ed Wolpow has Challenges (:)
following up Meyer's point
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to warm puppy"

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