One Sunday in 1953, Cornell students Doug McIlroy and Bob Vanderhoeek, weary of solving crossword puzzles, decided to try a different word game -- that of finding examples of words containing each of the 676 bigrams from AA (bazaar) to ZZ (puzzle). More than a decade later, Doug posted the incomplete list on a Bell Telephone Laboratories bulletin board in the mathematics department, asking for help in filling the gaps. Ed Gilbert, another Bell Labs employee, had recently acquired a computer-generated list of all tetragrams appearing in words in Webster's Second Edition; using clues provided by this, he was eventually able to discover examples for the 613 different bigrams this implied were in Webster. The results appeared in a Bell Labs memo and were later published in the November 1969 Word Ways. With the aid of the Webster computer tape used to generate the tetragram list, Doug issued another Bell Labs memo in 1974 listing the shortest dictionary words for each bigram. (The longest such "short" examples were the twelve-letter words arsfvedsonite for FV and benzpinacolone for ZP.)

Examples for ninety percent of the bigrams had been found; could the remainder be similarly illustrated with words? Obviously, one would have to turn to other English-language sources, but rich troves existed: Webster's Third and other American unabridged dictionaries, the Oxford English Dictionary, the Times Index-Gazetteer, American surnames, although not assembled in any single source promised the greatest riches of all -- more than one million different surnames were known to exist in Social Security records alone.

This article presents the successful results of this search: the commonest examples of words containing each of the 676 bigrams. For at least 80 percent of the bigrams in the list, the commonest word was decided by referring to Kucera and Francis's Computational Analysis of Present-Day American English (Brown University Press, 1967). This tabulates the number of occurrences of all words in a million-word sample of American English of 1961, carefully balanced to give representation to different subjects and media (books, magazines, newspapers). In the list below, the word having the greatest frequency among all words containing that bigram is given first: often, the word with the second-greatest frequency is given as well.

The remaining bigrams do not occur in the Kucera and Francis list, or occur so rarely that considerable doubt is raised that the commonest word with that bigram has been identified. For these bigrams, a differ-
ent ranking system had to be devised. I used the following, based in part on the reference work in which the word is found:

1. Words in Webster’s Pocket Dictionary or Collegiate Dictionary, plus inferred forms (plurals, gerunds and past tenses). In addition, given names (in the Collegiate appendix) have been allowed, as well as certain extremely common geographical names: names of countries, of US states and major US cities (listed in the main body of Webster’s Third).

2. Words in the main section of Webster’s Second or Third Editions (or analogous US dictionaries such as Random House or Funk & Wagnalls), excluding all personal and geographical placenames of the type omitted from the main body of the Second.

3. Names of foreign cities (as listed in Webster’s Third); US place names (as found, say, in Rand McNally’s Commercial Atlas); surnames having 10,000 or more representatives in Social Security files (available in a 1974 Social Security Administration report).

4. Obsolete words or variants not found in Webster’s Second or Third, but in Webster’s First or the Oxford English Dictionary; words in specialized dictionaries.

5. Foreign place names in atlases such as the Times Index-Gazetteer; surnames not in the Social Security list, but found in Who’s Who, telephone directories, etc.

Occasionally, the commonest Kucera and Francis word turned out to be of second rank, or even lower, even though a word of the first rank existed. In these situations, I placed the Kucera and Francis word in parentheses, and added the commonest word of first rank to the entry.

For words of second rank or more, the source is given: 2 and 3 for Webster’s Second and Third; 0 for the Oxford English Dictionary (followed by the dictionary entry to look under); TIC for the Times Index-Gazetteer; RM for the 1981 Rand McNally Commercial Atlas and Marketing Guide; OSN for the Official Standard Names Gazetteers issued for different countries.

A few references, highly specialized, were used only once or twice: CCN for the Century Cyclopedia of Names, 1954; NS for De Nederlandse Geslachtsnamen, 1971; CTL for Current Trends in Linguistics, edited by T. Seboek (Volume 1, Soviet & East European Linguistics, 1963); WB for Webster’s Biographical Directory, 1966 addenda; D for Dorland’s Illustrated Medical Dictionary, 24th Edition, 1965; and TD for telephone directories.

Eight bigrams -- FX, JO, MX, PX, QG, QJ, QK and QP -- are tagged with stars. These come from sources that many readers would question as English; six are place names associated with long-extinct Indian settlements in North America, one is a nonce-word, and one is a Maltese word. Improvements for these six bigrams would be most welcome.

I am much indebted to Philip Cohen, Dmitri Borgmann and Jeff Grant for filling in various holes in the table.
Dictionary, In addition, allowed, names in the main

Tried Editions

or Funk & acenames

US place

Social Security report

cond or Third,

; words in

Lex-Gazetteer,

Who's Who,

turned out to

the first rank

nis word in

to the entry.

2 and 3

D for Dorland's

D for telephone

QP -- are

readers would

long-extinct

, and one is

uld be most

in and Jeff

AA Isaac, bazaar

B about, above

C back, each

D had, made

E aesthetic

F after, staff

G against, again

H ahead

I said, against

J major, majority

K make, take

L all, also

M same, came

N and, an

O Laos, extraordinary

P perhaps, happened

Q aqueous, opaque

R are, years

S as, was

T at, that

U because, beautiful

V have, gave

W away, saw

X tax, maximum

Y may, way

Z jazz, magazine

BA back, probably

B Bobby, lobby, grabbed

C subcommittee

D subdivision

E be, been

F clubfoot, obfuscate

G subgroups

H clubhouse

I big, Bill

J subject, objective

K subkingdom

L public, possible

M submarine

N obnoxious

O about, both

P bombproof, subpoena

Q subquality 3

R brought, brown

S observed, jobs

T obtained, doubt

U but, business

V obviously, obvious

W subway

X subxerophilous 3

Y by, baby

Z subzone 3

CA can, because

B Macbeth, ebolic 3

C according, account

D anecdote

E since, place

F flicflac 3

G eegonine 3

H which, such

I city, social

J arcjet 3 addenda

K back, black

L close, clear

M acme

N picnic

O could, come

P ecphonesis 3

Q acquire, acquired

R across, increase

S politics, characteristics

T fact, action

U cut, particular

V Mechanicville RM New York

W cwm

X acxoyat 2

Y policy

Z Czechoslovakia, czar

DA day, days

B goodbye, handbag

C broadcast

D added, suddenly

E made, under

F grandfather, handful

G knowledge, bridge

H childhood

I did, didn't

J adjustment, adjusted

K handkerchief

L hardly, friendly

M administration

N didn't, couldn't

O do, down

P standpoint

Q headquarters

R children, hundred

S hands, friends

T width, breadth

U during, individual

V advantage, advance

W Edward, dwelling

X Dxar Charf OSN Morocco

Y body, already

Z adz
EA years, each
B baseball, somebody
C because, second
D used, united
E been, see
F before, left
G began, college
H behind, behavior
I their, being
J rejected, prejudice
K week, weeks
L well, himself
M them, system
N been, when
O people, George
P keep, department
Q required, equipment
R were, her
S these, states
T get, between
U Europe, neutral
V even, never
W new, few
X next, example
Y they, eyes
Z squeeze, freezing

FA fact, far
B halfback
C briefcase
D serfdom
E life, few
F off, different
G afghan
H offhand
I first, find
J jordhs
K calkkill 3
L floor, influence
M (Hoffman), feoffment
N aloofness, stiffness
O for, before
P offprint
Q Futalaufquen TIG Argentina
R from, free
S beliefs, offset
T after, left
U full, future
V arvedsonite 3
W halfway
X fxr
Y identify, justify
Z styfziekte 3

GA against, again
B (Digby), pegboard
C dogcart
D kingdom
E get, general
F meaningful
G suggested
H through, might
I give, given
J logjam
K gingko, Bangkok
L English, single
M judgment
N foreign, design
O good, go
P bagpipe, flagpoles
Q Ngqika CCN Xhosa subgroup
R great, program
S things
T Washington, strength
U figure
V dogvane 3
W (Sedgwick), dogwood
X Longxuyen 3 VietNam
Y energy
Z zigzagging

HA that, had
B neighborhood
C (Khrushchev), forthcoming
D the, he
E youthful, faithful
G churchgoing
H withheld, withholding
I his, this
J highjacker 2
K (Oshkosh), latchkey
L highly
M establishment
N John, technical
O who, should
P mouthpiece, birthplace
Q earthquake
R through, three
S months
T might, right
U church, thus
V boschvark 3
W highway
X Shahian O (ask), meohx O (mix)
Y why, physical
Z (mahzeer), mahzor 3

IA social, sp.
B possible, might
C which, Art
D said, did
E experience
F if, life
G might, right
H likelihood
I Hawaii, sl
J marijuana
K like, like
L will, still
M him, time
N in, into
O national, P
P equipment
Q techniques
R their, first
S is, his, the
T it, with
U medium
V give, give
W Taiwan, h
X six, fixed
Y biyearly
Z size, org
QA Qariqa 3, qasida 3
B Shubba TIG Jordan
C qepe D
D taluqdar 2
E qere 3
F waqf 2, cinqfoil 2
G Saggui Gyit’ina 3
H fiqh Random House
I qiviut, qintar
J Chuftatchyqj 3
K Asikeynik 3
L taglid 3
M Luqman 2
N Onaistra TIG Syria
O qoph
P Maqpiato 3
Q zaqum 2
R miqra 2
S bugsha
T Qrah TIG Jordan
U quite, question
V qvint 2
W acqwyte 2
X Clerq NS surname
Y Qyrghyz 3
Z Ahmaqzal TIG Pakistan

RA general, program
B urban, harbor
C church, force
D toward, order
E are, were
F surface, performance
G large, organization
H perhaps, Rhode Island
I right, during
J perjury
K work, New York
L world, early
M form, information
N government, turned
O from, through
P purpose, corps
Q torque
R carried, married
S first, years
T part, important
U true, run
V service, services
W forward, otherwise
X (Marx), Marxist, interxylary 3
Y very, every
Z (Schwarzkopf), scherzo

SA said, same
B husband
C school, schools
D Tuesday, wisdom
E these, because
F successful
G disguised
H she, should
I since, business
J misjudged
K asked, ask
L island, slowly
M small
N wasn’t, isn’t
O so, some
P special, space
Q square, squad
R classroom, crossroads
S less, business
T first, most
U such, sure
V Louisville, transverse
W answer
X Mesx CTL Georgian dialect
Y system, systems
Z (Szold), grosz

TA state, take
B football
C kitchen, watch
D outdoor
E after, state
F platform
G outgoing, shotgun
H the, that
I time, still
J bootjack
K catkins
L little, directly
M department, treatment
N witness, brightness
O to, into
P output
Q cotquean
country, street
S its, itself
T little, better
U turned, study
V postvocalic, Latvia
W two, between
X postxyphoid 2
Y city, society
Z Switzerland, blitz
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<td>Public, subject</td>
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<td>Such, much</td>
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<td>Study, students</td>
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<td>Question, true</td>
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<td>F</td>
<td>Sufficient</td>
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<td>Through, thought</td>
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<td>Uh, huh, brouhaha</td>
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<td>I</td>
<td>Quite, required</td>
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<td>J</td>
<td>(Trujillo), hallelujah</td>
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<td>K</td>
<td>Duke</td>
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<td>L</td>
<td>Would, could</td>
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<td>Number, human</td>
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<td>Under, around</td>
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<td>O</td>
<td>Continuous, liquor</td>
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<td>P</td>
<td>Up, upon</td>
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<td>Our, your</td>
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<td>Must, because</td>
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<td>T</td>
<td>But, out</td>
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<td>Vacuum</td>
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<td>W</td>
<td>Rauwolfia 3, spreeuw3</td>
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<td>X</td>
<td>Flux, luxury</td>
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<td>Y</td>
<td>Buy, guy</td>
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<td>Z</td>
<td>Puzzled, buzz</td>
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<th>Available, various</th>
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<tr>
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<td>Verte O (ubeity), Skovby TIG Den</td>
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<tr>
<td>C</td>
<td>Novic 2</td>
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<tr>
<td>D</td>
<td>Heavd 2</td>
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<tr>
<td>E</td>
<td>Have, over</td>
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<tr>
<td>F</td>
<td>Thravfie O (thrawve)</td>
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<td>G</td>
<td>Avgas</td>
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<tr>
<td>H</td>
<td>Givhans RM S. Caro., vha O (who)</td>
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<tr>
<td>I</td>
<td>Service, having</td>
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<tr>
<td>J</td>
<td>Evje TIG Norway</td>
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<tr>
<td>K</td>
<td>Sovkhoz</td>
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<td>L</td>
<td>Vei 3</td>
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<td>N</td>
<td>Czarevna 2</td>
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<td>O</td>
<td>Voice, involved</td>
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<tr>
<td>P</td>
<td>Sovpren3</td>
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<tr>
<td>Q</td>
<td>Mavqi'im TIG Israel, Sovquinet D</td>
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<tr>
<td>R</td>
<td>(Chevrolet), chevron</td>
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<tr>
<td>S</td>
<td>Slavs, revs</td>
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<td>T</td>
<td>Polovtsian 3, twelvth O (twelfth)</td>
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<tr>
<td>U</td>
<td>Vulnerable</td>
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<td>V</td>
<td>Revved, flivver</td>
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<td>W</td>
<td>Vwang TIG Nigeria</td>
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<tr>
<td>X</td>
<td>Vxorious O (uxorious)</td>
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<td>Y</td>
<td>Heavy, navy</td>
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<td>Z</td>
<td>Evzone</td>
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<tr>
<th>WA</th>
<th>Was, way</th>
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<tr>
<td>B</td>
<td>Cowboy</td>
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<tr>
<td>C</td>
<td>Newcomer</td>
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<td>D</td>
<td>Crowd</td>
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<td>E</td>
<td>Were, we</td>
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<tr>
<td>F</td>
<td>Awful</td>
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<td>G</td>
<td>Blowgun</td>
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<td>H</td>
<td>Which, when</td>
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<td>I</td>
<td>With, will</td>
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<tr>
<td>J</td>
<td>Plowjogger 2</td>
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<tr>
<td>K</td>
<td>Hawk, awkward</td>
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<tr>
<td>L</td>
<td>Knowledge, slowly</td>
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<tr>
<td>M</td>
<td>Showmanship</td>
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<td>N</td>
<td>Down, own</td>
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<td>O</td>
<td>Would, two</td>
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<td>P</td>
<td>Newport, viewpoint</td>
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<tr>
<td>Q</td>
<td>Cawquaw 3</td>
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<td>R</td>
<td>Wrote, written</td>
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<td>S</td>
<td>News, knows</td>
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<td>T</td>
<td>Growth</td>
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<td>U</td>
<td>Swung</td>
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<td>V</td>
<td>Lowveld 3, howve 2</td>
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<td>W</td>
<td>Glowworm, powwow</td>
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<td>X</td>
<td>Lexxern O (lucern)</td>
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<tr>
<td>Y</td>
<td>Lawyer</td>
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<td>Z</td>
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<td>Obxow</td>
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<td>C</td>
<td>Except, exchange</td>
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<td>D</td>
<td>Sexdecilion</td>
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<td>Fixed, exercise</td>
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<td>F</td>
<td>Oxford, exfoliate</td>
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<td>G</td>
<td>Foxglove</td>
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<tr>
<td>H</td>
<td>Exhibit, exhibition</td>
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<tr>
<td>I</td>
<td>Existence, maximum</td>
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<tr>
<td>J</td>
<td>Växjö TIG Sweden</td>
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<tr>
<td>K</td>
<td>Boxkeeper</td>
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<tr>
<td>L</td>
<td>Axle</td>
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<td>M</td>
<td>Aixminster, boxman</td>
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<td>N</td>
<td>Laxness</td>
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<tr>
<td>O</td>
<td>(Nixon), Anglo-Saxon, exotic</td>
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<td>P</td>
<td>Experience, expected</td>
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<td>Q</td>
<td>Exquisite</td>
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<td>Exradius, banxring</td>
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<td>S</td>
<td>Flaxseed, coxswain</td>
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<td>T</td>
<td>Next, extent</td>
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<td>U</td>
<td>Sexual, luxury</td>
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<tr>
<td>V</td>
<td>Knoxville, poxvirus 3 addenda</td>
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<tr>
<td>W</td>
<td>(Maxwell), boxwood</td>
</tr>
<tr>
<td>X</td>
<td>Waxxenn O (wax), Jixxi OSN Oman</td>
</tr>
<tr>
<td>Y</td>
<td>Oxygen</td>
</tr>
<tr>
<td>Z</td>
<td>Exxodiacal 2</td>
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</table>

Three of the names in Hodge's Hound are formed from words in Dance Religion and the 14th Rep. family of the Slavic language used by Franks and Slavs, revs S flaxseed, coxswain means 'record of American English spelling of the 14th Rep.'
Three of the bigrams with asterisks are found in Frederick Webb Hodge's Handbook of American Indians North of Mexico: AKIYENIK is a variant of AKIYENIK, the name of an Indian tribe; MAQPIATO is a synonym of ARAPAHO, a major Indian tribe (taken from "The Ghost-Dance Religion and the Sioux Outbreak of 1890" by James Mooney, in the 14th Report of the Bureau of American Ethnology, Part 2, 1896); and SAGUI GITUNAI is a variant of SAGUI-GITUNAI, the name of a family of the Eagle Clan of the Haida, a major Indian tribe (originally used by Franz Boas in the 12th Report on the Northwestern Tribes of Canada, 1898). TEMXWIGSAN is a place name ('gooseberry point') in C. Hart Merriam's Studies of California Indians (University of California, 1955). CHUFYTACHYQJ is a Creek 'province' in South Carolina, according to John R. Swanton's "Early History of the Creek Indians and their Neighbors" in the Smithsonian Institution's Bureau of American Ethnology Bulletin 75 (Government Printing Office, 1922). FXR is a nonce-spelling of the word 'for' in Edgar Allan Poe's short story, "X-ing a Paragraph". For FJ, the Maltese word FEJQIEN means 'recovery from illness, cure'. Finally, Hodge's Handbook of American Indians North of Mexico contains Q' OA' PX, a variant spelling of KOAPK, an Indian village on the coast of British Columbia.