Most mnemonics are constructed to aid in recalling the members of a single group, such as ROY G BIV for the colors of the spectrum, or Jesus Christ Made Seattle Under Protest for the Seattle east-west streets Jefferson, James, Cherry, Columbia, Marion, Madison, Spring, Seneca, University, Union, Pike and Pine.

In contrast, this article describes methods for constructing mnemonics for many partially-overlapping groups whose members are drawn from a stockpile containing n different types of objects. Perhaps the easiest way to visualize the situation is to think of a manufacturing process in which various products are built out of piece parts to individual order. For example, in an automobile assembly line one vehicle may be built with automatic transmission, power brakes, and tinted glass, and the next with manual transmission and a heavy-duty ignition system. Not all piece parts can be combined with each other; for example, certain color-clashes between upholstery and body may be prohibited.

As another example, consider the twenty amino acid residues which are assembled in combinations of three from a stockpile of four nucleotides (adenylic, cytidylic, guanylic and thymidylic acids). In this application, unlike the manufacturing one, the order in which the three chemical units are joined is important, and the mnemonic should take this restriction into account.

Intermediate cases exist which are partially ordered; an example is discussed in detail later in this article. However, in discussing the theory of group mnemonics it is useful to think only about the limiting cases of groups with no order (like allowable combinations of Chinese dishes - two from Column A, two from Column B) and groups with total order (like beads of different colors on a string).

In constructing mnemonics for unordered groups, one assigns different letters from the alphabet to the members of the stockpile in such a manner that the sets of these assigned to groups can be rearranged into words; the hope is, of course, that a set of words is easier to recall than various combinations like HPIXXT, VBGWSJ, etc. These mnemonics are very efficient - there are exactly as many letters used to represent each group as there are objects in that group - but unfortunately work only for small group sizes, small group member sizes, and small stockpile sizes. The following rule for deciding when the one-letter-per-group-member approach is feasible is derived from experience with balanced letter-groups, discussed in "Word Groups" in the May 1977 issue of Word Waters used), if

\[ m(n) \approx \frac{n}{2} \]

The third rule for various stockpiles is to order the sets, and if \( k \) exceeds what can be formed by

\[ m(\text{anagram}) \]

What can be done with consonants of various stockpiles is to use the one-letter-per-group-member approach, but with a restriction on the use of consonants. For example, when stockpiling consonants b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, and these are arranged in short phrases of three letters, one mnemonic that is possible is

\[ \text{BCDFGHK} \]

But a reasonable restriction on consonants should be that the mnemonic approach is not used with consonants c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, and these are arranged in short phrases of three letters, one mnemonic that is possible is

\[ \text{BCDFGHK} \]

To aid in the construction of a type-collection, the method of using consonants and vowels of groups.
of Word Ways. Let \( n \) = stockpile size (the number of different letters used), \( k \) = group member size (the number of letters in each word of the group), and \( m \) = group size (the number of words in the group); then, allowing words from Webster's Second or Third edition, the following rule can be formulated:

\[
\text{if } k \text{ is} \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 \quad 8 \quad 9 \quad 10 \quad 11 \quad 12
\]

\[
\text{mn must not exceed} \quad 120 \quad 180 \quad 180 \quad 170 \quad 150 \quad 120 \quad 90 \quad 70 \quad 55 \quad 45
\]

For example, if one has a stockpile of \( n = 8 \) different letters and these are formed into groups of \( k = 6 \) objects apiece, then at most \( m = 20 \) such groups can be constructed using a one-on-one mnemonic. This rule can be relied on for \( n \) greater than or equal to 10, but for smaller values of \( n \) it is too optimistic; for example, when \( n \) equals \( k \) (the stockpile size equals the group member size), the group size suggested by this rule substantially exceeds what is possible by anagramming a stockpile of favorable letters:

\[
\begin{align*}
\text{n} & \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 \quad 8 \quad 9 \quad 10 \quad 11 \\
\text{m(by rule)} & \quad 40 \quad 45 \quad 36 \quad 28 \quad 21 \quad 15 \quad 10 \quad 7 \quad 5 \\
\text{m(anagram)} & \quad 6 \quad 8 \quad 13 \quad 13 \quad 11 \quad 9 \quad 7 \frac{1}{2} \quad 6 \quad 5
\end{align*}
\]

The third row is a smoothed version of maximum group sizes for various stockpile sizes observed for Websterian words. For \( n \) under 10, I recommend reducing the \( mn \)-product by the ratio of the third to the second row in the above table; e.g., if \( k = 4 \), \( n = 8 \), set \( mn = 180(9/15) = 108 \), and the maximum number of groups that can be formed is predicted to be 108/8 = 13\(\frac{1}{2} \), not 22\(\frac{1}{2} \).

What can one do for a mnemonic if the rule is violated? Assign consonants only to the members of the stockpile, and augment the consonants assigned to a group with vowels to form a word or short phrase. This mnemonic method is more generally applicable than the earlier one; it is assumed that the group members are ordered rather than unordered, so the consonant-order cannot be tampered with. Experiments with language suggest that it is possible to use this method for stockpile sizes of 15 or less, for any values of \( k \) or \( m \). However, to make the job as easy as possible, it is recommended that the common consonants be assigned to those stockpile objects most frequently appearing in groups, and rare consonants be saved for those that appear less often.

To aid in this endeavor, the appendix of this article contains a type-collection of reasonably common words for all possible orders (repetitions allowed) of two and three consonants taken from the list BCDFGHKLMPRSTW. In assigning consonants to stockpile members, one should first use LNRST; there are no possible combinations of these unrepresented by words. Next, one should add D (only five missing combinations: TDT, DSN, TDN, DSL, LDT) and M (sixteen more missing). The optimum order beyond this is unknown but a reasonable approximation is CGPHBFKW. The remaining consonants should be used only if appearing in a very small number of groups.
And what if one has more than 20 different objects in the stockpile? Believing that interest in this case is limited, I have not worked out the details, but the general approach is the same - allow not only single consonants to represent stockpile members, but also common consonant bigrams such as ST, ND, and CH. When forming words by adding vowels, one must now be careful to alternate each consonant and consonant bigram with vowel(s).

As a practical matter, three-consonant words appear to be the largest ones that can be conveniently employed for mnemonics of ordered groups. If the groups are unordered, it seems likely that four-consonant words might be employed. A type-collection of these takes up considerably more space, and has not yet been compiled.

It is now time to illustrate the foregoing material with an example. The example used is the famous six-piece burr puzzle, consisting of six rods of wood or plastic of square cross-section that have various notches cut out of their centers to allow them to interlock. As the picture indicates, individual burrs are interlocked so that two burrs apiece are parallel to the x-, y-, and z-axes. The stockpile of burrs consists of the various notch patterns, replicated to allow for the fact that certain six-piece burrs use the same notched piece in two (or even three) positions.

![Diagram of six-piece burr puzzle]

The first complete analysis of the six-piece burr puzzle is contained in the article "The Six-Piece Burr", written by William H. Cutler and published on pages 241-50 of Volume 10 (1977-78) of the Journal of Recreational Mathematics. I suppress most mathematical details, noting only that a stockpile of 441 burrs (369 of them different) is required to form all 119,979 possible six-burr assemblies. Clearly, no one would ever be interested in this many burr puzzles, so Cutler restricted the analysis by considering only notchable burrs - briefly, those that do not contain any interior corners (a set of eight in the typical rectangular room), which, if made of wood, can be "cut out with dado blades on a table saw or with a coping saw". This reduces the count to 42 burrs (25 different) which combine to form 314 six-piece burrs. A 42-piece mahogany burr set has been marketed by Pentangle of Hampshire, England as the "Chinese Cross" for a price of £22.
Note that the burr puzzle is a hybrid, being neither a completely ordered nor a completely unordered group. In particular, one can characterize a six-piece burr solution by three unordered groups of two unordered letters each: for example, AB/CD/EF is equivalent to BA/CD/EF or CD/AB/FE but not to AD/BC/EF. In other words, once one has the six burrs identified by letters, one is free to rearrange these in certain ways but not others—in fact, 48 of the 720 possible rearrangements are allowable.

Unfortunately, 42 burrs are too many to conveniently illustrate the mnemonics developed above. To make the problem manageable, I look at two subsets of Cutler's notchable six-piece burrs. The first, marketed as the "Professor Puzzle" (A Hanson Product B-10141-2) in 1977 for $3, consists of twelve burrs (ten different) which can be assembled six at a time to form ten distinct solutions. (In Cutler's notation, the burr types labeled 1, 2, 3, 5, 6, 10, 12, 18, 19, and 22 are supplied, with duplicates for 2 and 3.)

If order is ignored, only the following six groups of burrs are needed to assemble the ten puzzles:

<table>
<thead>
<tr>
<th>Cutler Label</th>
<th>Solution</th>
<th>Mnemonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>87</td>
<td>1,18/2,2/3,3</td>
<td>SUTTEE</td>
</tr>
<tr>
<td>30</td>
<td>1,3/19,9,6/3,5</td>
<td>SEIZER</td>
</tr>
<tr>
<td>24</td>
<td>1,3/19,5/3,6</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>1,3/12,22/3,5</td>
<td></td>
</tr>
<tr>
<td>111</td>
<td>1,22/12,3/3,5</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>22,5/19,3/1,2</td>
<td>DRIEST</td>
</tr>
<tr>
<td>2</td>
<td>22,19/5,3/1,2</td>
<td>DIREST</td>
</tr>
<tr>
<td>p.250,4th sol.</td>
<td>5,10/22,3/12,2</td>
<td>RODENT</td>
</tr>
<tr>
<td>p.250,5th sol.</td>
<td>5,3/6,10/12,3</td>
<td></td>
</tr>
<tr>
<td>p.250,1st sol.</td>
<td>5,10/6,3/12,3</td>
<td></td>
</tr>
</tbody>
</table>

ZERONE, a trade name for an antifreeze, can be used to fill in the blank below REZONE.
Using the consonantal method of creating mnemonics for six-piece burr puzzle solutions, far more can be accomplished. I assigned consonants to 20 of the 25 different burr types (omitting only 10, 16, 17, 20 and 21 in Cutler's notation) according to the following:

1-D, 2-T, 3-S, 4-C, 5-L, 6-N, 7-V, 8-W, 9-F, 11-Q, 12-R, 13-K, 14-G, 15-H, 18-X, 19-B, 22-M, 23-P, 24-J and 25-Z. Note that in the burr puzzle the consonant assignments can be written on the burrs themselves, making it unnecessary to memorize this table. This assignment led to two-word mnemonic phrases for 146 burr assemblies, far more than one is likely to commit to memory. However, the vivid imagery used would certainly make it easy to remember smaller lists corresponding to subsets of the burrs, such as the "Professor Puzzle".

In the list of mnemonics given below, ones on the same line correspond to six-piece burrs using the same pieces; the consonants have merely been permuted in the phrases.

- DuBiouS SeeSaW
- BeERS' SuDS
- aSSeS FIxEd
- CaGeS DeSK
- FaCaDe KiSS
- FaCeD BeSS
- CheeSe KuDoS
- SaND SluG
- BoLD SoNS, BaNAL SeaSiDe
- SoLD SeRuM, iSRaeLi MaidS, MoDeL SeRuM
- SWiM Lads, SoLiD SWiM, DooMS oWLS
- HoUND SeaLS
- SeaFoOd JaiLs
- DoZeN SaFeS
- PRuNe SeeSaW, DeSiRe SPooN, DiPS NuRSe
- PaNSy WeeDS, SaND SwaP, PaD's NeW
- SKIP JuDaiCa, Jack SpeD
- PaGoDa eSKiMo
- DuCK SPuMe
- eCZeMa DeSK, SkiM ZoDiaC
- MaNly LoaDS, LLaMa DeNS
- NooNDay PaLs, PlaIN uNDieS
- MaPS FaKeD, FuMeS PeaKeD, SuMP FaKeD
- SeaFoOd BuMPl, FaMeD BioPsy, FoPS eMBeD
- PyGMy DiKeS
- PoDiuM HookS, PoKeD ShaMe
- DeSK BuMPl
- KeMP JeePeD
- aMaZeD MaKeuP
- aTtiC CuRRy
- STaGe CaReEr, GreaSe CaRT
- ChaiR ReST, CaesAR HurT
- LaRge CouNTy, eLiCIT aNGeR
- TRiM CuRL
- LaTiN RoaCH, HoRn CuLT
- oRNeRy TaPioCa

MouTH PR,
PoeTRy Re
Maps FaW
FocuS SaW
SoNw CoLo
RaIsIN CeR
HuGe RoS
arRoW CaT
Bob'S CoR
KoReaN Co
ReLeaSe Pe
uRw
oRAnGe Su
MeReLy In
SeWeR Ra
MoBiLe CI
FieRCE FI
PaNiC FI
PuMiCe Fi
WackY Ru
QuOrum Pr
GeNiAal Ho
aLaRM Ho
RIng NePa
PRiMe Lo	
FLOw Ma
aTTiC Ca
StooGe CI
DoTs Tou
SoCIal De
aSSeT Ta
PaGed To
TaPed TH
TiBeT Da
SeaSiDe a
cows Sta
GaGS Stc
ouTDoeS St
Bob'S STo
Bed5 Goa
Shoed Be
SaLaD au
CuKoo o
yuleTiDe a
MoISST De
SLiMy Bi
aNTS GaF
DeaTH Na
BiPEd Te
SweeT Du
MoST Ra
CaMP Da
for six-piece
I assigned
1, 2, 3-K,
Note that in
written on the
this table.
for 146 burr
to memory.
ake it easy
of the burrs,
the same line
the same consonants

MouTH PRayeR
PoetRy ReGiMe
MaPS FaVoR, SPaM FeVeR, FoP'S MoVeR
FoCuS SaVeR
SNoW CoLoR, SLoW CoRN
RaieSiN CeReAl, CLean eRaSeR
HuGeR RoSeS, GReaSy HoRSe, HeaRS GeySeR
aRRow CaSeS
BoB'S CoRK
KoReaN CoPyBoy
ReLeaSe HiNge, oRaNGe SHAle, SiNG HouRLy, HuRL SiGN,
uReaL SiGH, GReeN SHAle
oRaNGe SPEar, uNRiPe GoRse, SPRay RaNGe
MeReLy iRiSH, RuSH MuRaL, SMiLe HaRRy
SweePe RAMP, aRRow MaPS, SuMP WoRRy
MoBiLe CREeK
FiReCe FlaMe
PaNiC oFFeR
PuMBe FaIrWay
WaCKy RuMP
QuoRum PaCiFy
GeNiAL HeLEn, LoNELy eNOuGH
aLaRM HeLEn, REaLLy HuMaN
RiNg NEpAL, eNErGY PaNEl
PriMe LoaNer, RoMaN aPRil, LuNaR RAMP
PLOW MaNuRe, PaWN MoLaR
aTTiC CaDeT
STooGe CiTeD
DoTS TouCH
SuCiDe BeTTy
aSSEt TaXeD
PaGeD ToTEm
TaPeD TheMe
TiBeT DAMP
SeaSiDe aCToR
CoWS StayeD
GaGS STeeD
ouTDoeS SHAH
BoB'S SUtDiuO
BeDS GoaTS
ShoeD BeaST
SaLaD auCTiOn, TiLeD CaSiNo
CuCKoo ouTSiDe
yuleTiDe SHAm, MiDaS HoTeL
MoiST DeLuGe
SLiMy BiDeT, BoSoM LoCTeD
aNTS GaPeD, PaGAN ToaDS
DeaTH NaPS
BiPeD TEneS, PouND TuBeS
SWeeT DuMP, DaYtiMe WaSP, PaWS MaTeD
MoST RaPiD, TRiM PaDS, TRaDe MoPS
CaMP DaKoTa, PaCK TaMeD
N,BouDoiR, Nablona, BuRP, Berry, iSoN, BuSieR, BuTT, CauCuS, r, CoDeS, CaDeT, HaP, CHair, aP, CoLoR, a, CoMeS, CoMeT, aRY, CaNS, N, CRoP, SaR, CaSeS, CoST, CaTTy

DDiTy, DeFeA, DeW, DoN DaNCe, DaNDy, DyiNG, DiNaM, DoNkey, DeNiAl, DyNaNY, DiNeR, DeNSe, DeNT
DeF DuPeD, DePloy, DeePeN, DiaPeR, DePoSe, aDoPT, DePw
DeaR DRaB, DreaD, DrAG, DaRK, DeRail, DreaM, DroNe, DroP, DriE, DaReS, DaRT, DraW
DieS DiSoBey, DiSC, DoSeD, DoSaGe, DaSH, DeSK, DiSmay, DeSiRe, DiSeaSe, DuST
DoT DoDiToC, DaTeD, DoTaGe, DeaTH, DaTeL, DaYTiMe, eDiToN, DeToUR, DoTS, DiTTo, DeW DoWdy, DoNeL, DoWry, DoWS

FiB FaBLE, FaBiaN, FiBeR, FoBS
FiCe FaCaDe, FiCHu, FuCK, FaCiAl, FoCuS, FaCT
FaDe FaDeD, FuDGe, FeuDal, FeDoRa, FaDeS
oFF oFFiCe, eFFiCy, oFFal, aFFaIr, eFFuSe, FiTty
FoG FoCGy, FeiGh, FiGuRe, FoGS, FaGoT
FaKe FaKeD, FaKiR, FaKeS
FeEL FleeCE, FiELD, FLAC, FiLuKe, FaLL, FiLm, FiLeNi, FLaP, FiLoor, FaLSe, FaULT, FLaW

FaMe FaMed, FaMiLy, FaMiNe, FeMuR, FaMouS
FuN FuCe, FouND, FaNg, FaNC, FiNaL, FiNN, FiNeRy, FiNeS, FaINT
FoP FoPS
FiRe FoRce, FiRiDay, FiROG, FiROk, FiRaiL, FoRM, FeRuRY, FiRiouS, FoRT, FiRiWay
FuSe FiSaCO, FuSeD, FiSH, FuSeR, FuSS, FeaST
FoOT FaTeD, FaTiCue, FaITH, FaTaL, FaTiMa, oFteN, FuTuRe, FeTuS, FaTTY
FeW FoWL, FaWN, FeWeR

GaB GaBBy, GiBeD, GiBeS, GiBeS
GaD GiDDy, GoDLY, GiDoN, GiDeR, GiDeS, GoDoT
GoO GoOPeD, GaFFE, CooFS, GiFT
GaG eGeDeD, GiColo, GeLiGeR, GaGS
GHee GHoul, GHAna, eIGHT
GeeK GeeKS
GaLe GloBe, GaLeLiC, GoLD, GoLoGy, GuLL, GLuM, GLeN, GuLP, GLoRY, eAGLeS, GuIlTy, GloW
GaMe GaMed, GaMeLy, GuMMy, GeMiNi, GiMPy, GaMeR, GaMeS, GaMuT
GuB aGeNCY, aGeNdA, GoNG, GuNK, GeNiAl, GNoMe, GeNuINE, iGNoRe, GuNS, GiaNt, GiANW
GaP CaPeD, CuPPy, CaPeR, GyPSy, eCyPT
GaR GaRiB, GaRiCE, GiRiER, GeoRGE, GiReK, GiRL, GeRiM, GiReEN, GiRaPe, GaRiY, GoReS, GiReaT, GiRow
GaS GoOSeD, GaSh, GiOilSM, GiSP, GeYSeR, CueSS, CueST
GaTe GaiTeD, GoTH, GiTeP, GoiTaR, GoaTS, aGiTaTe, GeTaWay
GaWRy, GoWN, GoWeR

HaP, CHair, aP, CoLoR, a, CoMeS, CoMeT, aRY, CaNS, N, CRoP, SaR, CaSeS, CoST, CaTTy

HuB HoBby, HuBeR, HuBS, HaBiT
HiDe HooDeD, HeR, HyDRO, HiDeS, HiDeouT, HeaDWay
HooF HooFeD, HuFF, HeiFeR, HoOPS, HeFty
HoC HiGH, HuGeLy, HyGieNe, HuGeR, HoGS
HaHN
HoLe HoLiDay, HalF, HuLK, HeLL, HeLiUM, HeLeN, HeLP, HeaLer, HeeLS, HaLT
HoMe oHMic, HiMiD, HoMaGe, HoMeLy, HaMM, HuMaN, HuMP, HuMoR, HuMuS, HayMoW
HeN HeNeC, HaND, HaNG, HoN, HeNHa, HeNry, HeNy, HaNNT
HiP HooPeD, HoPLa, HaPpy, HyPeR, HeaPS, HyPaTiA
HeaR HeeRB, HeeRoIc, HaRD, HeeRoF, HaRK, HuRL, HaRM, HoRN, HaRP, HaRry, HoRSe, HeaRT
HoSe HoSeD, HaSH, HuSKy, HaSP, HoSiEy, HuSeS, HoST

e, aDiMiT
Most Word Ways readers are no doubt familiar with short lists of words showing the British and American equivalents for a common object (lorry/truck, petrol/gas, spanner/wrench, chemist/drugstore, char/maid). In a book with the above title, Norman W. Schur has identified nearly five thousand Briticisms ("words, idioms or phrases characteristic of or restricted to British English, especially as compared to American English") in three major categories:

1. words used to mean different things in America and England (bomb = "dazzling success" in Britain, "dismal flop" in America)
2. words used in England but not in America (hoarding = "billboard," dustman = "garbage man")
3. words which do not have American referents (beefeater, during hours, Oxbridge)

Entries range from one-line definitions to essays of a half-page or more, giving synonyms, etymology, etc. (see the delightful discussions accompanying loo, porlock, swan upping, twinned with, codswallop, fanny). This is the most comprehensive treatment of the subject available, and deserves to be on every Anglophile's bookshelf, whether or not he plans to converse with the natives. This edition was published by Facts on File in 1987 for $35.