The idea of milking chains by overlapping words is due to H. E. Dudeney, and is probably a follow-on of Lewis Carroll's word ladders. Dudeney used words of uniform length and constant overlap. Christopher McManus introduced Word Ways readers in November 1990 to Ana-Gram-Mar (AGM) chains, ones in which the word length may vary, but there is always single overlap (each letter appears in exactly two words); house-man-slaughter-house, gosspol-yester-morning-tide-water. In the May 1991 Word Ways, Ross Eckler called the Dudeney chains directed word chains and introduced notation for word length and degree of overlap. However, it is misleading to restrict the term directed word chains to only those having words of fixed length; AGM chains are directed as well. It is more useful to regard AGM chains as a special case of directed word chains. In three articles beginning in August 1991, I explored AGM chains. I call word parts frags; sometimes frags are words, sometimes not. Most of my work has been with (8,4) chains, such as tops-oils-kins-folk. In this article I consider directed word chains with words of uniform length (some are AGMs).

My database is mostly Websterian. My lists are about one-and-one-half times as long as the Official Scrabble Players Dictionary (my initial source), but short of Web 2 and Web 3. All words are lower case. A nice feature of these chains is that although many include words that are not common today, their meaning is apparent. My lists are restricted to lower case words as a consequence of my start with the OSPD.

Chains were devised by hand, but with the mule work done by computer. I used BASIC programs to create special lists and the standard WORDPERFECT search program to develop chains. A word processor in conjunction with BASIC is a most powerful tool.

Nine-Letter Ana-Gram-Mar Chains

There are different ways to chain words containing an odd number of letters. In the following chains of nine-letter words, frag lengths alternate 4-5-4-5-. My first step in boiling 26,300 nine-letter words down to a useful set was to collect and sort four- and five-letter beginning and ending frags. There were 7400 (4100) different four-letter beginnings (endings), and 13800 (9300) different five-letter beginnings (endings). Later steps selected words in which the left frag of length n was found in the list of right frags of length n, and the right frag of length 9-n was found in the list of left frags of length 9-n. The process was repeated several times to condense the resultant to core words. Two classes of words resulted, splitting 5-4 and 4-5; a few words appeared in both classes.

In the following heads, rain start, both chains paths between head-stone-walls and loud-mouth-pan.

Here and there, both paths between loud-mouth-pan and head-stone-walls.

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due to H. E. Carroll's word constant over­
erators in Novem­
which the word
p (each letter
house, gossy­
·d Ways, Ross
ins and intro­
~lap. However,
~ha
ins to only
::-e directed as
pecial case
Lng 10 August
:; sometimes
~le
I consider
me are AGMs).
bout one-and­
ers Dictionary
3. All words
that although
their 	 meaning
words as a
lile work done
al lists and
lop chains. A
owerful tool.

in both classes.

in the following chains, note the separate usage of head and
heads, rain and rains, etc. Note the use of overtrain and down­
start, both divided two ways. No effort was made to find minimum
paths between end words.

here-under-draw-downs-start-woman-head-water-buck-brush-fire-break-down­
start-ling-berry-bush-goats-kins-woman (note ring on woman)
video-disc-overt-rain-work-horse-back-cross-over-train-sick-rooms-
head-stone-wall-paper-back-stage-hand
rains-torm-enter-mete-yards-tick-birds
loud-mouth-part-ridge-bone-heads

lord-birds-eyes-train | root-stock-pots-hards-hell-pound-fish
fire-break | ster-coral
wise-crack | down-throw
hand-shake | wood-chuck-ling-berry-bush-goats-kins-woman

	est-cross-over | night-wear-isome-tric-homes-tall-grass---------work


green-head | heads-tone | block-head-skims | boat
grass-fire | water-skin | flint-wood | chuck-full-mouth-pipe-dream


dream-tide | tight-wire | cocks-wain-scoots | land


Nine-Letter Words, One-Letter Overlap

(M,n) chains use words of length m, each of which overlaps
the previous by n letters. In the simple case, m and n are chosen
so that the third word begins at the end of the first. However,
when m is odd and n = (m+1)/2, there is one-letter secondary
overlap. Eckler exhibits a network of interlocking (3,2) chains
in the May 1991 Word Ways. Here, I construct (9,5) chains. The
set of words useful for this kind of chain (obtained by procedures
analogous to the ones described previousl y) is almost as large
as the previous one, but the words are not as well-connected.
The following are the longest chains I can make. This type of
chain is more appropriate for short words, but nine-letter words
make good puzzles.

railroads trichomes thousands eleganter
roadstead homestall sandsoaps anterooms
steadily stallions soapstone roomstead
dyingness lionships stoneface steadiest
shipshape diestrous shapeless
trousered

Eight-Letter Words, Secondary Overlap

With (m,n) chains, if m is even and n = 1+(m/2), we have two­
letter secondary overlap. There is not much in the way of length
in the following (8,5) chains, but these also make good puzzles.
displace subhuman madwoman citharas confines placement humanest womanise harasses finespun cementer anestric anised assessor espundia entering stricter seedsmen essorant undialed chasuble eringoes icterode sublease erodents accouetre madoquas leaseman profiles accoutre madoquas semantic filespec reaching assassin anticked especial chingnas assinego

Seven-Letter Words, Secondary Overlap

Here is an introduction to the (7,4) chain. Now the game gets interesting!

rusalka isotoch alkalis unscrew tachist alismas crewels histrio mascher welsher trinonym antonym fiurama sheriff onymous onymize marabou riffles mousine singeing aboullic flesher bundist constat roother disturb gelidly descent statant thereto turbeth centric tantric retours bethumb carcass tricorn tricars ourself humbugs cassava cornett carsick selfish bugshas savanna netting sickness fishing shastra annatta tinged kinging hinging strains attains gledged gingall ainsell looting louting tinging

Six-Letter Words, Secondary Overlap

Here are (6,4) chains. Six seems to be the best length for this. These are well-enough connected to allow branching, but I have not found closed loops or enough joins to identify a core (it's close). Analysis of a slightly-larger database should prove useful.

niacin batata brenne acinar tatami incubi ennewe mach tamise cubist newest archil misere bistro westar replan chilli serene stroke stares planch illite renest rokete areste anchor litera nester ketene esteem choral teraph steric tenere teemer orally raphae ericas nereis emerod allyic phaeic icasms reises erodes

Chaining Words of Mixed Length

Neither eight- nor nine-letter words produced long chains with secondary overlap, so here are chains using eight- and nine-letter words together:

cuterebra rebrench ranch chaur

Puzzle 1

Fill the blank ping words (any length - 1. cock- 2. brain 3. ship 4. trans 5. paper 6. ball-

Puzzle 2

Provide extent to produce two of the longer thing answered by mon is answered by are neither A

case.

Answers can be issue.
THE GAME GETS ENDING

In the game getting gingly, cassava attains assassin, but I have a core which proves useful.

**Puzzle 1**

Fill the blank with one word so as to make two more overlapping words (i.e., a four-link AGM chain). The filler may be of any length — the longer, the better.

1. cock- -fatter  7. ship- -worm
2. brain- -power  8. show- -pieces
3. ship- -craft  9. cross- -talk
4. trans- -dress  10. sheep- -breeder
5. papers- -eller  11. corn- -picker
6. ball- -head  12. hand- -spring

**Puzzle 2**

Provide extensions in both directions from the following so as to produce two overlapping words. The longer the overlap, and the longer the words, the better. For example, -ignoratio- is answered by monsignor and rationale, which overlap at R; -hatcheck- is answered by nuthatch and checkout, which overlap at CH. These are neither AGM chains nor directed word chains, but a more general case.

- blastular- -pediatric- -semester-
- wheatears- -podiatric- -spacemen-
- downswing- -damascene- -turnover-
- frontally- -sighthole- -rillocks-
- desisting- -sovereign- -clothing-
- novelette- -archenemy- -commando-
- majorette- -outreach- -billions-
- tempress- -mentally-

Answers can be found in Answers and Solutions at the end of this issue.