In past Word Ways issues, I have explored (Carrollian) word networks (Feb, May, Aug 1989), insertion-deletion networks (Aug 1990) and directed word chain networks (Aug, Nov 1991); I now study substitute-letter transposition (SLT) networks. As defined by Dmitri Borgmann, a SLT is constructed by substituting a different letter in a word (as ASPEN to ACPEN) and rearranging the result to form another word (ACPEN to PECAN). A SLT network is a messy tangle; I chose instead to study the SLT network formed of words containing all different letters (non-pattern words, or isograms). As a bonus, isograms yield Baltimore transdeletions and pangrammatic chains which are described below.

Recently the editor sent me a floppy disk of boldface words in Webster's Second Edition. I extracted the lower case words, created plurals of a few and added it all to my database (mostly Official Scrabble Players Dictionary) words. With a few inclusions from Webster's Third Edition and Chambers Twentieth Century Dictionary, my data base (for words of nine or more) is summarized in the table below. The final column gives the number of different isograms after eliminating words that are transpositions of other words, keeping only the first word in each transposition set.

<table>
<thead>
<tr>
<th>Size</th>
<th>Words</th>
<th>Isograms</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>47400</td>
<td>5482</td>
</tr>
<tr>
<td>10</td>
<td>40000</td>
<td>2704</td>
</tr>
<tr>
<td>11</td>
<td>29900</td>
<td>892</td>
</tr>
<tr>
<td>12</td>
<td>23500</td>
<td>245</td>
</tr>
<tr>
<td>13</td>
<td>16800</td>
<td>52</td>
</tr>
<tr>
<td>14</td>
<td>11600</td>
<td>12</td>
</tr>
<tr>
<td>15</td>
<td>7100</td>
<td>1</td>
</tr>
</tbody>
</table>

Ten-Letter SLT Networks Of 2493 ten-letter isograms, 54 join (SLT to) CLARIONETS. Four isograms are eight steps away from it; the network on the next page joins these four far-out words. The span of the entire 2215-word main network is 15 (LACKEYDOMS or CHOKEDAMPS to FADMONGERS). Of the 277 words not in main, 220 are isolanos and 57 are in small nets. Those with more than two words are given at the right on the next page. A few odd joins in the main SLT network: EARTHLINGS to NIGHTMARES, AUTOSEXING to EXHAUSTING, POSTCLIMAX to COMPLAINTS.

Three minimum-length pangrammatic chains (all part of the main network, of course) are also given on the next page. All words can be found in Webster's Second.
fadmongery—FADMONGERS consumedly
daemonurgy confusedly CAL.
dutymonger unforcedly
gynemotus underbacks
germanious—augmentors—morganites
angiosperm neckguards
porcelains— impersonal—neuropasm
cliptonets ravenducks
interclack permutably—presumably
carchy abruptly
starchlike abruptly
gymmatrism unrightable
OB DURATELY unsinkable
shrinkable bowmakers
hacksilber blackmores
backslider—blockaders
breakdowns—breaks
SCOWBCKER WINDS

CHOKE DAMPS—shackledom—LACKEDOMS

coadjutrix underflows overbuilds
judicatory Y underboils B underboils N
jocularity L underboils I brodequins Q
oscularity S brodequins Q boundaries A
security E boundaries A xenosaurid X
lacquerist Q disenamour M resudation T
revictuals V randomizes Z designator G
lubricates B dragonizes G dragonizes Z
brutalizes Z jargonized J jargonizes J
subretinal N jeoparding P morganizes M
neutralism M pignorated T promazines P
unstarlike K overdating V womanizes W
plastering C overtaking X harmonizes H
integrals H overhating H freshmanic F
spacewright W athrogenic C chrysamine Y
whigrafts F athrogenic C hackneiyk K

Eleven-Letter SLT Networks Eliminating 34 transpositions from 892 isograms of length eleven leaves a working list of 858: 642 in the main network, 173 isolanos, and the remaining 43 forming small groups. Thirty words join ULCERATIONS directly; the span of the network is 14 (KITCHENWARD to HYPERBOLISM or PUBOVESICAL—CAL). At the long, I have
classical chain
cal chiral words able to work
CONJUGAL?
don’t make
WARDS, JAC

Twelve-Letter main networks and the main network MAOSE to end the separate hope for the main
V, W, F are

compulsively
deutoplasm
pseudomantic
consideratur

humboldtine
bleachground
chloride
lexicograph
blacktongue
bluestocking
ticklenburg
CAL. At the right are the largest separate chains, all three links long. I have been unable to construct a minimum-length pangrammatic chain; the two below use every letter but J. There are several words containing J in the main network, but I haven't been able to work them in. The chain on the right, the shortest between CONJUGALITY and CONJUGATIVE, gives a clue as to why J-words don't make it in the minimum-length chain. JUXTAPOSING, JUNGLEWARDS, JACKLIGHTER, LUMBERJACKS and JACQUEMINOT are isolanos.

Twelve-Letter SLT Networks Of the 241 isograms, 107 are in the main network and 80 are isolanos. Three (CULTERANISMO, MALERUPTIONS and RECOMPLAINTS) have eight joins each. A portion of the main network is given below. The span of 13 is from PHYTALBUMOSE to either HUMBOLTINES or OUTFIELDSMAN. It is followed by the separate nets and the four transposition pairs. There is no hope for a minimum-length pangrammatic chain, but the portion of the main network shown includes all letters but Q. The letters V, W, F and K are almost as rare here as X and Z.
incomputable=uncompatible
dasyproctine=trypanocides
uncomputably=uncompatibly
amylopectins=polysemantic

**Thirteen-Letter SLT Networks**  
Partly by adding S to some of the twelve-letter words, I managed to find 52 isograms of size thirteen. None are transpositions of one another; 22 are in the main network, 26 are isolanos and the remaining four form two simple chains.

- salpingectomy
- endolymphatic--physicomental--lycanthropies--lycanthropize
- hemidactylous--hydroclimates--hypsometrical--embryoplastic
- musicotherapy
- sulphozincate--courtezanship--unatmospheric--turbomachines
- pervulgations--postneuralgic--pneumogastric--uncompahgrite
dentsosurgical
bleachgrounds--chloroguanides--declinographs
brachydontism--tymanichords
philaceous--sulphocyanide

**Fourteen-Letter and Larger SLT Networks**  
I have only twelve isograms of length fourteen. There are two joins: lycanthropized--lycanthropizes and sulphogermanic--uncompahgrites. There is only one size-fifteen isogram: DERMATOGLYPHICS. Borgmann went on to isograms of size twenty; his UNCOPYRIGHTABLE seems all right, but his ground is a bit shaky above that.

**SLT Clusters**  
A set of isograms that derive from the different possible transdeletions of a word form a SLT cluster; the same is true for the results of transaddition. If a word of length \( n \) can be transdeleted to \( n \) different words, each with a different letter removed, the result is known as a Baltimore transdeletion. Of my 2493 ten-letter isograms, 1888 can be transdeleted to at least one nine-letter isogram. Three words have Baltimore transdeletions, plus two "almosts" which *Word Ways* readers might be able to complete (as was done for John Holgate's work in the February 1989 *Word Ways*).

- clarionets: serotinal, ostrarine, sterolin, coastline, consertal, clarinet, sarcolite, contrails, acroleins, crotaline
- nucleators: colatures, consertal, outlearns, nectarous, calutrons, consultant, senocular, translude, consolate, recontual
- rediscant: seduction, inducers, courtside, construed, reduction, unstoryed, incrusted, centroids, countries, decurations
- ulceration: clarionet, cautioner, outlinear, larcuration, inoculate, cornulite, aluernic, nucleator, centurial
- postmedian: dominates, pedantism, tamponed, dopamines, pintadoes, ptomaines, stonedamp, piedmonts, (postmedia)

Here are some companion transadditions; the ideal would have 26 - 9 = 17 transadditions, using all the remaining letters in turn.

- crotaline: clarionets, centroidal, francolite, chlorinate, pratincol, melicratan, ulceration, inter vocal, intercoxal, lectionary, relocating

**Back To Netwl**

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ostracine: clarcremations, nercotinal, raptantipoles, trapesing: into departings, plus the
Back To Networks  Note that some words appear in several different SLT clusters; SLT networks of different word sizes can join each other to form a hypernet. (Kyle Corbin hints at this in his May 1989 Word Ways article.) Unfortunately, my attempts at drawing a hypernet produced a horrible tangle. Here are some SLT clusters organized so that some of the hypernet is evident.

Back To Networks  Note that some words appear in several different SLT clusters; SLT networks of different word sizes can join each other to form a hypernet. (Kyle Corbin hints at this in his May 1989 Word Ways article.) Unfortunately, my attempts at drawing a hypernet produced a horrible tangle. Here are some SLT clusters organized so that some of the hypernet is evident.

uncompahgrites: unatmospheric: euchromatins
lycanthropizes: lycanthropies: cheiroplasty, hyperactions, lycanthropes
hypsometrical: cheiroplasty

turbomachines: euchromatins, turbomachine, bimucronates

pervulgations: pervulgation, pulverations

salpingectomy: polysemantic

physiocentral: polysemantic

cheiroplasty: spirochetal, rhyacolites, physiolater, polyarchist

recomplaints: postmineral, complainers, reclalmant, inspecposition, centropers

maleruptions: postmineral, maleruption, tourmalines, superlation

metrosalpinx: postmineral, spermatoxin

neuroblastic: ulcerations, inscrutable, construable, subrelation

countervails: ulcerations, couniversal, involucrate, novaculites

culteranism: ulcerations, neuromastic, euchromatin

consideratum: desucration, neuromastic, endostracum, semirotunda

hyperactions: neophrastic, hyperaction, acetopyrrins, hypertonias, psychotrine

phantomizers: phantomizer, misanthrope

lycanthropes: lycanthrope, hyposternal

spirochetal: sarcophile, proethical, phacolites, spirocheta, carpolites, aphrolites, strophical, splotchier

postmineral: meliorants, impersonal, intemporal, reimplants, prestomial, rantipoles, spermatation
tourmalines: meliorants, tourmaline, emulations, trimensual, uranolites, luminators

misanthrope: morphinate, morphiates, opisthenar, matronship, spermation, mentorship

inspectoratal: clarionets, psiloceran, praticole, pleonastic, interclasp, carpolites, recaptions, rantipoles

neuromastic: cremations, nectarium, nucronates, sanctorium, cautioners

ulcerations: clarionets, isonuclear, insuscitile, lacustrine, cautioners, nucleiators, uranolites, luracations, uncloister, ulceration

The capitalized Webster's Second word RETICULOSA added to the last, plus the coined UNEROTICAL, makes a Baltimore transdeletion.