

APPENDIX III

(Workpaper referred to in course of Text)

"AGRICOLA INCURVO TERRAM DIMOVIT ARATRO"

(Virgil, "Georgics")

First Stage Translation

into English

with the aid of

Roget's Thesaurus

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The Cambridge Language Research Unit  
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Carried out in  
November 1957  
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OUTLINE OF A THESAURUS-USING TRANSLATION PROGRAMME

(Latin to English)

Using Roget's Thesaurus, Penguin Edition

The essential feature of this programme, is the use of a thesaurus as an interlingua: the translation operations are carried out on a head\* language into which the input text is transformed and from which an output is obtained. These operations are of three kinds: semantic, syntactic and grammatical.

The general arrangement of the programme is as follows:

- I. Dictionary matching: the chunks of the input language are matched with the entries in a Latin-Interlingual Dictionary giving the raw material of head language; this consists of heads representing the semantic, syntactic and grammatical elements of the input.
- II. Operations on the semantic heads: these give a first stage translation.
- III. Operations on the syntactic heads: giving a syntactically complete, though unparsed, translation.
- IV. Operations on the grammatical heads: giving a parsed and correctly ordered output.
- V. Cleaning up operations: The output is "trimmed" by e.g. insertion of capital letters, removal of repetitions like "farmer-er".

This programme is based partly on an interlingual translation programme by R.H. Richens published in July, 1957 as a workpaper of the C.L.R.U. entitled The Thirteen Steps; partly on a thesaurus-using translation procedure by Margaret Masterman, from a paper entitled Potentialities of a Mechanical Thesaurus, read at the 2nd International Conference on Machine Translation (M.I.T. Octo. 17th, 1956);

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\* The notion of "heads" is taken from the concepts of topics under which Roget classified words in his thesaurus.

and partly on a library retrieval procedure making use of a thesaurus by T. Joyce and R.M. Needham described in a C.L.R.U. workpaper entitled The Thesaurus Approach to Information Retrieval.

Only Stage II of the procedure is given in detail here.

INFORMATION OBTAINED FROM STAGE I

The Latin sentence to be translated was chunked as follows:

AGRI-COL-A INCURV-O TERR-AM DI-MOV-IT AR-ATRO

A number of these generated syntactic heads only. Those with semantic head entries are AGRI- -COL- IN- CURV- TERR- DI- -MOV- AR-.

The interlingual dictionary entries, for each chunk were constructed by a transformation into thesaurus heads of the information given in Lewis' "Latin Dictionary for Schools" for all words containing the chunk in question. This can be followed by comparing the semantic head sets and the dictionary entries taken from Lewis' Dictionary given overleaf.

SAMPLE HEAD SETS CORRESPONDING  
WITH LEWIS' DICTIONARY ENTRIES  
FROM WHICH THEY WERE MADE.

AGRI-

- 181 REGION  
189 ABODE  
371 AGRICULTURE  
780 PROPERTY

ager, agri, ... [L. 1 AG; cf. Germ. Acker, Engl. acre].  
I. In a restricted sense, improved or productive land, a  
field, farm, estate, arable land, pasture, etc.: agrum hunc  
moronius amat, T. Heaut. 146: ager quantum fertilia,  
sive cultura fructuosus esse non potest, Theoc. 2, 13: sibi  
praeter agri solum nihil esse reliqui, the bare ground,  
1, 11, 5: in agro colendo vivere, Hor. 26: patris agrus  
fandere carmina, H. 1, 1, 12: conserere, V. E. 1, 78: of a  
vineyard, V. 11, 2, 6: revolvit agri terminas, of an es-  
tate, H. 2, 18, 24: situs agri, of the farm, H. E. 1, 14, 4.  
—II. In an extended sense. A. Territory, district, do-  
main, the soil belonging to a community (syn.: terra, tellus,  
arvum, solum, rus, hausa). 1. In gen.: ut melior fan-  
dus Hirpinus sit, sive ager Hirpinus (totum unum pos-  
sides), quam, etc., Agr. 2, 2: ager Herbitensis habet  
arvum (X'Li), 2 Ferr. 3, 12: Rhenus, qui agrum Helve-  
tium a Germania dividit, 1, 2, 3: Noricus, 1, 5, 4: in agro  
Troada, N. Fov. 3, 3: in agro Arctio, M. C. 24, 1: his  
civitas data agerque, L. 2, 16, 4: ager Apollinis, the domain  
of Apollo's temple in Patara, V. 12, 516.—2. Esp.: ager  
Romanus, the Roman possessions in land (opp. ager pere-  
grinus, foreign territory), including ager publicus, public  
property, domain, and ager privatus, private estate: quan-  
tum ager cum esset publicus populi Romani factus, 2  
Ferr. 2, 12: privatus agros publicos pecunia colere, Agr.  
2, 22.—B. Plur. agri (post also in sing.), the fields, the open  
country, the country (= rus, opp. urbs, in prose): neque  
agri neque urbis odium, T. Heut. 973: homines ex agris  
concurrunt, 2 Ferr. 4, 26: non solum ex urbe, sed etiam  
ex agris, Oct. 2, 8: vastati agri sunt, urbs exhausta, L. 2,  
22, 2: per agros perque vias, O. 4, 779: domus longae quae  
prospicit agrus, H. E. 1, 10, 25.—Aut of distance, in ag-  
rum, backward, in dypti: mille pedes in fronte, trescentos  
in agrum dare, H. E. 1, 2, 12.—C. Poet (opp. montes,  
collis, L. 10, 2, 8): montes agrisque salutas, O. 2, 25.

3. agricola, ae, m. [ager + R. GEL-]. I. Prop. a  
landowner, agriculturist, planter, farmer, peasant: cul-  
tural, Ros. 47: diligentissimus, Deul. 27: indomitus, V. 7,  
231: agricolam hunc hinc parum, H. E. 1, 2, 8: fortunatus,  
V. G. 2, 498: cultor, N. Oct. 2, 1.—II. Praeger, a man-  
tic, boor, clown: et rudent, Ros. 94.

SAMPLE HEAD SETS CORRESPONDING  
WITH LEWIS' DICTIONARY ENTRIES  
FROM WHICH THEY WERE MADE.

TERR- (1)

- 181 REGION
- 211 BASE
- 318 WORLD
- 342 LAND
- 673 PREPARATION

TERR- (2)

- 668 WARNING
- 669 ALARM
- 378 PAIN
- 860 FEAR
- 887
- BLUSTERER

*terra, s. f. (s. v. terra). I Prop. A. In gen. de  
terra (cf. solus): locum in quo habitant, ND. 2, 26:  
unde terra, Rep. 1, 22.—II. Sup. person. ad a gen-  
das, Terra, Maris (cf. Sicilia, Coris, Cyprius): Terra ipse  
sancti et in habitant, ND. 2, 22; O.—II. Meton. A.  
The land (opp. mare, aqua): res investas ex terra, Rep. 2,  
10: Manilla terra ex sibus oppidi partibus mari abluar:  
reliqua quarta est, quae aditum habitas ab terra, Cato, C.  
2, 1, 6: hoc a Vibone Brundisium terra petere, Plana, 98:  
ipse terra eodem parsi, L. 21, 18, 2: ex magna locustas  
terram videtur, Mar. 3: aestivibus terra marique impo-  
nere, by loci sed sic, Pomp. 10: insulas terra marique  
locus, I. Ferr. 2: terra ad mari alandi, 2. Ferr. 2, 4: ho-  
mines terra ex mari mittent, 2. Ferr. 2, 26: et terra et  
mari offensa, 2. Ferr. 5, 101: mari verique bella com-  
muna, Dom. 19: et in mari et in terra, L. 27, 29, 3: et  
mari et terra, N. Har. 1, 2: terra atque veris, S. C. 26, 2:  
natura vis ab his investigata est, ut nulla pars orbis, mari,  
terra (ut postea loquitur) praetermissa sit, Plu. 2, 9.—II.  
The ground, earth (cf. solus). terrae motus, earthquake,  
Dio. 1, 24: quae gignuntur a terra... quae a terra nascuntur*

*terror, s. m. [R. 2 TER, TERB]. I. Great fear,  
afright, dread, alarm, terror (cf. pavor, irradatio, metus):  
definitum terrorem metum concitantem, Tusc. 4, 19: terror  
infectus Caesari de eius actis, Prov. C. 43: terrore, iniecio  
terrore mortis horrescunt, Plu. 6, 21: homines inermes  
terrore periculoque mortis repellere, Cato, 22: si Antonio  
passim Gallia... quantum rei p. terror impendat, Phil.  
2, 27: se non terrorem inferre vobis, Mil. 71: ut quam  
maximum hostibus terrorem inferant, 7, 8, 7: reddidit in-  
latum ambo terrurum, L. 2, 60, 4: terrore committitur, Rep. 2,  
41: se terrori hostibus futurum, 7, 66, 6: qui modo ter-  
rori fuerant, L. 24, 26, 2: tantus terrore incidit exercitui,  
ut, etc., Cato, C. 2, 12, 2: tantus repente terror invasit, ut,  
etc., Cato, C. 1, 14, 1: Romanos auxiliare tyranni in ter-  
rorem ac tumultum commoverunt, L. 24, 26, 2: sic terrore  
oblato a duobus, Cato, C. 1, 76, 5: tantum Romae terrorem  
flore, ut, etc., L. 10, 1, 2: instantem terrorem inno-  
vere patribus, ut, etc., L. 2, 4, 9: si tantus habet metus et  
pavorum terror, V. 11, 367: vulgi pavorum terror habet, O.  
P. 2, 228: terrore pavore, O. P. 4, 271: ingentem Galli  
terrorem memoriae pristinae cladis attulerant, L. 6, 42, 7:  
arcanus terror, secret dread, Ta. G. 40: saepe totius anni  
fractus uno belli terrore amittitur, apprehension of war,  
Pomp. 15: nullum terrorem externum esse, i. e. dread of  
foreign enemies, L. 2, 10, 14: peregrinus terror, L. 2, 10,  
4: terror servilis, ne quis cuius domi hostis esset, dread  
of the slave, L. 2, 10, 2.—II. Meton. A. An object of  
fear, cause of alarm, terror, dread: duabus huius urbis  
terroribus depulsa, Rep. 1, 71: ceteri omnes concubitus  
maritalique terrorem, frightful occurrences, L. 29, 27, 14:  
ingens hostium terror (i. e. obscuro armed with scythes),  
Curt. 4, 2, 4: terrore Macedonum (i. e. elephants), Curt. 4,  
2, 10.—II. Frightful reports, terrible news: non speculatus  
terrorem hosti atque demerit, Att. 2, 26, 2: Hecentius  
mores terrorem ad me attulit, Scamandrus, Septem. Att. 2,  
2, 2: Romanum tanti terrorem esset edidit, ut, etc., L. 2, 42,  
6: abas praecuna terror adfuerat, Scythae adveniens, etc.,  
Curt. 7, 4, 22.—C. Of eloquence, tremendous power: (Pe-  
trilla) vis dicendi terrorem, Brut. 44.*

INTERLINGUAL DICTIONARY

AGRI-

-COL -

-IN-

|                 |                 |                 |
|-----------------|-----------------|-----------------|
| 181 REGION      | 188 INHABITANT  | 54 COMPOSITION  |
| 189 ABODE       | 186 PRESENCE    | 176 TENDENCY    |
| 371 AGRICULTURE | 758 CONSIGNEE   | 221 INTERIORITY |
| 780 PROPERTY    | 371 AGRICULTURE | 232 ENCLOSURE   |
|                 | 342 LAND        | 247 CONVOLUTION |
|                 | 876 COMMONALTY  | 264 MOTION      |
|                 |                 | 259 FURROW      |
|                 |                 | 278 DIRECTION   |
|                 |                 | 286 APPROACH    |
|                 |                 | 294 INGRESS     |
|                 |                 | 300 INSERTION   |

-CURV-

244 ANGULARITY  
245 CURVATURE  
279 DEVIATION

TERR- (1)

181 REGION  
211 BASE  
318 WORLD  
342 LAND  
673 PREPARATION

TERR- (2)

668 WARNING  
669 ALARM  
378 PAIN  
860 FEAR .  
887 BLUSTERER

DI-

44 DISJUNCTION  
49 DECOMPOSITION  
91 BISECTION

-MOV-

371 AGRICULTURE  
61 DERANGED  
140 CHANGE  
264 MOTION  
673 PREPARATION  
615 MOTIVE  
824 EXCITATION  
49 DECOMPOSITION  
44 DISJUNCTION  
259 FURROW

AR- (1)

371 AGRICULTURE  
259 FURROW  
248 CONVOLUTION  
876 COMMONALTY

AR- (2)

340 DRYNESS  
384 CALEFACTION

AR- (3)

1000 TEMPLE  
903 MARRIAGE

DISCURSIVE DESCRIPTION OF THE SET OF OPERATIONS USED  
ON SEMANTIC HEADS; THAT IS, OF STAGE II OF THE TRANS-  
LATION PROCEDURE

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A. Elimination of unwanted heads by intersection:

i) Standard Procedure:

It is assumed that those semantic concepts relevant to the sentence to be translated will occur repeatedly (i.e. at least more than once). Selection of the heads representing those concepts could therefore be obtained by an intersection procedure as follows:

Each member of the head set representing a chunk is matched in turn with all other heads occurring for other chunks in the sentence. Only those occurring twice or more are retained.

ii) Removal of Puns:

This procedure should eliminate puns: a chunk such as TERR- has two completely different sets of uses, represented by completely different sets of heads, only one of which is relevant in a particular context. The unwanted heads will probably fail to occur elsewhere in the sentence so that only the relevant heads representing the appropriate chunk in question are retained.

iii) Scale of Relevance Procedure:

It may happen that all members of the head set for a particular chunk fail to intersect. In this case, we try to find heads in the rest of the sentence which are closely related to the heads in this set. For the present test heads which are within the same bracket in the Table of Contents in Roget's Thesaurus, are regarded as closely related. The procedure is as follows: all the heads occurring in the same bracket of the Table of Contents as those already given for a non-intersecting chunk are introduced; from a practical point of view they are regarded as representing a new chunk in the sentence. The intersection procedure can be carried out as before. If unsuccessful, the manoeuvre can be repeated using bigger brackets in the Table of Contents. It should be noted that the introduction of these new head sets may increase the number of intersections for other chunks in the sentence. After the intersection has been carried out, the

heads retained for the new chunk are amalgamated with those of the chunk which generated it.

We now have for each unit of head language a group of heads which have shown themselves to be relevant to the subject under discussion. Thus for -MOV- we have:

AGRICULTURE  
PREPARATION  
DECOMPOSITION  
DISJUNCTION  
FURROW



LIST OF HEADS IN BRACKETS 'SPECIAL FORM' AND 'MOTION, WITH  
REFERENCE TO DIRECTION' REQUIRED FOR EXTENDED INTERSECTION  
PROCEDURE

SPECIAL FORM

244 ANGULARITY  
245 CURVATURE  
247 CIRCULARITY  
249 ROTUNDITY  
246 STRAIGHTNESS  
248 CONVOLUTION

MOTION WITH REFERENCE TO DIRECTION

278 DIRECTION  
280 PRECESSION  
282 PROGRESSION  
284 PROPULSION  
286 APPROACH  
288 ATTRACTION  
290 CONVERGENCE  
292 ARRIVAL  
294 INGRESS  
296 RECEPTION  
298 FOOD  
300 INSERTION  
302 PASSAGE  
303 OVERSTEP  
305 ASCENT  
307 ELEVATION  
309 LEAP  
311 CIRCUITION  
312 ROTATION  
314 OSCILLATION  
315 AGITATION  
279 DEVIATION  
281 SEQUENCE  
283 REGRESSION  
285 TRACTION  
287 RECESSION  
289 REPULSION  
291 DIVERGENCE  
293 DEPARTURE  
295 EGRESS  
297 EJECTION  
299 EXCRETION  
301 EXTRACTION  
304 SHORTCOMING  
306 DESCENT  
308 DEPRESSION  
310 PLUNGE  
313 EVOLUTION

THE SETS OF HEADS IN HEAD LANGUAGE AFTER THE NON-INTERSECT-  
ING HEADS HAVE BEEN ELIMINATED

|               |                     |              |
|---------------|---------------------|--------------|
| <u>AGRI-</u>  | <u>-COL-</u>        | <u>IN-</u>   |
| REGION        | AGRICULTURE         | CONVOLUTION  |
| AGRICULTURE   | LAND                | FURROW       |
|               | COMMONALTY          | MOTION       |
|               | --                  |              |
| <u>-CURV-</u> | <u>SPECIAL FORM</u> | <u>TERR-</u> |
| ANGULARITY    | ANGULARITY          | REGION       |
| CURVATURE     | CURVATURE           | LAND         |
|               | CONVOLUTION         | PREPARATION  |
| <u>DI-</u>    | <u>-MOV-</u>        | <u>AR-</u>   |
| DISJUNCTION   | AGRICULTURE         | AGRICULTURE  |
| DECOMPOSITION | PREPARATION         | FURROW       |
|               | DECOMPOSITION       | CONVOLUTION  |
|               | DISJUNCTION         | COMMONALTY   |
|               | FURROW              |              |
|               | MOTION              |              |

N.B. The thesaurus has been expanded so as to allow of the insertion of a set of curve-producing tools (of which Roget takes cognisance of only one member, corkscrew) under CONVOLUTION. Roget classifies a plough-share as a cutting-edge; but not as a device for turning over the sod. In fact, ploughs, c.q.r. anchors, etc. are less convoluted than horns, serpents and corkscrews, but more convoluted than horse-shoes, crooks or sickles; and therefore constitute an intermediate head. Lacking courage to construct this, we have classed them under CONVOLUTION.

The introduction of SPECIAL FORM is due to the failure of -CURV- to intersect with any of the other words. We therefore introduce, as a new chunk all the other heads in the bracket titled 'SPECIAL FORM' which includes ANGULARITY and "CURVATURE" given by -CURV-. We can then obtain our intersections. The bracket titled MOTION, with reference to DIRECTION was also introduced as it includes DEVIATION which is also given by -CURV-. This did not however result in any intersections and was therefore eliminated.

b) Selection of correct output word from the select head-sets representing each chunk.

Here the actual translation from head language to output language is made. (As the output language is English, the interlingual thesaurus, Roget, can still be used. This need not necessarily be the case.) The procedure is as follows: the contents of each head retained for a chunk are compared in turn with those of all other heads retained for that chunk. Any word which occurs more than twice is retained as output. This output constitutes a first stage semantic translation of the text. (It is obvious that difficulties may occur either if no intersection is obtained, or if there is only one head retained for a word.)

OUTPUT OF SET OF TRANSLATION-INTERSECTIONS TO OBTAIN WORDS OF  
OUTPUT TEXT

(An example in full is given on the next page of a translation between two heads.)

(The notation used below is to be interpreted as follows:

$A \wedge B = C$ ----  $C$  is to be interpreted, "When the list of synonyms given by Roget under the Head  $A$  is compared with the list of synonyms given by Roget under Head  $B$ , the series of words  $C_1$ ---- $C_2$ , which we will call the output, will be found to occur in both lists of synonyms.) The output of these intersections should be referred to any words having the two heads concerned. E. g. Agriculture  $\wedge$  Furrow relates both to -MOV- and AR-.

|                   |                        |   |
|-------------------|------------------------|---|
| 1. Agriculture    | $\wedge$ Region        | = etc, 189                              |
| 2. Agriculture    | $\wedge$ Land          | = Farmer                                |
| 3. Agriculture    | $\wedge$ Commonalty    | = Ploughman, tiller of the soil, rustic |
| 4. Agriculture    | $\wedge$ Furrow        | = Plough                                |
| 5. Agriculture    | $\wedge$ Convolution   | = No output                             |
| 6. Agriculture    | $\wedge$ Preparation   | = Till, cultivate the soil              |
| 7. Agriculture    | $\wedge$ Decomposition | = No output                             |
| 8. Agriculture    | $\wedge$ Disjunction   | = No output                             |
| 9. Agriculture    | $\wedge$ Motion        | = No output                             |
| 10. Land          | $\wedge$ Preparation   | = No output                             |
| 11. Land          | $\wedge$ Commonalty    | = No output                             |
| 12. Land          | $\wedge$ Region        | = Ground, soil                          |
| 13. Region        | $\wedge$ Preparation   | = No output                             |
| 14. Furrow        | $\wedge$ Convolution   | = No output                             |
| 15. Furrow        | $\wedge$ Commonalty    | = No output                             |
| 16. Angularity    | $\wedge$ Curvature     | = Bend, etc. 217                        |
| 17. Angularity    | $\wedge$ Convolution   | = No output                             |
| 18. Curvature     | $\wedge$ Convolution   | = Curl                                  |
| 19. Convolution   | $\wedge$ Commonalty    | = No output                             |
| 20. Disjunction   | $\wedge$ Decomposition | = Disperse, etc. 73, break up           |
| 21. Convolution   | $\wedge$ Motion        | = No output                             |
| 22. Disjunction   | $\wedge$ Preparation   | = No output                             |
| 23. Disjunction   | $\wedge$ Furrow        | = No output                             |
| 24. Disjunction   | $\wedge$ Motion        | = No output                             |
| 25. Decomposition | $\wedge$ Preparation   | = No output                             |
| 26. Decomposition | $\wedge$ Furrow        | = No output                             |
| 27. Decomposition | $\wedge$ Motion        | = No output                             |
| 28. Preparation   | $\wedge$ Furrow        | = No output                             |
| 29. Preparation   | $\wedge$ Motion        | = cultivator, cultivate                 |
| 30. Furrow        | $\wedge$ Motion        | = No output                             |

If two Heads have a common cross reference, this head should be included in the intersection procedure. We now bring down:

73 Dispersion  
 189 Abode  
 217 Obliquity

We then reinsert ABODE in the head-set of AGRI-, (where it once belonged). OBLIQUITY we insert in the Head-sets of -CURV- and SPECIAL FORM, which both contain ANGULARITY and CURVATURE as members); and we insert DISPERSION as an extra head in the Head-sets of DI- and -MOV-, both of which have both DISJUNCTION and DECOMPOSITION as members. We then perform a further set of intersections as follows:

|                 |                    |                                 |
|-----------------|--------------------|---------------------------------|
| 31. Agriculture | $\wedge$ Abode     | = farm                          |
| 32. Region      | $\wedge$ Abode     | = etc. 232                      |
| 33. Angularity  | $\wedge$ Obliquity | = incline, bend, crook, crooked |
| 34. Curvature   | $\wedge$ Obliquity | = bend, crook, etc, 245         |
| 35. Convolution | $\wedge$ Obliquity | = twist                         |

|                  |   |            |   |           |
|------------------|---|------------|---|-----------|
| 37 Decomposition | ^ | Dispersion | = | No output |
| 38. Agriculture  | ^ | Dispersion | = | sow       |
| 39. Preparation  | ^ | Dispersion | = | No output |
| 40. Farrow       | ^ | Dispersion | = | No output |

We now bring down:

44 Disjunction  
232 Enclosure  
245 Curvature

of which we retain only ENCLOSURE, (under AGRI- , since both the others already exist under the relevant heads.)

We thus get the further set of intersections:

|                 |   |           |   |           |
|-----------------|---|-----------|---|-----------|
| 41. Agriculture | ^ | Enclosure | = | No output |
| 42. Abode       | ^ | Enclosure | = | No output |
| 43. Region      | ^ | Enclosure | = | No output |

EXAMPLE OF METHOD OF TRANSLATION INTERSECTION

- 259 Farrow - N. farrow, groove, rut, scratch, streak, stria, crack, score, incision, slit; chamfer, fluting, channel, gutter, trench, ditch, dike, dyke, moat, fosse, trough, kennel; ravine, etc. 198.  
V. furrow etc, n; flute, groove, carve, corrugate, plough, incise, chase, enchase, grave, etch, bite in, cross-hatch.  
Adj. furrowed etc, v; ribbed, striated, fluted; corduroy,
- 371 Agriculture - N, agriculture, cultivation, husbandry, farming, agronomy; georgics; tillage, tilth, gardening, vintage; hort-, arbor-, silv-, vit-, flor-iculture; intensive culture; landscape gardening; forestry, afforestation, husbandman, horticulturist, gardener, florist; agriculturalist; yeoman, farmer, cultivator, tiller of the soil, ploughman, sower, reaper; woodcutter, backwoodsman, forester; vine grower, vintager.  
field, meadow, garden; botanic-, winter-, ornamental-, flower-, kitchen-, market-, hop- garden; nursery; green-, hot-, glass-, house; conservatory, cucumber-, cold-frame, cloche, bed, border; lawn; park etc, 840; parterre, shrubbery, plantation, avenue, arboretum, pinery, orchard; vineyard, vinery orangery; farm etc. 189.  
V. cultivate; till; farm, garden; sow, plant; reap, mow, cut, crop etc. 789; manure, dig, delve, dibble, hoe, plough. harrow, rake, week, lop and top, force, transplant, thin out; bed out, prune, graft.  
Adj. agricultural, -arian, arable; rural, rustic, country, bucolic; horticultural.

The procedure consists in comparing the above sections word by word, from which it will be seen that the common output is plough.

WARNING: The use of hyphens in Roget's Thesaurus is ambiguous, since the constituent words of a hyphenated sequence of words, e.g. set - shoot - up, are not repeated within the same head, even though set, and set up can be synonyms of one another.

In this matter the person operating the thesaurus must use his own judgment.

SEMANTIC TRANSLATION OF THE TEXT

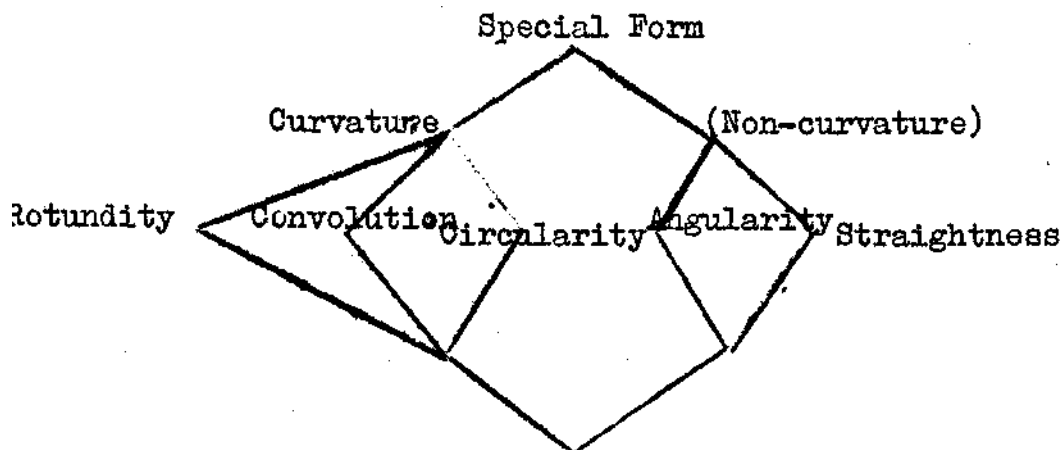
(that is, translation with the syntax unresolved  
with DI- and -MOV- combined and IN- and -CURV-  
combined)

| AGRI-                       | -COL-                                       | INCURV-  | TERR-        |
|-----------------------------|---|--|--------------|
| farm                        | farmer                                      | bend   | ground, soil |
| pen                         | ploughman,<br>tiller of the<br>soil, rustic | incline, bend<br>crook, crooked<br>bend, crook,<br>twist |              |
| DIMOV-                      |   | -AR-   |              |
| plough                      |   | ploughman<br>tiller of the soil                          |              |
| cultivation                 |   | rustic   |              |
| till, cultivate the<br>soil |   | plough   |              |
| cultivate                   |   |  |              |
| disperse, break up          |   |  |              |
| sow                         |   |  |              |

N.B, There is no output for IN- . This in fact  
reflects the somewhat redundant character it has.

The syntactical and grammatical operations must now be  
carried out to choose between these alternatives, to  
re-order the whole sentence and to introduce the addi-  
tional elements which are necessary to make - the  
output a correct English sentence.

The Head set of the new "chunk" shown as a lattice so that the procedure for applying the Scale of Relevance procedure may be made precise.



NOTE. It can be seen that the use of the bracket group of heads as described in the Scale of Relevance procedure, can be looked at from another point of view as utilising the lattice property of language. Made more precise, the procedure is: compare each head in the head-set of the non-intersecting chunk (in this case -CURV-) with the Table of Contents, (this last being arranged as a lattice). If, to find a common idea between any two heads in the head set not more than two steps need be taken up the lattice, bring this common idea down as a new chunk in the input text, this new chunk being inserted after the original non-intersecting chunk. (Thus SPECIAL FORM, the new chunk, will be inserted after -CURV-),

See whether any of the heads in the head set of the new chunk intersects with any head of any of the head sets in the chunks of the input text.

If an intersection is obtained, amalgamate the head sets of SPECIAL FORM and -CURV- to form a single head-set.

If no intersection is obtained, extend the procedure to bring down the second Scale of Relevance (i.e. in this case, bring down all the heads given in Roget's Table of Contents under (GENERAL, SPECIAL and SUPERFICIAL FORM and try again for an intersection, as above.

If it is still the case that no intersection is obtained, the chunk -CURV-, (or more probably the whole word INCURVO) becomes an untranslatable word of Head Language, - as it might be a foreign word - and is carried through complete into the English output, all heads being given in the English output text.