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Technical Note 255

PLACEBO IV
RULES, CONCORDANCE, SAMPLE COMPUTER GENERATION

WILLIAM C. WATT

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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PLACEBO IV

Rules, Concordance, Sample Computer Generation

William C. Watt

This paper presents materials which make the microgrammar PLACEBO IV accessible to close inspection. In the form given here, the microgrammar (when transferred to punched cards and when allied with the requisite 'service programs') may be used for random generation as well as, with minor modifications, for analytical parsing. These materials also facilitate the conversion of PLACEBO IV to the production and analysis of sentences other than those it now specifies.

0. Introduction*

This paper consists almost entirely of materials on the microgrammar PLACEBO IV. Considered as a computer-algorithm only, PLACEBO IV is here presented in a form which may be examined quite independently of any other papers on its natural-language aspects. Considered as a natural-language microgrammar, however, and as a functioning part of a planned artificial-intelligence system, it is here displayed mainly to be read together with two other papers: A Prerequisite to the Utility of Microgrammars (in press), and General Properties of Microgrammars (in preparation). In the absence of these two notes, the brief remarks which follow should serve to place PLACEBO IV in the context of relevant current research.

PLACEBO IV is one of a sequence of microgrammars of which the last will be a working component of a planned synthetic-intelligence system. In this system, neuropathologists will be able to use a computer as an ally in the analysis of pictures of brain-tissue, and of sets of such

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pictures. For a complex of reasons which are taken up in the General Properties paper, it is extremely desirable that the users of this system be enabled to communicate with the computer, not in some general-purpose programming language like ALGOL, but in English itself. Or, at least, in some semblance of English: in a language which, to the user, seems to be English. In other words, in a "language" which allows him free use of the sentences he would naturally use under the restricted circumstances of the using situation. Such a coherent set of sentences -- such a professional subdialect, if you will -- we may call a "microlanguage"; the algorithm which determines such a sentence-set -- which can generate and parse its sentences -- we will call a "microgrammar".

PLACEBO IV is such a microgrammar, then. It has been designed with no eye toward future expansion into a grammar for the whole of English; I do not think any rational man would propose such an expansion. It is meant, on the other hand, to be expandable: into, ultimately, the "last PLACEBO", the working member of the above mentioned intelligence system. As such, PLACEBO IV hopefully forms the "core" of this last grammar: i.e., its rules are the most basic of those ultimately needed, and its categories are varied enough to encompass most of those required in the end.

Despite the fact that it was designed for a specific purpose, and despite the fact that it conspicuously includes special-purpose lexical items (such as "astrocyte", or the verb "Cajal"), PLACEBO IV may still be of use elsewhere. For the microgrammar can easily be reterminalized, so to speak: its output can easily be made to speak of naval armadas instead of brain-sections.

This paper is divided into three main sections. Section 1 lists the 670-odd rules of PLACEBO IV, prefaced by a key to the format in which this Context-Free Phrase Structure is given. This format, as distinguished from the more conventional one, has no significance behond the need to conform to the input demands of available "service programs" (see just below).

Section 2 provides a concordance to the rules exhibited in Section 1. This mechanically-produced aid is one of the outputs of a family of service-programs written by Richard B. Thomas in 1962 at the National Bureau of Standards. (These programs have now been described in Computer Programs for Processing Phrase Structure Grammars, by Cohen, Sillars, and Thomas: NBS Report 8161). The concordance is preceded by a brief guide to its use; it is followed by some of the arithmetical data on PLACEBO IV which Thomas' program has calculated.

Section 3 exhibits a number of sentences generated from the rules of PLACEBO IV on an IBM 7094, using a generating program again written by Thomas. (This program is also described in Cohen-Sillars-Thomas.) Some of these sentences are displayed together with the "trace of generation" which the program furnishes; Section 3 opens with an aid to matching these "traces" against their respective sentences.

The primary purpose of issuing PLACEBO IV in the present form is to make this microgrammar accessible to close inspection, and to facilitate anyone else's making his own use of it, if any should wish. It may be used as it stands for generation, and with minor changes (described below) for analysis (parsing) of the sentences it can generate; or the user, armed with both rules and concordance, may "reterminalize" it at will.

1. The Rules of PLACEBO IV.

1.1 Prefatory Note.

What follows is a complete listing of the rules of the microgrammar PLACEBO IV. The rules are given in alphanumeric order*, except that the initiating grammatical category ('top node') is listed first. Most of the categories, as will be evident, have names which are of mnemonic value to people working with the microgrammar; there is no general key to these mnemonics, however, (though many of them can be figured out rather easily), and I have not thought it worthwhile to explain them one-by-one. They play no role in the algorithmic functioning of the microgrammar.

PLACEBO IV, as mentioned above, is in what is known generally as the 'Simple (or Context-Free) Phrase Structure' model, but is in an unusual format. The following 'key' should ease familiarization with this format:

Read the symbol " = " as " → ", and interpret as "is rewritten as" or "is instantiated as".

Read "S = DIR,STTT" as "S = DIR
S = STTT"; the symbol "," may be read off as "or".

Interpret " + " as "concatenated with and followed by".

In sum, then, the PLACEBO IV rule "AJC = AJCA, AJCB, AJCC + AJFIXE, AJCD + AJFIXE" is equivalent to the rules:

AJC = AJCA

AJC = AJCB

AJC = AJCC + AJFIXE

AJC = AJCD + AJFIXE

Two additional conventions must be explained. The symbol " * " flanks all terminals, as in the rule "ABT = * ABOUT*'; all symbols on the left of " = " having starred symbols on the right, are instantiated only as terminals: these are what I have elsewhere called "penterminal" symbols. Note that the penterminal symbol " X " has the instance " * * "

* Letters are in order A...Z, numerals are in order 0...9, letters precede numerals, '12' follows '11' but also follows '112'.

-- that is, its instance is a space. Use of the " X " penterminal constitutes a kind of 'overt deletion'; its function is explained in my General Properties of Microgrammars.

Note lastly that a "terminal" consists only and entirely of what appears between asterisks. For example, the terminal quoted above is not "about", but " about", with preceding space. Spaces must be introduced in this way whenever (in the generation of strings) it is desirable to separate symbols, such as words. This preceding space is omitted when the terminal is a suffix, for example -- e.g. AJFIXING = *ING* -- and in general whenever a terminal may be directly preceded by another terminal, e.g. AJLGCAB = *REGULAR*, which may in string-generation be preceded by * IR*, derived from the rule AJNEGFXB = * IR*.**

In the form presented here, PLACEBO IV has been 'weighted' for generation. That is, to prevent the frequent occurrence of very long sentences of low readability, certain rules have been 'weighted' with several " X " penterminals, in order that the generating program, in making its random choices, will have a statistical probability of choosing to delete certain symbols rather than entering their further instances and thus entering a recursive loop. If used as is for parsing purposes, PLACEBO IV will be a faulty instrument, for wherever one of these 'favored' deletions is analyzed as present in an input string, the parsing program will be at pains to point out that the deletion could have resulted from, first, the first ' X ' of the rule in question; from, secondly, the second ' X ' of that rule; and so on. These multiple spurious ambiguities would be extremely undesirable; hence, before PLACEBO IV is used for analysis, or parsing, all but one ' X ' should be removed from each rule in which more than one ' X ' occurs.

** When not to be preceded by "ir", the terminal "regular" is preceded by a space introduced by preceding the penterminal AJLGCAB by the penterminal " Z ", whose only instance is " * * ".

1.2. The List of Rules.

```
S=DIR,STTT,Q,A.
A=YN+PT.
ABT=* ABOUT*.
ADJ=ADJC,ADJV.
ADJC=AJJC+AJJA.
ADJV=AJJV+AJJA.
ADJ3=AJJ3A,AJJ3B,AJLGVC.
ADVBCPV=ADVORMR,ADVORLS.
ADVOR=SPQR+DFIXWD.
ADVORLS=LS+ADVOR.
ADVORMR=MR+ADVOR.
AJC=AJCA,AJCB,AJCC+AJFIXE,AJCD+AJFIXE.
AJCA=AJCAA,AJCAB.
AJCAA=AJCAAA,AJCAAB.
AJCAAA=* LIGHT*,* DARK*.
AJCAAB=* GRAY*,* BLACK*.
AJCAB=* SMALL*,* ROUND*.
AJCB=* BIG*.
AJCC=AJCCA,AJCCB.
AJCCA=* WHIT*,* BLU*.
AJCCB=* LARG*.
AJCD=* DENS*.
AJCPV=AJMR,AJLS.
AJFIXAL=*AL*.
AJFIXAR=*AR*.
AJFIXD=*D*.
AJFIXE=*E*.
AJFIXED=*ED*.
AJFIXELLATE=*ELLATE*.
AJFIXIC=*IC*.
AJFIXICAL=*ICAL*.
AJFIXING=*ING*.
AJFIXIVE=*IVE*.
AJFIXL=*L*.
AJFIXLIC=*LIC*.
AJFIXO=*O*.
AJFIXTH=*TH*.
AJFIXTHER=TH+ER.
AJFIXULAR=*ULAR*.
AJJA=X,AJJB+AND+AJJJ.
AJJB=X,X,X,CM+AJJD.
AJJC=AJC,AJLGC,AJCPV.
AJJD=AJJJ+AJJB.
AJJJ=AJJC,AJJV.
AJJV=AJLGV.
AJJ3A=AJCAA,CLR,AJCCB+AJFIXE,AJCD+AJFIXE.
AJJ3B=NCBABA+AJFIXAL,NCBABBA+NFIX1RIL+AJFIXLIC,
 NCBABC+AJFIXULAR,PRNCBAC+AJFIXAR,NCBABDA+AJFIXAL,
 NCBABEA+AJFIXULAR,NCBAC+AJFIXAR, NCBAD+AJFIXIC, NCBAE+AJFIXL,
 NCBAABA+AJFIXICAL.
AJLG=AJLGC,AJLGV.
AJLGC=AJLGCA,AJLGCB,AJLGCC.
AJLGCA=Z+AJLGCAABC,AJLGCAD.
AJLGCAA=*DEFINED*.
AJLGCAB=*REGULAR*.
```

```
AJLGCAC=*DEFINITE*.
AJLGCAD=* PEAR-SHAPED*,* FUSIFORM*.
AJLGCAABC=AJLGCAA,AJLGCAB,AJLGCAC.
AJLGCB=NNBAA+AJFIXAR,NNBAB+AJFIXULAR,NNBAC+AJFIXED,
 NNBAD+AJFIXELLATE.
AJLGCC=NCBAD+AJFIXIC,NCBAE+AJFIXL,
 NCBAC+AJFIXIC.
AJLGV=AJLGVA,AJLGVC.
AJLGVA=AJNEGFXA+AJLGCAA,AJNEGFXB+AJLGCAB,AJNEGFXC+AJLGCAC.
AJLGVC=NVBAA+AJFIXIC,NVBAB+AJFIXL,NVBAC+AJFIXAL,
 NVBAD+AJFIXAL,NVBAEBRV+NVBAEFUL+AJFIXAL.
AJLS=LS+AJNCT.
AJLT=LT+AJNCT.
AJMR=AJCA+ER,AJCB+G+ER,AJCC+ER,MR+AJLG.
AJMT=AJCA+EST,AJCB+G+EST,AJCC+EST,MT+AJLG.
AJNCT=ADVOR,AJC,AJLG.
AJNEGFXA=* UN*.
AJNEGFXB=* IR*.
AJNEGFXC=* IN*.
AJNP1=AJNP1V,AJNP1C.
AJNP1C=ADJC+N111,N111C.
AJNP1V=ADJV+N111,N111V.
AJNP2=ADJ+N222,N222.
AJNP3=ADJ3+N333,N333.
AJOB=ADJ,MST,LOC,AJOBP.
AJOBP=AJVPSVA+XAS+DND.
AJP1NEG=EEE1NEG+AJOB.
AJP1POS=EEE1POS+AJOB.
AJP2NEG=EEE2NEG+AJOB.
AJP2POS=EEE2POS+AJOB.
AJP3NEG=EEE3NEG+AJ3OB.
AJP3POS=EEE3POS+AJ3OB.
AJREL=AJRELA,Z+AJRELB,AJRELC.
AJRELA=* DIFFERENT*.
AJRELB=*DISTINGUISHABLE*.
AJRELC=AJNEGFXC+AJRELB.
AJSPV=AJMT,AJLT.
AJVPSVA=LABL+L+VPSVFXED.
AJ3OB=ADJ3+POAJ,MST,LOC,AJOBP.
AL=* ALL*.
ALL=* ALL*.
ALPC=DETAL+DFDK1+NICON.
AND=* AND*.
ANDOR=* AND*,* OR*,* AND/OR*.
AP=* APART*.
ARPREAR3=PREAR+DFDK1.
AS=* AS*.
AT=* AT*.
AV=* AVERAGE*.
AWAY=* AWAY FROM*,* FROM*.
BERT=Z+NBR29+DJUNA.
BIT=* BIT*.
BU=X,LU.
BY=* BY*.
CALL=VCALL+OBVCALL.
```

```
CLC=* O-CLOCK*.
CLCE=* 1*,* 2*,* 3*,* 4*,* 5*.
CLCN=* 10*,* 11*,* 12*,* 1*,* 2*.
CLCS=* 4*,* 5*,* 6*,* 7*,* 8*.
CLCW=* 7*,* 8*,* 9*,* 10*,* 11*.
CLR=AJCAAB,AJCCA+AJFIXE.
CM=*, *.
CORX=* ON THE X COORDINATE*.
CORY=* ON THE Y COORDINATE*.
CPV=AJCPV,ADVBCPV.
CYTO=* CYTO*.
DEC=Z+PTT+NBR.
DEF=DFDK1+AJNP1,DEFAR+AJSPV+N111.
DEFAR=* THE*.
DEF1=DFDK1+AJNP1.
DEF11=EA+OF+DEF2.
DEF111=DEF1,DEF11.
DEF2=DFDK2+AJNP2.
DERITH=DERITH1,DERITH2.
DERITH1=NUM1+MU1.
DERITH2=NUM2+MU2.
DETAL=AL+OF.
DFDK1=DEFAR,DKAR1.
DFDK2=DEFAR,DKAR2.
DFIXWD=*WARD*.
DIR=DIRR+PT.
DIRR=LYZ,SYN,LAB.
DJUNA=* TIMES*.
DKAR1=* THIS*.
DKAR2=* THESE*.
DL=* --((-- *.
DND=DL+NPOLAB+DR.
DO=* DO*.
DR=* --))-- *.
EA=* EACH*.
EEE1NEG=EEE1POS+NOT.
EEE1POS=* IS*.
EEE2NEG=EEE2POS+NOT.
EEE2POS=* ARE*.
EEE3NEG=EEE3POS+NOT.
EEE3POS=* IS*.
EE1NEG=EE1POS+NOT.
EE1POS=* IS*.
EE2NEG=EE2POS+NOT.
EE2POS=* ARE*.
EE3NEG=EE3POS+NOT.
EE3POS=* IS*.
EO=* EACH OTHER*.
EOB1=PRON1,N1.
EOB2=PRON2,EPRDN2.
EOB3=PRON3,EPRDN3.
EPRDN2=EPRDQFAR+PO2.
EPRDN3=EPRDN33+PO3.
EPRDN33=EPRDQFR+AJNP3.
EPRDQFAR=EPRDQFR+AJNP2.
```

```
EPRDQFR=* *.
EP1POS=E1POS+EOB1.
EP1NEG=E1NEG+EOB1.
EP2NEG=E2NEG+EOB2.
EP2POS=E2POS+EOB2.
EP3NEG=E3NEG+EOB3.
EP3POS=E3POS+EOB3.
EQ=* =*.
EQL=EQU+POEQ.
EQU=* EQUAL TO*.
ER=*ER*.
EST=*EST*.
EVERY=* EVERY*.
EXTR=VEXTR+POVEXTR.
E1NEG=E1POS+NOT.
E1POS=* IS*.
E2NEG=E2POS+NOT.
E2POS=* ARE*.
E3NEG=E3POS+NOT.
E3POS=* IS*.
FORGE=VFRG+N123.
FRCN=Z+NBRMDGT+YINGDANG+NBR29.
FROM=* FROM*.
FROMRK=FROM+DFDK1+MRK.
G=*G*.
GAVIN=* MANY*.
HQ=VHQBAA+VHQBAB.
HQOB1=LYZMSTT1V+EQL,LYZMSTT1C+EQL.
HQOB2=INDFRA+LYZMSTT2A+EQL,INDFRAN+AV+LYZMSTT2B+EQL.
HQOB3=LYZMSTT1V+EQL,LYZMSTT1C+EQL.
HQ1NEG=VFIXNEG1+HQ.
HQ1POS=VHQBAA+VFXS.
HQ2NEG=VFIXNEG2+HQ.
HQ2POS=HQ.
HQ3NEG=VFIXNEG3+HQ.
HQ3POS=VHQBAA+VFXS.
HR=* HERE*.
HUM=TW,FRCN.
HYN=*-*.
IN=* IN*.
INDEF=INDFRAN+AJNP1V,INDFRA+AJNP1C.
INDFRA=* A*.
INDFRAN=* AN*.
KIRSCH=RAK+HYN+LTR,N+HYN+NBR,RAK+HYN+NBR,Z+LTR.
L=*L*.
LAB=LABL+DEF111+PONLAB.
LABL=* LABEL*.
LIPKIN=N1,AJNP1.
LOC=AT+LOCX+AND+XAT+LOCY,HR.
LOCEXTR=PREFRMRK1,PREFRMRK2.
LOCX=NUM+CORX.
LOCY=NUM+CORY.
LS=* LESS*.
LT=* LEAST*.
LTR=*A*,*B*,*C*,*D*,*E*,*F*,*G*,*H*,*I*,*J*,*K*,*L*,*M*,*N*,*O*,*P*,
```

```
 *Q*,*R*,*S*,*T*,*U*,*V*,*W*,*X*,*Y*,*Z*.
LU=DERITH,GAVIN+DJUNA,PUM.
LYZ=Q,VYZPROS.
LYZAL=VLYZAL+OBVLYZAL.
LYZMST=DEFAR+XAV+LYZMSTT1.
LYZMSTT1=LYZMSTT1A,LYZMSTT1B.
LYZMSTT1A=PRNCBAG+OF+PRNCBAE,LYZMST1V,LYZMSTT1AB,LYZMSTT1AC.
LYZMSTT1AB=* COLOR*.
LYZMSTT1AC=* SIZE*.
LYZMSTT1B=AJCD+NFIX1ITY.
LYZMSTT1C=INDFRA+LYZMSTT1CC.
LYZMSTT1CC=PRPRNCBAE+PRNCBAE,PRNCBAF.
LYZMSTT1V=INDFRAN+LYZMSTT1VV.
LYZMSTT1VV=XAV+LYZMSTT1VVV,AV+LYZMSTT1CC.
LYZMSTT1VVV=LYZMST1V,PRNV11.
LYZMSTT2A=LYZMSTT2AA,LYZMSTT2AB.
LYZMSTT2AA=LYZMSTT2AAA,LYZMSTT2AAB,LYZMSTT2AAC.
LYZMSTT2AAA=RLDSBNA+NFIX1ITY.
LYZMSTT2AAB=RLDSANC+NFIX1ION.
LYZMSTT2AAC=* DISTANCE APART*.
LYZMSTT2AB=* LABEL*,* PROCESSING*.
LYZMSTT2B=LYZMSTT2AA,LYZMSTT1.
LYZMST1V=* AREA*.
LYZSPEC=VLYZA+DEF2,VLYZB+OBVLYZB,VLIST+DEF2.
M=* MATCH*.
MARK=DFDK1+MRK.
MOB1=N123+WRT1.
MOB2=N123+WRT2,XEO+WRT2.
MOB2NEG=N123NEG+WRT2,XEO+WRT2.
MOB3=N123+WRT1.
MOB3NEG=N123NEG+WRT1.
MOOF=PROXNOR,PROXQUAN.
MR=* MORE*.
MRK=* MARK*.
MRKK=VMRK+LOC.
MST=NUM1+WATT+POMU,NUM2+WATT+NFIX2S+POMU.
MT=* MOST*.
MU1=WATT,BIT.
MU2=MU1+NFIX2S.
M1NEG=VFIXNEG1+M.
M1POS=M+VFXES.
M2NEG=VFIXNEG2+M.
M2POS=M.
M3NEG=VFIXNEG3+M.
M3POS=M+VFXES.
N=NVBAX1,NCBAX1.
NBR=NBR1,NBR2.
NBRT=HUM,Z+BERT.
NBRDGT=NBR29.
NBRHDRD=NBRMDGT.
NBRHDRDA=NBRMDGTA.
NBRHDRDS=NBRHDRD+NBRTENSA.
NBRHDRDSA=NBRHDRDA+NBRTENSA.
NBRMDGT=NBR1,NBR29.
NBRMDGTA=NBRZO,NBRMDGT.
```

```
NBRTEN=NBRMDGT.
NBRTENA=NBRMDGTA.
NBRTENS=NBRTEN+NBRMDGTA.
NBRTENSA=NBRTENA+NBRMDGTA.
NBRTHSNDS=NBR1+NBRHDRDSA.
NBRZO=*0*.
NBR1=*1*.
NBR2=NBRDGT,NBRTENS,NBRHDRDS,NBRTHSNDS.
NBR29=*2*,*3*,*4*,*5*,*6*,*7*,*8*,*9*.
NCBAA=NCBAAA,NCBAAB.
NCBAAA=* PROCESS*,* MASS*.
NCBAAB=NCBAABA+NFIX1EX.
NCBAABA=* CORT*.
NCBAB=NCBABA,NCBABB,NCBABC,NCBABD,NCBABE.
NCBABA=* NEURON*.
NCBABB=NCBABBA+NFIX1ER,NCBABBA+NFIX1RIL.
NCBABBA=* FIB*.
NCBABC=* CELL*.
NCBABD=NCBABDA+NFIX1E.
NCBABDA=* MEMBRAN*.
NCBABE=NCBABEA+NFIX1LE.
NCBABEA=* MUSC*,* VENTRIC*.
NCBAC=* NUCLE*,* NUCLEOL*.
NCBAD=* DENDRIT*.
NCBAE=* MICROGLIA*.
NCBAF=NCBAFA,NCBABC+NCBAFA.
NCBAFA=* BOD*.
NCBAX1=NCBAA,NCBAB,NCBAC+NFIX1US,NCBAD+NFIX1E,
 NCBAE,NCBAF+NFIX1Y.
NCBAX2=NCBAA+NFIX2ES,NCBAB+NFIX2S,NCBAC+NFIX2I,NCBAD+NFIX1E+NFIX2S,
 NCBAE+NFIX2E,NCBAF+NFIX2IES.
NFIX1ATION=*ATION*.
NFIX1E=*E*.
NFIX1ER=*ER*.
NFIX1EX=*EX*.
NFIX1ION=*ION*.
NFIX1ITY=*ITY*.
NFIX1LE=*LE*.
NFIX1MENT=*MENT*.
NFIX1O=*O*.
NFIX1RIL=*RIL*.
NFIX1UM=*UM*.
NFIX1US=*US*.
NFIX1Y=*Y*.
NFIX2A=*A*.
NFIX2E=*E*.
NFIX2ES=*ES*.
NFIX2I=*I*.
NFIX2IES=*IES*.
NFIX2S=*S*.
NGEN1=* BLOB*.
NGEN2=NGEN1+NFIX2S.
NICON=* PICTURE*.
NNBAA=* LINE*.
NNBAB=* TRIANG*.
```

```
NNBAC=* PINCH*.
NNBAD=* ST*.
NN2=NVBAX2,NCBAX2.
NN3=NN3B,NN3A.
NN3A=NN3AA,NN3AB.
NN3AA=* NISSL SUBSTANCE*,* CHROMATIN*,* COLAGEN*,
 * MYELIN*.
NN3AB=CLR+NN3ABA,NCBAABA+NFIX1EX.
NN3ABA=* MATTER*.
NN3B=NCBAC+AJFIXO+NN3BA,CYTO+NN3BA.
NN3BA=*PLASM*.
NO=* NO*.
NON1=NON1A,NON1B,NON1C.
NON1A=NPREN11+PONPREN1.
NON1B=NPREN111+PONPREN2,N+Z+HYN+NPREN111.
NON1C=NPREN1111+PONPREN3.
NON2=NON2A,NON2B,NON2C.
NON2A=NPREN22+PONPREN12.
NON2B=NPREN222+PONPREN2,N+Z+HYN+NPREN222.
NON2C=NPREN2222+PONPREN3.
NON3=NPREN33+PONPREN12.
NOR=DEC,FRCN.
NOT=*NT*,*N-T*,* NOT*.
NPOLAB=LIPKIN,KIRSCH.
NPREN11=PRNV1,PRNC1.
NPREN111=PRNC11,PRNV11.
NPREN1111=PRNC111.
NPREN22=PRNVBA+NFIX2S,PRNCBAA+NFIX2ES,PRNCBAB+NFIX2I.
NPREN222=PRNCBAE+NFIX2S,VARRD+NFIX2S,PRNV11A+NFIX2S,VARRB+NFIX2S.
NPREN2222=PRNCBAC+NFIX2ES,PRNCBAD+NFIX2S.
NPREN33=NN3.
NRSPT1=NRSPT1A,XNRSPT1A+NRSPT1A+AND+NRSPT1A.
NRSPT1A=LYZMSTT1,LYZMSTT2AB.
NTHH=NTHN+STROF+AJFIXTH.
NTHN=* N*.
NUM=NUM1,NUM2.
NUM1=Z+NBR1.
NUM2=Z+NBR2.
NVBAA=* ASTROCYT*.
NVBAB=* EPENDYMA*.
NVBAC=* AXON*,* ARACHNOID*,* ARTEFACT*.
NVBAD=* ENDOTHELI*.
NVBAE=NVBAEBRV,NVBAEBRV+NVBAEFUL+NFIX1O.
NVBAEBRV=* OLIGO*.
NVBAEFUL=*DENDROGLI*.
NVBAX1=NVBAA+NFIX1E,NVBAB,NVBAC,
 NVBAD+NFIX1UM,NVBAE.
NVBAX2=NVBAA+NFIX1E+NFIX2S,NVBAB+NFIX2S,NVBAC+NFIX2S,
 NVBAD+NFIX2A,NVBAE+NFIX2S.
N1=N11+PO1.
N11=INDEF,DEF,PARPLU.
N111=N,NON1.
N111C=NCBAX1,PRNC1+PONPREN12.
N111V=NVBAX1,PRNV1+PONPREN12.
N123=N1,N2,N3.
```

```
N123NEG=N1,PRDN2NEG,PRDN3NEG.
N2=N2QFAR+PO2,N2CJ.
N2CJ=N2CJA+N123+AND+N123.
N2CJA=X,X,X,X,N2CJA+N123+CM.
N2CJANEG=X,X,X,X,N2CJANEG+N123NEG+CM.
N2CJNEG=N2CJANEG+N123NEG+ANDOR+N123NEG.
N2QFAR=QFAR+AJNP2.
N222=NN2,NON2.
N3=N33+PO3.
N33=QFAR3+AJNP3.
N333=NN3,NON3.
OBAWAY=N123,MARK.
OBVCALL=DEF111,DEF2.
OBVLYZAL=ALL+NGEN2.
OBVLYZB=OBVLYZB1,OBVLYZB2.
OBVLYZB1=LYZMST+OF+DEF111.
OBVLYZB2=DEFAR+XAV+LYZMSTT2B+OF+DEF2,LYZMST+OF+DEF11.
OF=* OF*.
PARNTHEQ=PRNL+NTHN+EQ+NBR2+PRNR.
PARPLU=NUM1+OF+DFDK2+AJNP2.
PART=MRKK,XTR,MRKK+CM+XTR.
PICALL=ALPC+LOCEXTR.
PICSPEC=ALL+DEF2.
POAJ=X,X,ANDOR+ADJ3.
POEQ=MST,POEQN.
POEQN=THOF+N123.
POEXTR=X,CM+WHOLE.
POMU=IN+WOPOMU.
PONLAB=XWTL+DND.
PONPREN1=X,OF+N1.
PONPREN12=PONPREN1,PONPREN2.
PONPREN2=X,OF+N2.
PONPREN3=X,OF+AJNP3.
PORLV=X,X,X,AND+RLV+PORLV.
POSYNN=AND+VPOSYNN.
POVEXTR=PICALL,PICSPEC.
POVVLISTA=X,PVLSTA.
POVVLISTB=X,PVLSTB.
PO1=X,X,X,X,X,X,X,PO11.
PO11=WHCL1,WHCL1+AND+PO11.
PO2=X,X,X,X,X,X,X,PO22.
PO22=WHCL2,WHCL2+AND+PO22.
PO3=X,X,X,X,X,X,X,PO33.
PO33=WHCL3,WHCL3+AND+PO33.
PRDN2=PRDN2QFAR+PO2,N2CJ.
PRDN2NEG=PRDN2QFNEG+PO2,N2CJNEG.
PRDN2QFAR=PRDQFAR+AJNP2.
PRDN2QFNEG=PRDQFARNEG+AJNP2.
PRDN3=PRDN33+PO3.
PRDN3NEG=PRDN33NEG+PO3.
PRDN33=PRDQFAR3+AJNP3.
PRDN33NEG=PRDQFAR3NEG+AJNP3.
PRDQFAR=PRDQFR,NUM2,DFDK2.
PRDQFARNEG=PRDQFRNEG,NUM2,DFDK2.
PRDQFAR3=PRDQFR,ARPREAR3.
```

```
PRDQFAR3NEG=PRDQFRNEG,ARPREAR3.
PRDQFR=* *,* SOME*.
PRDQFRNEG=* *,* ANY*.
PREAR=X,PREAR3.
PREAR3=MOOF+OF.
PRED1=PRED1NEG,PRED1POS.
PRED1NEG=EP1NEG,VP1NEG,AJP1NEG,RELP1NEG.
PRED1POS=EP1POS,VP1POS,AJP1POS,RELP1POS.
PRED2=PRED2NEG,PRED2POS.
PRED2NEG=EP2NEG,VP2NEG,AJP2NEG,RELP2NEG.
PRED2POS=EP2POS,VP2POS,AJP2POS,RELP2POS.
PRED3=PRED3NEG,PRED3POS.
PRED3NEG=EP3NEG,VP3NEG,AJP3NEG,RELP3NEG.
PRED3POS=EP3POS,VP3POS,AJP3POS,RELP3POS.
PREFRMRK1=NUM1+BIT+FROMRK.
PREFRMRK2=NUM2+BIT+NFIX2S+FROMRK.
PREPDIR=* AT*,* TO*,* TOWARD*.
PRNCBAA=* PROCESS*.
PRNCBAB=* NUCLE*,* NUCLEOL*.
PRNCBAC=* GRANUL*.
PRNCBAD=* FLAKE*.
PRNCBAE=* PERIMETER*.
PRNCBAF=* COLOR*,* SIZE*,* SHAPE*.
PRNCBAG=* LENGTH*,* WIDTH*,* HEIGHT*.
PRNCBAH=* NETWORK*.
PRNC1=PRNCBAA,PRNCBAB+NFIX1US.
PRNC11=PRNCBAH,VARRD.
PRNC111=PRNCBAD,PRNCBAC+NFIX1E.
PRNL=* (*.
PRNR=* )*.
PRNVBA=* AXON*.
PRNV1=PRNVBA.
PRNV11=PRNV11A,PRNV11B.
PRNV11A=VARRA+NFIX1MENT,VARRC+NFIX1ATION.
PRNV11B=VARRB.
PRON1=* THIS*.
PRON2= * THESE*.
PRON3=* THIS*.
PROSS=WHOLE,PART.
PROX=X,X,X,ABT.
PROXNOR=PROX+Z+NOR.
PROXQUAN=* MOST*,* ALL*,* SOME*,* NONE*.
PRPRNCBAE=X,PRNCBAG+OF.
PRT=INDFRA+PRTT.
PRTT=* PART*.
PT=*.*.
PTT=*.*.
PUM=* MUCH*.
PVLSTA=* IN SEQUENCE*,* IN ORDER*,* IN ALPHABETICAL ORDER*.
PVLSTB=EVERY+NTHH+UNO+PARNTHEQ+OF.
Q=QQ+PT.
QFAR=QFR,NUM2,DFDK2.
QFAR3=QFR,ARPREAR3.
QFR=* *,* SOME*,* ALL*.
QQ=Q1,Q2,Q3.
```

```
Q1=Q1EP,Q1VP,Q1AJP,Q1RELP,Q1MP,Q1HQP.
Q1AJP=EEE1POS+SB1+AJOB.
Q1EP=E1POS+SB1+EOB1.
Q1HQP=VAUX1+SB1+HQ+HQOB1.
Q1MP=VAUX1+SB1+M+MOB1.
Q1RELP=EE1POS+SB1+RELOB1.
Q1VP=VAUX1+SB1+V+VOB1.
Q2=Q2EP,Q2VP,Q2AJP,Q2RELP,Q2MP,Q2HQP.
Q2AJP=EEE2POS+SB2+AJOB.
Q2EP=E2POS+SB2+EOB2.
Q2HQP=VAUX2+SB2+HQ+HQOB2.
Q2MP=VAUX2+SB2+M+MOB2.
Q2RELP=EE2POS+SB2+RELOB2.
Q2VP=VAUX2+SB2+V+VOB2.
Q3=Q3EP,Q3VP,Q3AJP,Q3RELP,Q3MP,Q3HQP.
Q3AJP=EEE3POS+SB3+AJ3OB.
Q3EP=E3POS+SB3+EOB3.
Q3HQP=VAUX3+SB3+HQ+HQOB3.
Q3MP=VAUX3+SB3+M+MOB3.
Q3RELP=EE3POS+SB3+RELOB3.
Q3VP=VAUX3+SB3+V+VOB3.
RAK=* RAK*.
RE=* WITH REGARD TO*.
REL=RLV+PORLV,RLVD.
RELOB1=REL+N123.
RELOB2=REL+N123,RLVI+N2.
RELOB3=REL+N123.
RELP1NEG=EE1NEG+RELOB1.
RELP1POS=EE1POS+RELOB1.
RELP2NEG=EE2NEG+RELOB2.
RELP2POS=EE2POS+RELOB2.
RELP3NEG=EE3NEG+RELOB3.
RELP3POS=EE3POS+RELOB3.
RLDS=RLDSA,RLDSB.
RLDSA=RLDSANA+AP,RLDSANB+AJFIXED,RLDSANC+AJFIXE,RLDSANC+AJFIXED.
RLDSANA=* FAR*.
RLDSANAA=RLDSANA,RLDSAND.
RLDSANACPV=RLDSANAA+AJFIXTHER.
RLDSANB=* DISPERS*.
RLDSANC=* SEPARAT*.
RLDSAND=* FUR*.
RLDSB=RLDSBNA+AJFIXE.
RLDSBNA=* DENC*.
RLDSCPV=RLDSANACPV+AP,RLDSBNA+ER,MR+RLDSANB+AJFIXED,
 MR+RLDSANC+AJFIXE,LS+RLDSANB+AJFIXED,LS+RLDSANC+AJFIXE.
RLV=RLVA,RLVB,RLVC,RLVE,RLVF,RLVG,
 RLVH.
RLVA=RLVAA,RLVAB,RLVAC.
RLVAA=RLVAAA+RLVAAB,RLVAAC+RLVAAD.
RLVAAA=* IN*.
RLVAAB=X,RLVAAD.
RLVAAC=* OUT*.
RLVAAD=*SIDE*,*SIDE OF*.
RLVAB=VEDA+IN,VEDB+BY,VEIV+OF,PRT+OF.
RLVAC=RLVACA,RLVACB.
```

```
RLVACA=RLVACAGN,RLVACSP.
RLVACAGN=RLVACAGNA,RLVACAGNB.
RLVACAGNA=* NEXT TO*,* NEAR*,* TANGENT TO*.
RLVACAGNB=VTCH+AJFIXING.
RLVACB=RLVACBGN,RLVACSP.
RLVACBGN=RLDSANA+AWAY.
RLVACSP=RLVDIRN,RLVDIRE,RLVDIRS,RLVDIRW.
RLVB=RLVB1,RLVB2.
RLVB1=DERITH1+AWAY.
RLVB2=DERITH2+AWAY.
RLVC=CPV+THAN.
RLVD=BU+RLDSANACPV+AWAY+OBAWAY+THAN+FROM.
RLVDIRE=RLVDIREGN,RLVDIRESP.
RLVDIREGN=* TO THE RIGHT OF*.
RLVDIRESP=PREPDIR+CLCE+CLC+FROM.
RLVDIRN=RLVDIRNGN,RLVDIRNSP.
RLVDIRNGN=* ABOVE*,* OVER*.
RLVDIRNSP=PREPDIR+CLCN+CLC+FROM.
RLVDIRS=RLVDIRSGN,RLVDIRSSP.
RLVDIRSGN=* BELOW*,* UNDER*,* UNDERNEATH*.
RLVDIRSSP=PREPDIR+CLCS+CLC+FROM.
RLVDIRW=RLVDIRWGN,RLVDIRWSP.
RLVDIRWGN=* TO THE LEFT OF*.
RLVDIRWSP=PREPDIR+CLCW+CLC+FROM.
RLVE=AS+AJNCT+AS.
RLVF=NBRT+AS+AJNCT+AS.
RLVG=AJREL+FROM.
RLVH=* COMPOSED OF*,* ANALYZABLE INTO*,* BASED ON*,* DERIVED FROM*.
RLVI=AS+RLDS+AS,RLDSCPV+THAN.
RSPT1=XAV+NRSPT1.
RSPT2=RSPT1,LYZMSTT2AA.
SB1=PRON1,N1.
SB2=PRON2,N2.
SB3=PRON3,N3.
SPQR=RLVAAA,RLVAAC.
STMT=STTPOS,STTNEG.
STROF=*-*.
STTNEG=STTNEG1,STTNEG2,STTNEG3.
STTNEG1=SB1+PRED1NEG.
STTNEG2=SB2+PRED2NEG.
STTNEG3=SB3+PRED3NEG.
STTPOS=STTPOS1,STTPOS2,STTPOS3.
STTPOS1=SB1+PRED1POS.
STTPOS2=SB2+PRED2POS.
STTPOS3=SB3+PRED3POS.
STTT=STMT+PT.
SYN=SYNN+POSYNN.
SYNN=CALL,PROSS,FORGE.
TH=*TH*.
THAN=* THAN*.
THOF=* THAT OF*.
TW=* TWICE*.
UNO=* ONE*.
V=VH,VCN.
VARRA=* ARRANGE*,* ALIGN*.
```

```
VARRB=* ARRAY*.
VARRC=* ORIENT*.
VARRD=* POSITION*.
VAUX1=DO+VFXES.
VAUX2=DO.
VAUX3=DO+VFXES.
VCALL=* CALL UP*.
VEXTR=* EXTRACT*.
VCN=* CONTAIN*.
VEDA=VCN+AJFIXED,VINCL+AJFIXD.
VEDB=VNTRSCT+AJFIXED.
VEIV=VINCLBAB+AJFIXIVE.
VFIXE=*E*.
VFXES=*ES*.
VFIXNEG1=VAUX1+NOT.
VFIXNEG2=VAUX2+NOT.
VFIXNEG3=VAUX3+NOT.
VFXS=*S*.
VFRG=* DRAW*,* DIAGRAM*,* CAJAL*.
VH=VHBAA+VHBAB.
VHBAA=* HA*.
VHBAB=*VE*.
VHQBAA=* HA*.
VHQBAB=*VE*.
VINCL=VINCLBAA+VFIXE.
VINCLBAA=VINCLBAAA+VINCLBAAB.
VINCLBAAA=* INCLU*.
VINCLBAAB=*D*.
VINCLBAB=VINCLBAAA+VINCLBABB.
VINCLBABB=*S*.
VLIST=VVLIST+POVVLISTA+POVVLISTB.
VLYZA=* COUNT*.
VLYZAL=VLYZA,VLYZB+LYZMST+OF.
VLYZB=* FIND*.
VMARK=* PLACE*.
VMRK=VMARK+INDFRA+MRK.
VNTRSCT=* INTERSECT*.
VOB1=PRON1,N1.
VOB2=PRON2,PRDN2.
VOB2NEG=PRON2,PRDN2NEG.
VOB3=PRON3,PRDN3.
VOB3NEG=PRON3,PRDN3NEG.
VPOSYNN=* DISPLAY*,* STORE*,* HOLD*.
VPSVFXED=*ED*.
VP1NEG=V1NEG+VOB1,M1NEG+MOB1,HQ1NEG+HQOB1.
VP1POS=V1POS+VOB1,M1POS+MOB1,HQ1POS+HQOB1.
VP2NEG=V2NEG+VOB2NEG,M2NEG+MOB2NEG,HQ2NEG+HQOB2.
VP2POS=V2POS+VOB2,M2POS+MOB2,HQ2POS+HQOB2.
VP3NEG=V3NEG+VOB3NEG,M3NEG+MOB3NEG,HQ3NEG+HQOB3.
VP3POS=V3POS+VOB3,M3POS+MOB3,HQ3POS+HQOB3.
VTCH=* TOUCH*.
VVLIST=VVVLIST,VLYZA+AND+VVVLIST.
VVVLIST=* LIST*.
VYZPROS=LYZAL,LYZSPEC.
V1NEG=VFIXNEG1+V.
```

```
V1POS=VHBAA+VFXS,VCN+VFXS.
V2NEG=VFIXNEG2+V.
V2POS=VH,VCN.
V3NEG=VFIXNEG3+V.
V3POS=VHBAA+VFXS,VCN+VFXS.
WATT=* MICRON*.
WH=* WHICH*.
WHCL1=WH+PRED1.
WHCL2=WH+PRED2.
WHCL3=WH+PRED3.
WHOLE=* ENLARGE*,* CUSTER*,* TWIST*,* SHRINK*.
WITH=* WITH*.
WMW=* CANT ANSWER*.
WOPOMU=PRNCBAE,PRNCBAG.
WRT1=RE+RSPT1.
WRT2=RE+RSPT2.
X=* *.
XAS=X,AS.
XAT=X,AT.
XAV=X,AV.
XEO=X,X,X,EO.
XNRSPT1A=X,X,X,X,NRSPT1A+CM.
XSTTNEG=X,CM+STTNEG.
XSTTPOS=X,CM+STTPOS.
XTR=EXTR+POEXTR.
XWTL=X,WITH+DEFAR+LABL.
YES=* YES*.
YINGDANG=*/*.
YN=YES+XSTTPOS,NO+XSTTNEG,WMW.
Z=* *.
```

2. The Concordance.

2.1 Prefatory Note.

The Concordance which follows needs very little by way of explanation. Its design and format are exemplified by its treatment of the rule (from the listing of Section 1, above):

S = DIR, STTT, Q, A.

Each symbol which in the rule appears to the right of " = ", as an instance, appears in the Concordance at the left margin. A, for example, is the second such symbol in the Concordance. To the right of and below each such symbol the Concordance gives the instantiators ("rule-heads") it can be derived from: that is, the symbols which occur on the left of " = " wherever the subject symbol appears on the right. A is given for example as being derivable from S and only from S. By contrast, ADJ is given as being instantiable by either or two symbols, AJNP2 and AJOB. The symbol S is given as having NO ANTECEDENT because it is the initiating category ("top node"): it cannot be instanced by anything else.

This is a Concordance for non-terminals only. A similar Concordance for terminals would also be useful; but at present I do not have access to a service-program able to supply such a compilation.

Section 2.2, the Concordance, is followed by a Section 2.3, which provides a rough arithmetical characterization of PLACEBO IV.

2.2 The Concordance of Rules

C O N C O R D A N C E

NONTERMINAL SYMBOLS

S

** NO ANTECEDENT **

A

S

A B T

P R O X

A D J

A J N P 2

A J O B

A D J C

A D J

A J N P 1 C

A D J V

A D J

A J N P 1 V

A D J 3

A J N P 3

A J 3 O B

P O A J

A D V B C P V

C P V

A D V O R

A D V O R M R

A D V O R L S

A J N C T

A D V O R L S

A D V B C P V

A D V O R M R

A D V B C P

A J C

A J J C

A J N C T

A J C A

A J C

A J M R

A J M T

A J C A A

A J J 3 A

A J C A

A J C A A A

A J C A A

A J C A A B

A J C A A

C L R

A J C A B

A J C A

A J C B

A J C

A J M R

A J M T

A J C C

A J C

A J M R

A J M T

A J C C A

A J C C

C L R

A J C C B

A J J 3 A

A J C C

A J C D

A J J 3 A

A J C

L Y Z M S T T 1 B

A J C P V

A J J C

C P V

A J F I X A L

A J J 3 B

A J L G V C

A J F I X A R

A J J 3 B

A J L G C B

A J F I X D

V E D A

A J F I X E

A J J 3 A

A J C

C L R

R L D S A

R L D S B

R L D S C P V

A J F I X E D

A J L G C B

R L D S A

R L D S C P V

V E D A

V E D B

A J F I X E L L A T E

A J L G C B

A J F I X I C

A J J 3 B

A J L G V C

A J L G C C

A J F I X I C A L

A J J 3 B

A J F I X I N G

R L V A C A G N B

A J F I X I V E

V E I V

A J F I X L

A J J 3 B

A J L G V C

A J L G C C

A J F I X L I C

A J J 3 B

A J F I X O

N N 3 B

A J F I X T H

N T H H

A J F I X T H E R

R L D S A N A C P V

A J F I X U L A R

A J J 3 B

A J L G C B

A J J A

A D J C

A D J V

A J J B

A J J A

A J J D

A J J C

A D J C

A J J J

A J J D

A J J B

A J J J

A J J A

A J J D

A J J V

A D J V

A J J J

A J J 3 A

A D J 3

A J J 3 B

A D J 3

A J L G

A J M R

A J N C T

A J M T

A J L G C

A J J C

A J L G

A J L G C A

A J L G C

A J L G C A A

A J L G C A A B C

A J L G V A

A J L G C A B

A J L G C A A B C

A J L G V A

A J L G C A C

A J L G C A A B C

A J L G V A

A J L G C A D

A J L G C A

A J L G C A A B C

A J L G C A

A J L G C B

A J L G C

A J L G C C

A J L G C

A J L G V

A J J V

A J L G

A J L G V A

A J L G V

A J L G V C

A D J 3

A J L G V

A J L S

A J C P V

A J L T

A J S P V

A J M R

A J C P V

A J M T

A J S P V

A J N C T

A J L S

A J L T

RLVE

RLVF

AJNEGFXA

AJLGVA

AJNEGFXB

AJLGVA

AJNEGFXC

AJLGVA

AJRELC

AJNP1

DEF

DEF1

LIPKIN

AJNP1C

AJNP1

INDEF

AJNP1V

AJNP1

INDEF

AJNP2

DEF2

EPRDQFAR

PARPLU

N2QFAR

PRDN2QFAR

PRDN2QFNEG

AJNP3

EPRDN33

PONPREN3

N33

PRDN33

PRDN33NEG

AJOB

AJP1NEG

AJP1POS

AJP2NEG

AJP2POS

Q1AJP

Q2AJP

AJOBP

AJOB

AJ3OB

AJP1NEG

PRED1NEG

AJP1POS

PRED1POS

AJP2NEG

PRED2NEG

AJP2POS

PRED2POS

AJP3NEG

PRED3NEG

AJP3POS

PRED3POS

AJREL

RLVG

AJRELA

AJREL

AJRELB

AJREL

AJRELC

AJRELC

A J R E L

A J S P V

D E F

A J V P S V A

A J O B P

A J 3 O B

A J P 3 N E G

A J P 3 P O S

Q 3 A J P

A L

D E T A L

A L L

O B V L Y Z A L

P I C S P E C

A L P C

P I C A L L

A N D

A J J A

L O C

N R S P T 1

N 2 C J

P O R L V

P O S Y N N

P O 1 1

P O 2 2

P O 3 3

V V L I S T

A N D O R

P O A J

N 2 C J N E G

A P

A R P R E A R 3

Q F A R 3

P R D Q F A R 3

P R D Q F A R 3 N E G

A S

X A S

R L V I

R L V E

R L V F

A T

L O C

X A T

A V

H Q O B 2

X A V

L Y Z M S T T 1 V V

A W A Y

R L V D

R L V A C B G N

R L V B 1

R L V B 2

B E R T

N B R T

B I T

M U 1

P R E F R M R K 1

P R E F R M R K 2

B U

R L V D

B Y

R L V A B

C A L L

S Y N N

C L C

R L V D I R E S P

R L V D I R N S P

R L V D I R S S P

R L V D I R W S P

C L C E

R L V D I R E S P

C L C N

R L V D I R N S P

C L C S

R L V D I R S S P

C L C W

R L V D I R W S P

C L R

A J J 3 A

N N 3 A B

C M

A J J B

X N R S P T 1 A

N 2 C J A

N 2 C J A N E G

P A R T

P O E X T R

X S T T N E G

X S T T P O S

C O R X

L O C X

C O R Y

L O C Y

C P V

R L V C

C Y T O

N N 3 B

D E C

N O R

D E F

N 1 1

D E F A R

D F D K 1

D E F

D F D K 2

L Y Z M S T

O B V L Y Z B 2

X W T L

D E F 1

D E F 1 1 1

D E F 1 1

D E F 1 1 1

O B V L Y Z B 2

D E F 1 1 1

O B V C A L L

L A B

O B V L Y Z B 1

D E F 2

O B V C A L L

D E F 1 1

L Y Z S P E C

O B V L Y Z B 2

PICSPEC

DERITH

LU

DERITH1

DERITH

RLVB1

DERITH2

DERITH

RLVB2

DETAL

ALPC

DFDK1

ALPC

ARPREAR3

DEF

DEF1

FROMRK

MARK

DFDK2

DEF2

PARPLU

QFAR

PRDQFAR

PRDQFARNEG

DFIXWD

ADVOR

DIR

S

DIRR

DIR

DJUNA

BERT

LU

DKAR1

DFDK1

DKAR2

DFDK2

DL

DND

DND

AJOBP

PONLAB

DO

VAUX1

VAUX2

VAUX3

DR

DND

EA

DEF11

EEE1NEG

AJP1NEG

EEE1POS

EEE1NEG

AJP1POS

Q1AJP

EEE2NEG

AJP2NEG

EEE2POS

EEE2NEG

AJP2POS

Q2AJP

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EEE3NEG
        AJP3NEG
EEE3POS
        EEE3NEG
        AJP3POS
        Q3AJP
EE1NEG
        RELP1NEG
EE1POS
        EE1NEG
        RELP1POS
        Q1RELP
EE2NEG
        RELP2NEG
EE2POS
        EE2NEG
        RELP2POS
        Q2RELP
EE3NEG
        RELP3NEG
EE3POS
        EE3NEG
        RELP3POS
        Q3RELP
EO
        XEO
EOB1
        EP1POS
        EP1NEG
        Q1EP
EOB2
```



```
        EP2NEG
        EP2POS
        Q2EP
EOB3
        EP3NEG
        EP3POS
        Q3EP
EPRDN2
        EOB2
EPRDN3
        EOB3
EPRDN33
        EPRDN3
EPRDQFAR
        EPRDN2
EPRDQFR
        EPRDQFAR
        EPRDN33
EP1POS
        PRED1POS
EP1NEG
        PRED1NEG
EP2NEG
        PRED2NEG
EP2POS
        PRED2POS
EP3NEG
        PRED3NEG
EP3POS
        PRED3POS
EQ
```

PARNTHEQ

EQL

HQOB1

HQOB2

HQOB3

EQU

EQL

ER

AJMR

AJFIXTHER

RLDSCPV

EST

AJMT

EVERY

PVLSTB

EXTR

XTR

E1NEG

EP1NEG

E1POS

EP1POS

E1NEG

Q1EP

E2NEG

EP2NEG

E2POS

E2NEG

EP2POS

Q2EP

E3NEG

EP3NEG

E3POS

E3NEG

EP3POS

Q3EP

FORGE

SYNN

FRCN

HUM

NOR

FROM

FROMRK

RLVD

RLVG

RLVDIRESP

RLVDIRNSP

RLVDIRSSP

RLVDIRWSP

FROMRK

PREFRMRK1

PREFRMRK2

G

AJMR

AJMT

GAVIN

LU

HQ

HQ1NEG

HQ2NEG

HQ2POS

HQ3NEG

Q1HQP

Q 2 H Q P

Q 3 H Q P

H Q O B 1

V P 1 N E G

V P 1 P O S

Q 1 H Q P

H Q O B 2

V P 2 N E G

V P 2 P O S

Q 2 H Q P

H Q O B 3

V P 3 N E G

V P 3 P O S

Q 3 H Q P

H Q 1 N E G

V P 1 N E G

H Q 1 P O S

V P 1 P O S

H Q 2 N E G

V P 2 N E G

H Q 2 P O S

V P 2 P O S

H Q 3 N E G

V P 3 N E G

H Q 3 P O S

V P 3 P O S

H R

L O C

H U M

N B R T

H Y N

K I R S C H

N O N 1 B

N O N 2 B

I N

P O M U

R L V A B

I N D E F

N 1 1

I N D F R A

L Y Z M S T T 1 C

H Q O B 2

I N D E F

V M R K

P R T

I N D F R A N

L Y Z M S T T 1 V

H Q O B 2

I N D E F

K I R S C H

N P O L A B

L

A J V P S V A

L A B

D I R R

L A B L

A J V P S V A

L A B

X W T L

L I P K I N

N P O L A B

L O C

AJOB

AJ3OB

MRKK

LOCEXTR

PICALL

LOCX

LOC

LOCY

LOC

LS

ADVORLS

AJLS

RLDSCPV

LT

AJLT

LTR

KIRSCH

LU

BU

LYZ

DIRR

LYZAL

VYZPROS

LYZMST

VLYZAL

OBVLYZB1

OBVLYZB2

LYZMSTT1

LYZMSTT2B

LYZMST

NRSPT1A

LYZMSTT1A

LYZMSTT1

LYZMSTT1AB

LYZMSTT1A

LYZMSTT1AC

LYZMSTT1A

LYZMSTT1B

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LYZMSTT1C

HQOB1

HQOB3

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HQOB1

HQOB3

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LYZMSTT1VVV

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HQOB2

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LYZMSTT2B

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LYZMSTT2AAB

LYZMSTT2AA

LYZMSTT2AAC

LYZMSTT2AA

LYZMSTT2AB

LYZMSTT2A

NRSPT1A

LYZMSTT2B

HQOB2

OBVLYZB2

LYZMST1V

LYZMSTT1A

LYZMSTT1VVV

LYZSPEC

VYZPROS

M

M1NEG

M1POS

M2NEG

M2POS

M3NEG

M3POS

Q1MP

Q2MP

Q3MP

MARK

OBAWAY

MOB1

VP1NEG

VP1POS

Q1MP

MOB2

VP2POS

Q2MP

MOB2NEG

VP2NEG

MOB3

VP3POS

Q3MP

MOB3NEG

VP3NEG

MOOF

PREAR3

MR

ADVORMR

AJMR

RLDSCPV

MRK

FROMRK

MARK

VMRK

MRKK

PART

MST

AJOB

AJ3OB

POEQ

MT

AJMT

MU1

DERITH1

MU2

MU2

DERITH2

M 1 N E G

V P 1 N E G

M 1 P O S

V P 1 P O S

M 2 N E G

V P 2 N E G

M 2 P O S

V P 2 P O S

M 3 N E G

V P 3 N E G

M 3 P O S

V P 3 P O S

N

N 1 1 1

K I R S C H

N O N 1 B

N O N 2 B

N B R

D E C

K I R S C H

N B R T

R L V F

N B R D G T

N B R 2

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N B R H D R D S

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N B R 1

N B R

N U M 1

N B R M D G T

N B R T H S N D S

N B R 2

N B R

NUM2

PARNTHEQ

NBR29

BERT

FRCN

NBRMDGT

NBRDGT

NCBAA

NCBAX1

NCBAX2

NCBAAA

NCBAA

NCBAAB

NCBAA

NCBAABA

AJJ3B

NCBAAB

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NCBAX2

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NCBAF

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NCBAC

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NCBAD

AJJ3B

AJLGCC

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AJJ3B

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LYZMSTT2AAA

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PRNV11A

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NFIX2S

MST

MU2

PREFRMRK2

NCBAX2

NGEN2

NVBAX2

NPREN22

NPREN222

NPREN2222

NGEN1

NGEN2

NGEN2

OBVLYZAL

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NNBAD

AJLGCB

NN2

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NN3

N333

NPREN33

NN3A

NN3

NN3AA

NN3A

NN3AB

NN3A

NN3ABA

NN3AB

NN3B

NN3BA

NN3B

NO

YN

NON1

N111

NON1A

NON1

NON1B

NON1

NON1C

NON1

NON2

N222

NON2A

NON2

NON2B

NON2

NON2C

NON2

NON3

N333

NOR

PROXNOR

NOT

EEE1NEG

EEE2NEG

EEE3NEG

EE1NEG

EE2NEG

E E 3 N E G

E 1 N E G

E 2 N E G

E 3 N E G

V F I X N E G 1

V F I X N E G 2

V F I X N E G 3

N P O L A B

D N D

N P R E N 1 1

N O N 1 A

N P R E N 1 1 1

N O N 1 B

N P R E N 1 1 1 1

N O N 1 C

N P R E N 2 2

N O N 2 A

N P R E N 2 2 2

N O N 2 B

N P R E N 2 2 2 2

N O N 2 C

N P R E N 3 3

N O N 3

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R S P T 1

N R S P T 1 A

N R S P T 1

X N R S P T 1 A

N T H H

P V L S T B

N T H N

N T H H

P A R N T H E Q

N U M

L O C X

L O C Y

N U M 1

M S T

D E R I T H 1

P R E F R M R K 1

N U M

P A R P L U

N U M 2

M S T

D E R I T H 2

P R E F R M R K 2

N U M

Q F A R

P R D Q F A R

P R D Q F A R N E G

N V B A A

A J L G V C

N V B A X 1

N V B A X 2

N V B A B

A J L G V C

N V B A X 1

N V B A X 2

N V B A C

A J L G V C

N V B A X 1

N V B A X 2

N V B A D

A J L G V C

N V B A X 1

N V B A X 2

N V B A E

N V B A X 1

N V B A X 2

N V B A E B R V

A J L G V C

N V B A E

N V B A E F U L

A J L G V C

N V B A E

N V B A X 1

N 1 1 1 V

N

N V B A X 2

N N 2

N 1

E O B 1

N 1 2 3

L I P K I N

N 1 2 3 N E G

P O N P R E N 1

S B 1

V O B 1

N 1 1

N 1

N 1 1 1

A J N P 1 V

A J N P 1 C

N 1 1 1 C

N 1 1 1 V

N 1 2 3

N 1 2 3 N E G

N 2

N 2 C J

N 2 C J A

D E F

A J N P 1 C

A J N P 1 V

F O R G E

M O B 1

M O B 2

M O B 3

N 2 C J

N 2 C J A

O B A W A Y

P O E Q N

R E L O B 1

R E L O B 2

R E L O B 3

M O B 2 N E G

M O B 3 N E G

N 2 C J A N E G

N 2 C J N E G

N 1 2 3

P O N P R E N 2

S B 2

R E L O B 2

N 2

P R D N 2

N 2 C J

N 2 C J A

N 2 C J A N E G

N 2 C J A N E G

N 2 C J N E G

N 2 C J N E G

P R D N 2 N E G

N 2 Q F A R

N 2

N 2 2 2

A J N P 2

N 3

N 1 2 3

S B 3

N 3 3

N 3

N 3 3 3

A J N P 3

O B A W A Y

R L V D

O B V C A L L

C A L L

O B V L Y Z A L

L Y Z A L

O B V L Y Z B

L Y Z S P E C

O B V L Y Z B 1

O B V L Y Z B

O B V L Y Z B 2

O B V L Y Z B

O F

D E T A L

D E F 1 1

V L Y Z A L

L Y Z M S T T 1 A

P R P R N C B A E

P O N P R E N 1

P O N P R E N 2

P O N P R E N 3

P A R P L U

O B V L Y Z B 1

O B V L Y Z B 2

P V L S T B

P R E A R 3

R L V A B

P A R N T H E Q

P V L S T B

P A R P L U

N 1 1

P A R T

P R O S S

P I C A L L

P O V E X T R

P I C S P E C

P O V E X T R

P O A J

A J 3 O B

P O E Q

E Q L

P O E Q N

P O E Q

P O E X T R

XTR

POMU

MST

PONLAB

LAB

PONPREN1

NON1A

PONPREN12

PONPREN12

N111C

N111V

NON2A

NON3

PONPREN2

NON1B

NON2B

PONPREN12

PONPREN3

NON1C

NON2C

PORLV

PORLV

REL

POSYNN

SYN

POVEXTR

EXTR

POVVLISTA

VLIST

POVVLISTB

VLIST

PO1

N1

PO11

PO1

PO11

PO2

EPRDN2

N2

PRDN2NEG

PRDN2

PO22

PO2

PO22

PO3

EPRDN3

N3

PRDN3NEG

PRDN3

PO33

PO3

PO33

PRDN2

VOB2

PRDN2NEG

N123NEG

VOB2NEG

PRDN2QFAR

PRDN2

PRDN2QFNEG

PRDN2NEG

PRDN3

VOB3

PRDN3NEG

N123NEG

VOB3NEG

PRDN33

PRDN3

PRDN33NEG

PRDN3NEG

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PRDN2QFAR

PRDQFARNEG

PRDN2QFNEG

PRDQFAR3

PRDN33

PRDQFAR3NEG

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PRDQFAR

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PRDQFRNEG

PRDQFARNEG

PRDQFAR3NEG

PREAR

ARPREAR3

PREAR3

PREAR

PRED1

WHCL1

PRED1NEG

PRED1

STTNEG1

PRED1POS

PRED1

STTPOS1

PRED2

WHCL2

PRED2NEG

PRED2

STTNEG2

PRED2POS

PRED2

STTPOS2

PRED3

WHCL3

PRED3NEG

PRED3

STTNEG3

PRED3POS

PRED3

STTPOS3

PREFRMRK1

LOCEXTR

PREFRMRK2

LOCEXTR

PREPDIR

RLVDIRESP

RLVDIRNSP

RLVDIRSSP

RLVDIRWSP

PRNCBAA

NPREN22

PRNC1

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        NPREN2222
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        LYZMSTT1CC
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        WOPOMU
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        LYZMSTT1CC
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PRNR
        PARNTHEQ
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        NPREN22
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        N111V
        NPREN11
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        LYZMSTT1VVV
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PRNV11B
        PRNV11
PRON1
        EOB1
        SB1
        VOB1
PRON2
        EOB2
        SB2
        VOB2
        VOB2NEG
PRON3
        EOB3
        SB3
        VOB3
        VOB3NEG
```

PROSS			N 2 Q F A R
	SYNN	QFAR3	
PROX			N 3 3
	PROXNOR	QFR	
PROXNOR			QFAR
	MOOF		QFAR3
PROXQUAN		QQ	
	MOOF		Q
PRPRNCBAE		Q1	
	LYZMSTT1CC		QQ
PRT		Q1AJP	
	RLVAB		Q1
PRTT		Q1EP	
	PRT		Q1
PT		Q1HQP	
	DIR		Q1
	STTT	Q1MP	
	Q		Q1
	A	Q1RELP	
PTT			Q1
	DEC	Q1VP	
PUM			Q1
	LU	Q2	
PVLSTA			QQ
	POVVLISTA	Q2AJP	
PVLSTB			Q2
	POVVLISTB	Q2EP	
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	S	Q2HQP	
	LYZ		Q2
QFAR		Q2MP	

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Q 2 R E L P

Q 2

Q 2 V P

Q 2

Q 3

Q Q

Q 3 A J P

Q 3

Q 3 E P

Q 3

Q 3 H Q P

Q 3

Q 3 M P

Q 3

Q 3 R E L P

Q 3

Q 3 V P

Q 3

R A K

K I R S C H

R E

W R T 1

W R T 2

R E L

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R E L O B 3

R E L O B 1

R E L P 1 N E G

R E L P 1 P O S

Q 1 R E L P

R E L O B 2

R E L P 2 N E G

R E L P 2 P O S

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R E L O B 3

R E L P 3 N E G

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P R E D 3 N E G

R E L P 3 P O S

P R E D 3 P O S

R L D S

R L V I

R L D S A

R L D S

R L D S A N A

R L D S A

R L D S A N A A

R L V A C B G Ń

R L D S A N A A

R L D S A N A C P V

RLDSANACPV

RLVD

RLDSCPV

RLDSANB

RLDSA

RLDSCPV

RLDSANC

LYZMSTT2AAB

RLDSA

RLDSCPV

RLDSAND

RLDSANAA

RLDSB

RLDS

RLDSBNA

LYZMSTT2AAA

RLDSB

RLDSCPV

RLDSCPV

RLVI

RLV

PORLV

REL

RLVA

RLV

RLVAA

RLVA

RLVAAA

SPQR

RLVAA

RLVAAB

RLVAA

RLVAAC

SPQR

RLVAA

RLVAAD

RLVAA

RLVAAB

RLVAB

RLVA

RLVAC

RLVA

RLVACA

RLVAC

RLVACAGN

RLVACA

RLVACAGNA

RLVACAGN

RLVACAGNB

RLVACAGN

RLVACB

RLVAC

RLVACBGN

RLVACB

RLVACSP

RLVACA

RLVACB

RLVB

RLV

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RLVB

RLVB2

RLVB

RLVC

RLV

RLVD

REL

RLVDIRE

RLVACSP

RLVDIREGN

RLVDIRE

RLVDIRESP

RLVDIRE

RLVDIRN

RLVACSP

RLVDIRNGN

RLVDIRN

RLVDIRNSP

RLVDIRN

RLVDIRS

RLVACSP

RLVDIRSGN

RLVDIRS

RLVDIRSSP

RLVDIRS

RLVDIRW

RLVACSP

RLVDIRWGN

RLVDIRW

RLVDIRWSP

RLVDIRW

RLVE

RLV

RLVF

RLV

RLVG

RLV

RLVH

RLV

RLVI

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WRT1

RSPT2

RSPT2

WRT2

SB1

Q1EP

Q1VP

Q1AJP

Q1RELP

Q1MP

Q1HQP

STTNEG1

STTPOS1

SB2

Q2EP

Q2VP

Q2AJP

Q2RELP

Q2MP

Q2HQP

STTNEG2

STTPOS2

SB3

Q3EP

Q3VP

Q3AJP

Q3RELP

Q3MP

Q3HQP

STTNEG3

STTPOS3

SPQR

ADVOR

STMT

STTT

STROF

NTHH

STTNEG

STMT

XSTTNEG

STTNEG1

STTNEG

STTNEG2

STTNEG

STTNEG3

STTNEG

STTPOS

STMT

XSTTPOS

STTPOS1

STTPOS

STTPOS2

STTPOS

STTPOS3

STTPOS

STTT

S

SYN

DIRR

SYNN

SYN

TH

AJFIXTHER

THAN

RLVD

RLVI

RLVC

THOF

POEQN

TW

HUM

UNO

PVLSTB

V

Q1VP

Q2VP

Q3VP

V1NEG

V2NEG

V3NEG

VARRA

PRNV11A

VARRB

NPREN222

PRNV11B

VARRC

PRNV11A

VARRD

NPREN222

PRNC11

VAUX1

VFIXNEG1

Q1VP

Q1MP

Q1HQP

VAUX2

VFIXNEG2

Q2VP

Q2MP

Q2HQP

VAUX3

VFIXNEG3

Q3VP

Q3MP

Q3HQP

VCALL

CALL

VEXTR

EXTR

VCN

V

VEDA

V1POS

V2POS

V3POS

VEDA

RLVAB

VEDB

RLVAB

VEIV

RLVAB

VFIXE

VINCL

VFXES

M1POS

M3POS

VAUX1

VAUX3

VFIXNEG1

HQ1NEG

M1NEG

V1NEG

VFIXNEG2

HQ2NEG

M2NEG

V2NEG

VFIXNEG3

HQ3NEG

M3NEG

V3NEG

VFXS

HQ1POS

HQ3POS

V1POS

V3POS

VFRG

FORGE

VH

V

V2POS

VHBAA

VH

V1POS

V3POS

VHBAB

VH

VHQBAA

HQ

HQ1POS

HQ3POS

VHQBAB

HQ

VINCL

VEDA

VINCLBAA

VINCL

VINCLBAAA

VINCLBAB

VINCLBAA

VINCLBAAB

VINCLBAA

VINCLBAB

VEIV

VINCLBABB

VINCLBAB

VLIST

LYZSPEC 48

VLYZA

VLYZAL

LYZSPEC

VVLIST

VLYZAL

LYZAL

VLYZB

VLYZAL

LYZSPEC

VMARK

VMRK

VMRK

MRKK

VNTRSCT

VEDB

VOB1

VP1NEG

VP1POS

Q1VP

VOB2

VP2POS

Q2VP

VOB2NEG

VP2NEG

VOB3

VP3POS

Q3VP

VOB3NEG

VP3NEG

VPOSYNN

POSYNN

VPSVFXED

AJVPSVA

VP1NEG

PRED1NEG

VP1POS

PRED1POS

VP2NEG

PRED2NEG

VP2POS

PRED2POS

VP3NEG

PRED3NEG

VP3POS

PRED3POS

VTCH

RLVACAGNB

VVLIST

VLIST

VVVLIST

VVLIST

V.YZPROS

LYZ

V1NEG

VP1NEG

V1POS

VP1POS

V2NEG

VP2NEG

V2POS

VP2POS

V3NEG

V3POS

WATT

WH

WHCL1

WHCL2

WHCL3

WHOLE

WITH

WMW

WOPOMU

WRT1

WRT2

VP3NEG

VP3POS

MST

MU1

WHCL1

WHCL2

WHCL3

PO11

PO22

PO33

POEXTR

PROSS

XWTL

YN

POMU

MOB1

MOB3

MOB3NEG

MOB2

MOB2NEG

X

AJJA

AJJB

XAS

POAJ

PREAR

BU

PO2

PO3

XAT

XAV

PRPRNCBAE

XEO

PONPREN1

PONPREN2

PONPREN3

XNRSPT1A

PO1

N2CJA

N2CJANEG

POEXTR

XWTL

PORLV

POVVLISTA

POVVLISTB

PROX

RLVAAB

XSTTNEG

XSTTPOS

XAS

XAT

XAV

XEO

XNRSPT1A

XSTTNEG

XSTTPOS

XTR

XWTL

YES

YINGDANG

YN

Z

AJOBP

LOC

LYZMST

LYZMSTT1VV

OBVLYZB2

RSPT1

MOB2

MOB2NEG

NRSPT1

YN

YN

PART

PONLAB

YN

FRCN

A

AJLGCA

AJREL

BERT

D E C

N U M 1

N U M 2

F R C N

K I R S C H

P R O X N O R

N B R T

N O N 1 B

N O N 2 B

2.3 Distribution of the Rules.

Instantiators ("Rule-Heads")		
Penterminals		232
Others		444
	TOTAL	676
Instances ("Rewrites")		
Terminals		332
Nonterminals		835
	TOTAL	1,167

3. Sample Computer Generation.

3.1 Prefatory Note.

In 3.2, below, are exhibited a number of sentences machine-generated from the rules of PLACEBO IV by the random-generation program alluded to earlier. The first few of these sentences have been copied exactly as generated, with extra spaces shown where "overt deletions" were made and also with following "trace of generation". These "traces" are generally speaking rather formidable objects; but a perusal of them will greatly speed the reader's apprehension of the functioning of "random generation" and of the way in which PLACEBO IV specifies its strings. The following example may facilitate such a perusal.

LIST IN ORDER EVERY N'TH ONE (N =100) OF THE GRANULES OF CYTOPLASM.

S DIR DIRR LYZ VYZPROS LYZSPEC VLIST VVLIST VVVLIST /// POVVLISTA PVLSTA /// POVVLISTB PVLSTA EVERY /// NTHH NTHN /// STROF /// AFJIXTH /// UNO /// PARNTHEQ PRNL /// NTHN /// EQ /// NBR2 NBRHDRDS HBRHDRD NBRMDGT NBR1 /// NBRTENSA NBRTENA NBRMDGTA NBRZO /// NBRMDGTA NBRZO /// PRNR /// OF /// DEF2 DFDK2 DEFAR /// AJNP2 N222 NON2 NON2C NPREN2222 PRNCBAC /// NFIX2ES /// PONPREN3 OF /// AJNP3 N333 NN3 NN3B CYTO /// NN3BA /// PT ///

In the above given "trace", each symbol immediately preceding the symbol "///" is penterminal; thus, for every terminal in the above given sentence, there is a sequence of (one or more) symbols in the accompanying "trace" which is flanked by the symbol "///", except for the first such sequence of each trace, which has no "///" to the left. It is easy then to reorganize the sentence-and-trace to show the relation between the two.

```
1.  S DIR DIRR LYZ VYZPROS LYZSPEC VLIST VVLIST VVVLIST - - List
2.  POVVLISTA PVLSTA - - - - - - - - - - - - - - - - - - in order
3.  POVVLISTB PVLSTA EVERY - - - - - - - - - - - - - - - - - every
4.  NTHH NTHN  - - - - - - - - - - - - - - - - - - - - - - - - - n
5.  STROF  - - - - - - - - - - - - - - - - - - - - - - - - - - - '
```

6. AJFIXTH - th
7. UNO - one
8. PARNTHEQ PRNL - (
9. NTHN - n
10. EQ - =
11. NBR2 NBRHDRDS NBRHDRD NBRMDGT NBR1 - - - - - - - - - - - - 1
12. NBRTENSA NBRTENA NBRMDGTA NBRZO - - - - - - - - - - - - - - 0
13. NBRMDGTA NBRZO - 0
14. PRNR -)
15. OF - of
16. DEF2 DFDK2 DEFAR - the
17. AJNP2 N222 NON2 NON2C NPREN2222 PRNCBAC - - - - - granul
18. NFIX2ES - es
19. PONPREN3 OF - of
20. AJNP3 N333 NN3 NN3B CYTO - - - - - - - - - - - - - - - cyto
21. NN3BA - plasm
22. PT - .

To throw some light on the process involved here, line-1 may be examined. The program has been told to generate a sentence beginning with the symbol "S" (another initiating symbol could have been prescribed); hence the first symbol displayed will necessarily be "S". In a random generation process, such as the one in question here, the program will make a random choice among any options it meets in the path-of-instantiation; and the program meets such a group of options immediately, in the instantiation of "S". For, as may be seen in the list of rules given in 1.2, S = DIR,STTT,Q,A. In this case, the program randomly chose "DIR". "DIR" is the second symbol in line-1. Now "DIR" is instantiated; DIR = DIRR + PT. "DIRR" is the next symbol in line-1: "PT" does not appear in line-1, however. This is because the program has momentarily shelved "PT"

(i.e., put it in the push-down store) while it fully instantiates "DIRR"; as can be seen, in fact, the program does not get back to instantiate "PT" until the very last line.

"DIRR" will now be instantiated, in accordance with the rule DIRR = LYZ,SYN,LAB. Again the program makes a random choice, selecting "LYZ". Now "LYZ" is instanced: LYZ = Q, VYZPROS; "VYZPROS"is chosen. VYZPROS = LYZAL,LYZSPEC; "LYZSPEC" is selected. LYZSPEC = VLYZA+DEF2, VLYZB+OBVLYZB, VLIST+DEF2. The last option is chosen, and "VLIST" appears in line-1. The second constituent of the choice, "DEF2", is shelved, as "PT" was; "VLIST" will be instantiated to terminal level (and so will every symbol encountered in the course of instantiating it to terminal level) before the program returns to instantiate "DEF2". In fact, as we see, "DEF2" is returned to in line-16. (The program returns to "DEF2" before it returns to the earlier-shelved "PT" because of the nature of a push-down store: first in, last out.) Now "VLIST" is instanced: VLIST = VVLIST+POVVLISTA+POVVLISTB. Both "POVVLISTA" and POVVLISTB" are shelved while "VVLIST" is continued. VVLIST = VVVLIST, VLYZA+AND+VVVLIST; "VVVLIST" is selected. "VVVLIST" is penterminal as we see in the rule VVVLIST = * LIST*; the program has reached the point where it prints out "///" in the trace and the terminal " LIST" in the string.

The program operates in like manner on the other rules and symbols required to produce the above-given string, and in like manner to produce the strings which now follow.

3.2 Sample Computer Generation, Random, from the Rules of PLACEBO IV.

NUMBER 12

THIS IS NOT FURTHER AWAY FROM THE LEAST DENSE EPENDYMA THAN FROM A LINEAR DENDRITE WHICH ISN'T MUCH FARTHER FROM A PROCESS THAN FROM LIGHT NUCLEOPLASM .

S STTT STMT STTNEG STTNEG3 SB3 PRON3 /// PRED3NEG RELP3NEG EE3NEG EE3POS /// NOT /// RELOB3 REL RLVD BU X /// RLDSANACPV RLDSANAA RLDSAND /// AJFIXTHER TH /// ER /// AWAY /// OBAWAY N123 N1 N11 DEF DEFAR /// AJSPV AJLT LT /// AJNCT AJC AJCD /// AJFIXE /// N111 N NVBAX1 NVBAB /// PO1 X /// THAN /// FROM /// N123 N1 N11 INDEF INDFRA /// AJNP1C ADJC AJJC AJLGC AJLGCB NNBAA /// AJFIXAR /// AJJA X /// N111 N NCBAX1 NCBAD /// NFIX1E /// PO1 PO11 WHCL1 WH /// PRED1 PRED1NEG RELP1NEG EE1NEG EE1POS /// NOT /// RELOB1 REL RLVD BU LU PUM /// RLDSANACPV RLDSANAA RLDSANA /// AJFIXTHER TH /// ER /// AWAY /// OBAWAY N123 N1 N11 INDEF INDFRA /// AJNP1C N111C PRNC1 PRNCBAA /// PONPREN12 PONPREN2 X /// PO1 X /// THAN /// FROM /// N123 N3 N33 QFAR3 QFR /// AJNP3 ADJ3 AJJ3A AJCAA AJCAAA /// N333 NN3 NN3B NCBAC /// AJFIXO /// NN3BA /// PO3 X /// PT ///

NUMBER 13

DOES THIS CONTAIN THIS.

S Q QQ Q1 Q1VP VAUX1 DO /// VFXES /// SB1 PRON1 /// V VCN /// VOB1 PRON1 /// PT ///

NUMBER 14

NO, THESE ARENT THESE.

S A YN NO /// XSTTNEG CM /// STTNEG STTNEG2 SB2 PRON2 /// PRED2NEG EP2NEG E2NEG E2POS /// NOT /// EOB2 PRON2 /// PT ///

NUMBER 15

ARE THESE DEFINITE .

S Q QQ Q2 Q2AJP EEE2POS /// SB2 PRON2 /// AJOB ADJ ADJC AJJC AJLGC AJLGCA Z /// AJLGCAABC AJLGCAC /// AJJA X /// PT ///

NUMBER 75

ALL LIGHT COLAGEN HAS SOME DENSE CYTOPLASM .

S STTT STMT STTPOS STTPOS3 SB3 N3 N33 QFAR3 QFR /// AJNP3 ADJ3 AJJ3A AJCAA AJCAAA /// N333 NN3 NN3A NN3AA /// PO3 X /// PRED3POS VP3POS V3POS VHBAA /// VFXS /// VOB3 PRDN3 PRDN33 PRDQFAR3 PRDQFR /// AJNP3 ADJ3 AJJ3A AJCD /// AJFIXE /// N333 NON3 NPREN33 NN3 NN3B CYTO /// NN3BA /// PONPREN12 PONPREN2 X /// PO3 X /// PT ///

NUMBER 76

FIND THE SIZE OF ALL BLOBS.

S DIR DIRR LYZ VYZPROS LYZAL VLYZAL VLYZB /// LYZMST DEFAR /// XAV X /// LYZMSTT1 LYZMSTT1A LYZMSTT1AC /// OF /// OBVLYZAL ALL /// NGEN2 NGEN1 /// NFIX2S /// PT ///

NUMBER 77

CANT ANSWER.

S A YN WMW /// PT ///

NUMBER 81

THIS IS 1 BIT FARTHER FROM THE NUCLEOLIC, IRREGULAR, LESS MICROGLIAL, INDEFINITE AND STELLATE EPENDYMAS THAN FROM SOME OF THE MYELIN .

S STTT STMT STTPOS STTPOS3 SB3 PRON3 /// PRED3POS RELP3POS EE3POS /// RELOB3 REL RLVD BU LU DERITH DERITH1 NUM1 Z /// NBR1 /// MU1 BIT /// RLDSANACPV RLDSANAA RLDSANA /// AJFIXTHER TH /// ER /// AWAY /// OBAWAY N123 N2 N2QFAR QFAR DFDK2 DEFAR /// AJNP2 ADJ ADJC AJJC AJLGC AJLGCC NCBAC /// AJFIXIC /// AJJA AJJB CM /// AJJD AJJJ AJJV AJLGV AJLGVA AJNEGFXB /// AJLGCAB /// AJJB CM /// AJJD AJJJ AJJC AJCPV AJLS LS /// AJNCT AJLG AJLGC AJLGCC NCBAE /// AJFIXL /// AJJB CM /// AJJD AJJJ AJJV AJLGV AJLGVA AJNEGFXC /// AJLGCAC /// AJJB X /// AND /// AJJJ AJJC AJLGC AJLGCB NNBAD /// AJFIXELLATE /// N222 NN2 NVBAX2 NVBAB /// NFIX2S /// PO2 X /// THAN /// FROM /// N123 N3 N33 QFAR3 ARPREAR3 PREAR PREAR3 MOOF PROXQUAN /// OF /// DFDK1 DEFAR /// AJNP3 N333 NN3 NN3A NN3AA /// PO3 X /// PT ///

NUMBER 82

WHITE MATTER WHICH ISNT CYTOPLASM IS THIS.

S STTT STMT STTPOS STTPOS3 SB3 N3 N33 QFAR3 QFR /// AJNP3 N333 NON3 NPREN33 NN3 NN3A NN3AB CLR AJCCA /// AJFIXE /// NN3ABA /// PONPREN12 PONPREN1 X /// PO3 PO33 WHCL3 WH /// PRED3 PRED3NEG EP3NEG E3NEG E3POS /// NOT /// EOB3 EPRDN3 EPRDN33 EPRDQFR /// AJNP3 N333 NON3 NPREN33 NN3 NN3B CYTO /// NN3BA /// PONPREN12 PONPREN1 X /// PO3 X /// PRED3POS EP3POS E3POS /// EOB3 PRON3 /// PT ///

NUMBER 83

NO .

S A YN NO /// XSTTNEG X /// PT ///

NUMBER 110

YES .

S A YN YES /// XSTTPOS X /// PT ///

NUMBER 111

DOES THIS MATCH GRANULAR COLAGEN WHICH IS DENSE AND WHICH IS NOT MANY TIMES FARTHER FROM THIS MARK THAN FROM THE DARKEST MICROGLIA AND WHICH DOES NOT HAVE A SIZE EQUAL TO THAT OF THIS PROCESS AND WHICH ISN'T LABELLED --((-- AN UNDEFINED AND WHITER AXON OF A CELL --))-- WITH REGARD TO LENGTH OF PERIMETER AND PROCESSING.

S Q QQ Q1 Q1MP VAUX1 DO /// VFXES /// SB1 PRON1 /// M /// MOB1 N123 N3 N33 QFAR3 QFR /// AJNP3 ADJ3 AJJ3B PRNCBAC /// AJFIXAR /// N333 NON3 NPREN33 NN3 NN3A NN3AA /// PONPREN12 PONPREN2 X /// PO3 PO33 WHCL3 WH /// PRED3 PRED3POS AJP3POS EEE3POS /// AJ3OB ADJ3 AJJ3A AJCD /// AJFIXE /// POAJ X /// AND /// PO33 WHCL3 WH /// PRED3 PRED3NEG RELP3NEG EE3NEG EE3POS /// NOT /// RELOB3 REL RLVD BU LU GAVIN /// DJUNA /// RLDSANACPV RLDSANAA RLDSANA /// AJFIXTHER TH /// ER /// AWAY /// OBAWAY MARK DFDK1 DKAR1 /// MRK /// THAN /// FROM /// N123 N1 N11 DEF DEFAR /// AJSPV AJMT AJCA AJCAA AJCAAA /// EST /// N111 N NCBAX1 NCBAE /// PO1 X /// AND /// PO33 WHCL3 WH /// PRED3 PRED3NEG VP3NEG HQ3NEG VFIXNEG3 VAUX3 DO /// VFXES /// NOT /// HQ VHQBAA /// VHQBAB /// HQOB3 LYZMSTT1C INDFRA /// LYZMSTT1CC PRNCBAF /// EQL EQU /// POEQ POEQN THOF /// N123 N1 N11 DEF DFDK1 DKAR1 /// AJNP1 AJNP1C N111C PRNC1 PRNCBAA /// PONPREN12 PONPREN2 X /// PO1 X /// AND /// PO33 WHCL3 WH /// PRED3 PRED3NEG AJP3NEG EEE3NEG EEE3POS /// NOT /// AJ3OB AJOBP AJVPSVA LABL /// L /// VPSVFXED /// XAS X /// DND DL /// NPOLAB LIPKIN N1 N11 INDEF INDFRAN /// AJNP1V ADJV AJJV AJLGV AJLGVA AJNEGFXA /// AJLGCAA /// AJJA AJJB X /// AND /// AJJJ AJJC AJCPV AJMR AJCC AJCCA /// ER /// N111 NON1 NON1A NPREN11 PRNV1 PRNVBA /// PONPREN1 OF /// N1 N11 INDEF INDFRA /// AJNP1C N111C NCBAX1 NCBAB NCBABC /// PO1 X /// PO1 X /// DR /// WRT1 RE /// RSPT1 XAV X /// NRSPT1 XNRSPT1A X /// NRSPT1A LYZMSTT1 LYZMSTT1A PRNCBAG /// OF /// PRNCBAE /// AND /// NRSPT1A LYZMSTT2AB /// PT ///

NUMBER 112

YES, THESE HAVE SOME CYTOPLASM AND THIS INDEFINITE MICROGLIA .

S A YN YES /// XSTTPOS CM /// STTPOS STTPOS2 SB2 PRON2 /// PRED2POS VP2POS V2POS VH VHBAA /// VHBAB /// VOB2 PRDN2 N2CJ N2CJA X /// N123 N3 N33 QFAR3 QFR /// AJNP3 N333 NN3 NN3B CYTO /// NN3BA /// PO3 X /// AND /// N123 N1 N11 DEF DFDK1 DKAR1 /// AJNP1 AJNP1V ADJV AJJV AJLGV AJLGVA AJNEGFXC /// AJLGCAC /// AJJA X /// N111 N NCBAX1 NCBAE /// PO1 X /// PT ///

NUMBER 113

THESE ARE LABELLED --((-- ASTROCYTIC EPENDYMA --))-- .

S STTT STMT STTPOS STTPOS2 SB2 PRON2 /// PRED2POS AJP2POS EEE2POS /// AJOB AJOBP AJVPSVA LABL /// L /// VPSVFXED /// XAS X /// DND DL /// NPOLAB LIPKIN AJNP1 AJNP1V ADJV AJJV AJLGV AJLGVC NVBAA /// AJFIXIC /// AJJA X /// N111 N NVBAX1 NVBAB /// DR /// PT ///

NUMBER 114

THIS IS LABELLED AS --((-- PROCESS OF AN UNDEFINED AND ARACHNOIDAL PROCESS --))-- .

S STTT STMT STTPOS STTPOS1 SB1 PRON1 /// PRED1POS AJP1POS EEE1POS /// AJOB AJOBP AJVPSVA LABL /// L /// VPSVFXED /// XAS AS /// DND DL /// NPOLAB LIPKIN AJNP1 AJNP1C N111C PRNC1 PRNCBAA /// PONPREN12 PONPREN1 OF /// N1 N11 INDEF INDFRAN /// AJNP1V ADJV AJJV AJLGV AJLGVA AJNEGFXA /// AJLGCAA /// AJJA AJJB X /// AND /// AJJJ AJJV AJLGV AJLGVC NVBAC /// AJFIXAL /// N111 NON1 NON1A NPREN11 PRNC1 PRNCBAA /// PONPREN1 X /// PO1 X /// DR /// PT ///

NUMBER 115

THIS IS INCLUSIVE OF SOME MASSES .

S STTT STMT STTPOS STTPOS3 SB3 PRON3 /// PRED3POS RELP3POS EE3POS /// RELOB3 REL RLV RLVA RLVAB VEIV VINCLBAB VINCLBAAA /// VINCLBABB /// AJFIXIVE /// OF /// PORLV X /// N123 N2 N2QFAR QFAR QFR /// AJNP2 N222 NN2 NCBAX2 NCBAA NCBAAA /// NFIX2ES /// PO2 X /// PT ///

NUMBER 116

THE GRANULAR NUCLEOPLASM OF 2 AXONAL ASTROCYTE - ARRAYS ISN'T LABELLED AS --((-- RAK-R --))-- .

S STTT STMT STTNEG STTNEG3 SB3 N3 N33 QFAR3 ARPREAR3 PREAR X /// DFDK1 DEFAR /// AJNP3 ADJ3 AJJ3B PRNCBAC /// AJFIXAR /// N333 NON3 NPREN33 NN3 NN3B NCBAC /// AJFIX0 /// NN3BA /// PONPREN12 PONPREN2 OF /// N2 N2QFAR QFAR NUM2 Z /// NBR2 NBRDGT NBR29 /// AJNP2 ADJ ADJV AJJV AJLGV AJLGVC NVBAC /// AJFIXAL /// AJJA X /// N222 NON2 NON2B N NVBAX1 NVBAA /// NFIX1E /// Z /// HYN /// NPREN222 VARRB /// NFIX2S /// PO2 X /// PO3 X /// PRED3NEG AJP3NEG EEE3NEG EEE3POS /// NOT /// AJ30B AJOBP AJVPSVA LABL /// L /// VPSVFXED /// XAS AS /// DND DL /// NPOLAB KIRSCH RAK /// HYN /// LTR /// DR /// PT ///

NUMBER 117

LIST IN ORDER EVERY N'TH ONE (N =100) OF THE GRANULES OF CYTOPLASM.

S DIR DIRR LYZ VYZPROS LYZSPEC VLIST VVLIST VVVLIST /// POVVLISTA PVLSTA /// POVVLISTB PVLSTB EVERY /// NTHH NTHN /// STROF /// AJFIXTH /// UNO /// PARNTHEQ PRNL /// NTHN /// EQ /// NBR2 NBRHDRDS NBRHDRD NBRMDGT NBR1 /// NBRTENSA NBRTENA NBRMDGTA NBRZO /// NBRMDGTA NBRZO /// PRNR /// OF /// DEF2 DFDK2 DEFAR /// AJNP2 N222 NON2 NON2C NPREN2222 PRNCBAC /// NFIX2ES /// PONPREN3 OF /// AJNP3 N333 NN3 NN3B CYTO /// NN3BA /// PT ///

NUMBER 157

SOME UNDEFINED, EPENDYMAL AND STELLATE FLAKES DONT MATCH WITH REGARD TO AVERAGE AREA.

S STTT STMT STTNEG STTNEG2 SB2 N2 N2QFAR QFAR QFR /// AJNP2 ADJ ADJV AJJV AJLGV AJLGVA AJNEGFXA /// AJLGCAA /// AJJA AJJB CM /// AJJD AJJJ AJJV AJLGV AJLGVC NVBAB /// AJFIXL /// AJJB X /// AND /// AJJJ AJJC AJLGC AJLGCB NNBAD /// AJFIXELLATE /// N222 NON2 NON2C NPREN2222 PRNCBAD /// NFIX2S /// PONPREN3 X /// PO2 X /// PRED2NEG VP2NEG M2NEG VFIXNEG2 VAUX2 DO /// NOT /// M /// MOB2NEG XEO X /// WRT2 RE /// RSPT2 RSPT1 XAV AV /// NRSPT1 NRSPT1A LYZMSTT1 LYZMSTT1A LYZMST1V /// PT ///

NUMBER 158

CAJAL A PEAR-SHAPED AND SMALL OLIGO AND DISPLAY.

S DIR DIRR SYN SYNN FORGE VFRG /// N123 N1 N11 INDEF INDFRA /// AJNP1C ADJC AJJC AJLGC AJLGCA AJLGCAD /// AJJA AJJB X /// AND /// AJJJ AJJC AJC AJCA AJCAB /// N111 N NVBAX1 NVBAE NVBAEBRV /// PO1 X /// POSYNN AND /// VPOSYNN /// PT ///

NUMBER 250

CAJAL 1 OF THESE IRREGULAR OLIGODENDROGLIOS AND STORE.

S DIR DIRR SYN SYNN FORGE VFRG /// N123 N1 N11 PARPLU NUM1 Z /// NBR1 /// OF /// DFDK2 DKAR2 /// AJNP2 ADJ ADJV AJJV AJLGV AJLGVA AJNEGFXB /// AJLGCAB /// AJJA X /// N222 NN2 NVBAX2 NVBAE NVBAEBRV ///NVBAEFUL /// NFIX10 /// NFIX2S /// PO1 X /// POSYNN AND /// VPOSYNN /// PT ///

NUMBER 443

IS THIS AT 1 ON THE X COORDINATE AND AT 1 ON THE Y COORDINATE.

S Q QQ Q3 Q3AJP EEE3POS /// SB3 PRON3 /// AJ30B LOC AT /// LOCX NUM NUM1 Z /// NBR1 /// CORX /// AND /// XAT AT /// LOCY NUM NUM1 Z /// NBR1 /// CORY /// PT ///

NUMBER 444

IS MOST OF THIS GRAY MATTER 1 MICRON IN WIDTH.

S Q QQ Q3 Q3AJP EEE3POS /// SB3 N3 N33 QFAR3 ARPREAR3 PREAR PREAR3 MOOF PROXQUAN /// OF /// DFDK1 DKAR1 /// AJNP3 N333 NON3 NPREN33 NN3 NN3A NN3AB CLR AJCAAB /// NN3ABA /// PONPREN12 PONPREN2 X /// PO3 X /// AJ30B MST NUM1 Z /// NBR1 /// WATT /// POMU IN /// WOPOMU PRNCBAG /// PT ///

NUMBER 476

THESE AREN'T LABELLED --((-- UNDEFINED GRANULE OF GRAY MATTER OF 1 OF THE AXONS --))-- .

S STTT STMT STTNEG STTNEG2 SB2 PRON2 /// PRED2NEG AJP2NEG EEE2NEG EEE2POS /// NOT /// AJOB AJOBP AJVPSVA LABL /// L /// VPSVFXED /// XAS X /// DND DL /// NPOLAB LIPKIN AJNP1 AJNP1V ADJV AJJV AJLGV AJLGVA AJNEGFXA /// AJLGCAA /// AJJA X /// N111 NON1 NON1C NPREN1111 PRNC111 PRNCBAC /// NFIX1E /// PONPREN3 OF /// AJNP3 N333 NON3 NPREN33 NN3 NN3A NN3AB CLR AJCAAB /// NN3ABA /// PONPREN12 PONPREN1 OF /// N1 N11 PARPLU NUM1 Z /// NBR1 /// OF /// DFDK2 DEFAR /// AJNP2 N222 NON2 NON2A NPREN22 PRNVBA /// NFIX2S /// PONPREN12 PONPREN2 X /// PO1 X /// DR /// PT ///

Additional sentences from the same computer-run follow, here retyped without "trace" or "overt deletion" spaces:

1. "Count all blobs."
6. "These are 1 micron in perimeter."
24. "Call up each of these large, irregular and less dense arachnoids and store."
37. "Diagram all endothelial artefacts and store."
39. "Find the density of these arrangements."
42. "No, these arent 8 microns in height."
45. "Is this 1 micron in length."
52. "Enlarge and display."
62. "Find the average width of perimeter."
68. "All endothelial cytoplasm of 1 of the small oligos and the dendritic nucleoplasm is indistinguishable from a grayer and fusiform nucleolus."
121. "Label each of the nuclei with the label --((-- J --))--."
133. "Is a nucleolus here."
150. "Label each of these dense and oligodendroglial endothelia with the label --((-- RAK-P --))--."
186. "Does cortex contain some artefactal cytoplasm."
191. "Call up the pear-shaped axons and hold."
225. "Yes, this is this."
231. "All cytoplasm which doesn't have membranal nucleoloplasm and which is this and which is farther from a membrane than from 1 of these granules of endothelial black matter is here."
275. "A process isn't at 11 o'clock from some nucleoloplasm."
281. "Is 1 of these flakes a white cell body."
282. "Find the average density of each of the endothelia."
323. "Label each of these undefined perimeters with the label --((-- Y --))--."
373. "These arent astrocytes."
394. "Yes."

406. "Is this distinguishable from an endothelial, white and oligodendroglial oligo."

416. "Does this match the least inward endothelium with regard to label and length of perimeter."

440. "Does this match 6 dendrites and the flakes and 1 of the dendrites with regard to size."

455. "Do the astrocytes have a separation equal to that of some indefinite and big artefacts."

480. "Is this 6 microns in length."

489. "No, this doesn't contain a nucleus."

499. "A nucleolus contains 1 of the bodies."

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