
Compilation of small ribosomal subunit RNA sequences

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INTRODUCTION

The present compilation lists 106 sequences (1-106) of small ribosomal subunit RNAs (bacterial 16S rRNAs and the homologous RNAs in eukaryotic cytoplasmic ribosomes, plastid ribosomes and mitochondrial ribosomes; further abbreviated srRNAs) and updates the previous compilation which contained 57 entries (107). The sequences included are listed in Table 1 and belong to 40 eukaryotes, 12 archaeobacteria, 23 eubacteria, 5 plastids and 26 mitochondria. Only complete or virtually complete sequences are listed. An attempt was made to include all sequences published up to and including 1987 insofar as possible in view of the publication deadline.

CONVENTIONS AND SYMBOLS USED IN THE SEQUENCE ALIGNMENT

In the alignment each sequence is preceded by a number and by the initials of the species name. The number allows to identify it in Table 1 and to find the literature reference. The numbering at the top of each page applies to alignment positions, not to the nucleotides of any individual sequence. The sequences are listed in 5 blocks, comprising srRNAs from eukaryotes, archaeobacteria, eubacteria, plastids, and mitochondria.

All the sequences are listed using the ribonucleotide symbols U, C, A, and G, although all of them except No. 5 were derived by DNA sequence analysis of the cloned genes. The symbols Y (pyrimidine) and R (purine) denote incompletely identified nucleotides. The symbol X is used to indicate that nucleotides are present but have not been identified by sequencing. The lower case characters u, c, a, and g are used to indicate length heterogeneity of the rRNA chains. Posttranscriptional modifications are not indicated in the alignment but the existence of such data is mentioned in Table 1 if available.

The alignment of sequences for optimal similarity was obtained by visual

Table 1. srRNA sequences listed in the alignment
Footnotes are listed on the page following this Table.

Nr (a)	Species	Specification (b)	Taxonomic position (c)	S-value	Length (d)	Remark
Eukaryotes						
1	<i>Homo sapiens</i>		Chordata (Ph.)	18S	1868	e, h
2	<i>Mus musculus</i>		Chordata (Ph.)	18S	1869	
3	<i>Rattus norvegicus 1</i>	Male Sprague-Dawley, liver	Chordata (Ph.)	18S	1869	g
4	<i>Rattus norvegicus 2</i>	Male Sprague-Dawley, liver	Chordata (Ph.)	18S	1874	g
5	<i>Oryctolagus cuniculus</i>	Reticulocytes	Chordata (Ph.)	18S	1858	f, i
6	<i>Xenopus laevis</i>		Chordata (Ph.)	18S	1826	e
7	<i>Xenopus borealis</i>		Chordata (Ph.)	18S	1825	e
8	<i>Artemia salina</i>	Cysts	Arthropoda (Ph.)	18S	1810	
9	<i>Caenorhabditis elegans</i>	Strain CB2769	Nematelminthes (Ph.)	18S	1810	
10	<i>Oryza sativa</i>		Nematoda (Cl.)	18S	1759	
11	Zea mays		Liliopsida (Cl.)	17S	1812	
12	<i>Glycine max</i>	Cultivar Black Mexican, leaves	Liliopsida (Cl.)	17S	1809	
13	<i>Chlamydomonas reinhardtii</i>	Variety Wayne lambda-SR1	Spermatophyta (Ph.)	18S	1807	
14	<i>Ochromonas danica</i>		Spermatophyta (Ph.)	18S	1791	
15	<i>Neurospora crassa</i>		Chlorophyceae (Cl.)		1789	
16	<i>Saccharomyces cerevisiae</i>		Chrysophyceae (Cl.)		1795	
17	<i>Achlya bisexualis</i>		Pyrenomyces (Cl.)		1798	
18	<i>Dictyostellium discoideum</i>		Hemiascomycetes (Cl.)	18S	1809	
19	<i>Euplotis aediculatus</i>	Strain A364A	Ascomycotina (Ph.)		1809	
20	<i>Oxytricha nova</i>	Strain Ax3	Ascomycotina (Ph.)		1872	f
21	<i>Stylonychia pustulata</i>		Myxomycota (Ph.)	17S	1882	
22	<i>Tetrahymena thermophila</i>		Ciliata (Ph.)	18S	1882	
23	<i>Tetrahymena pigmentosa</i>		Ciliata (Ph.)	1771	1771	
24	<i>Tetrahymena breviwischi</i>	Strain A-17682a, ATCC 30377	Spirotricha (O.)		1771	
25	<i>Tetrahymena australis</i>	Strain UM 1286	Spirotricha (O.)		1771	
26	<i>Tetrahymena capricornis</i>	Strain KP7, ATCC 30832	Spirotricha (O.)	17S	1753	
27	<i>Tetrahymena patula</i>	Strain MG0, ATCC 30831	Holotricha (O.)	17S	1752	j
28	<i>Tetrahymena borealis</i>	Strain AU-F1-1, ATCC 30291	Holotricha (O.)	17S	1752	
29	<i>Tetrahymena tropicalis</i>	Strain LFF, ATCC 50064	Holotricha (O.)	17S	1752	
30	<i>Tetrahymena pyriformis</i>	Strain UM 731	Holotricha (O.)	17S	1752	
31	<i>Tetrahymena malaccensis</i>	Strain TC3, ATCC 30352	Holotricha (O.)	17S	1752	
32	<i>Paramecium tetraurelia</i>	Strain GL-C (a-micronuclear)	Holotricha (O.)	17S	1752	
33	<i>Paramecium micans</i>	Strain MP75, ATCC 50066	Holotricha (O.)	17S	1753	
34	<i>Plasmodium berghei</i>	Strain LB113614	Ciliata (Ph.)	17S	1753	
35	<i>Plasmodium berghei</i>	Strain NUY2	Flagellata (Ph.)	17S	1798	
36	<i>Acanthamoeba castellanii</i>		Sporozoa (Ph.)		2039	g
37	<i>Trypanosoma brucei</i>		Haemosporidia (O.)		2058	g
38	<i>Crithidia fasciculata</i>		Haemosporidia (O.)		2058	
39	<i>Euglena gracilis</i>		Rhizopoda (Ph.)		2303	
40	<i>Vairimorpha necatrix</i>	Variety Z	Flagellata (Ph.)		2206	
			Flagellata (Ph.)		2305	
			Sporozoa (Ph.)		1244	

Table 1. continued

81	Mitochondria							
82	<i>Novo aspians</i>	Placenta	Chordata (Ph.)	Mammalia (Cl.)	12S	954		
83	<i>Pan troglodytes</i>	Cultured cells	Chordata (Ph.)	Mammalia (Cl.)	12S	948		
84	<i>Gorilla gorilla</i>		Chordata (Ph.)	Mammalia (Cl.)	12S	948		
85	<i>Pongo pigmaeus</i>		Chordata (Ph.)	Mammalia (Cl.)	12S	950		
86	<i>Mus musculus</i>	L-cell, C2-1 line	Chordata (Ph.)	Mammalia (Cl.)	12S	953		
87	<i>Rattus norvegicus</i>	Liver	Chordata (Ph.)	Mammalia (Cl.)	12S	955		
88	<i>Bos taurus</i>	Heart	Chordata (Ph.)	Mammalia (Cl.)	12S	955		
89	<i>Xenopus laevis</i>		Chordata (Ph.)	Mammalia (Cl.)	12S	819		
90	<i>Drosophila yakuba</i>	Stock 2371.6, Ivory coast	Arthropoda (Ph.)	Insecta (Cl.)	18S	789		
91	<i>Drosophila virilis</i>	Stock 2375.8, Chile	Arthropoda (Ph.)	Insecta (Cl.)	18S	1964		
92	<i>Zea mays</i>		Spermatophyta (Ph.)	Liliopsida (Cl.)	18S	1955		
93	<i>Zea diploperennis</i>		Spermatophyta (Ph.)	Liliopsida (Cl.)	18S	1990		
94	<i>Triticum aestivum</i>		Spermatophyta (Ph.)	Liliopsida (Cl.)	18S	1897		
95	<i>Glycine max</i>	Cultivar Williams	Spermatophyta (Ph.)	Magnoliopsida (Cl.)	18S	1897		
96	<i>Oenothera sp.</i>	Strain paba A1, bi A1	Spermatophyta (Ph.)	Magnoliopsida (Cl.)	15S	1437		
97	<i>Aspergillus nidulans</i>		Ascomycotina (Ph.)	Plectomycetes (Cl.)	15S	1437		
98	<i>Saccharomyces cerevisiae</i>		Ascomycotina (Ph.)	Hemiascomycetes (Cl.)	15S	1686		g.n
99	<i>Saccharomyces cerevisiae</i>	Strain D273-10B, wild-type	Ascomycotina (Ph.)	Hemiascomycetes (Cl.)	15S	1686		g.o
100	<i>Tetrahymena pyriformis</i>	Strain ST	Ciliata (Ph.)	Holotricha (O.)	14S			g.p
101	<i>Tetrahymena pyriformis</i>	Stock 513 (Edinburgh)	Ciliata (Ph.)	Holotricha (O.)	14S			q
102	<i>Paramecium primaurelia</i>	Stock 51 (Edinburgh)	Ciliata (Ph.)	Holotricha (O.)	9S	611		q
103	<i>Paramecium tetraurelia</i>		Flagellata (Ph.)	Protozoa (O.)	9S	612		
104	<i>Trypanosoma brucei</i>	Strain 427	Flagellata (Ph.)	Protozoa (O.)	9S	612		
105	<i>Crithidia fasciculata</i>		Flagellata (Ph.)	Protozoa (O.)	9S	612		
106	<i>Leishmania tarantolae</i>		Flagellata (Ph.)	Protozoa (O.)	9S	610		

Footnotes to Table 1

- a) This number precedes the sequence on each alignment page and is also the reference number of the paper from which the sequence was taken.
- b) This column contains the following data, if specified by the authors:
 - Strain name for laboratory animals, (cultivated) variety for plants, culture collection and strain number in the case of microorganisms.
 - Tissue from which the DNA used for clone construction, or the RNA used for sequencing, was extracted in the case of differentiated organisms.
 - Ribosomal RNA operon to which belongs the cloned srRNA gene in the case of bacteria.
- c) The taxonomic position is described according to the following references: 113 for the Metazoa (species 1 to 9), 114 for the higher plants (species 10 to 12), 115 for the Algae (sequences 13 to 14), 116 for the Fungi (species 15 to 18), 117 for the Protozoa (species 19 to 40), 118 for the Archaeobacteria and the Eubacteria. Taxon designations corresponding to an established taxonomic level are followed by the abbreviation Ph. (phylum), Sph. (subphylum), Cl. (class), O. (order).
- d) A chain length is indicated in case the location of the srRNA termini was determined experimentally or derived on the basis of homology with other sequences. No value is mentioned in case the location of the termini is considered uncertain by the authors of the sequence.
- e) Complete data on nucleoside modification can be found in the paper reporting this sequence.
- f) Partial data on modified nucleosides are mentioned in this paper or other papers cited therein.
- g) Two different sequences have been determined for this species or organelle, both are listed.
- h) Two slightly different sequences for human 18S rRNA have been reported. The sequence in (119) has C·G instead of G·C in alignment positions 498-499, U instead of - at position 1885, and - instead of C at position 3528. The sequence reported in (120) has C instead of U at position 1883.
- i) The primary structure was determined by RNA sequencing.
- j) The species *Tetrahymena hyperangularis* (strain EN 101, ATCC 30273) and *Tetrahymena nanneyi* (strain XQ5, ATCC 30840) have the same 18S rRNA sequence as *Tetrahymena pigmentosa* and are reported in the same paper.
- k) The species *Tetrahymena canadensis* (strain UM 1215, ATCC 30368) has the same 18S rRNA sequence as *Tetrahymena borealis* and is reported in the same paper.
- l) A sequence missing 1 nucleotide was previously reported in (121) where complete data on nucleoside modification can be found.
- m) approximately 15 nucleotides adjacent to the 5'-terminus are missing because they were not comprised in the cloned sequence.
- n) The termini are allocated according to a sequence for the same species reported in (99).
- o) The termini are allocated according to a sequence for the same species reported in (101).
- p) The aligned sequence is the rDNA sequence. In the mature rRNA, the nucleotides in positions 348 to 537 of the alignment are deleted by processing.
- q) The location of the termini is uncertain.

inspection rather than by the use of a computer program. In the areas of variable primary and secondary structure (see below) a meaningful alignment is often difficult to achieve. In some of these areas the alignment may be improved in the future as more sequences become available. In other areas any evolutionary relationship may be lacking between sequences belonging to different primary kingdoms, because they seem to result from insertions that occurred independently in different evolutionary branches. The latter situation prevails in alignment positions 1189-1815, where prokaryotic srRNAs have a single helix of relatively constant structure, whereas eukaryotic srRNAs have up to 7 helices and form area V4 of variable secondary structure. Another such area corresponds with alignment positions 2391-2460 where eukaryotic and archaeobacterial srRNAs have a single helix of relatively constant structure, which in eubacterial and organelle srRNAs is replaced in part by area V6 of variable secondary structure.

SECONDARY STRUCTURE

The boxes superimposed on the sequence alignment enclose segments presumedly involved in base pairing. The boxes enclosing the complementary sequences forming helix 1 are numbered 1 and 1', and so on. Internal loops and bulges are indicated by nested boxes. Bases suspected to belong to pairs other than the Watson-Crick pairs G·C, A·U, or the wobble pair G·U (non-standard, non-canonical or odd base pairs), because they are intercalated between Watson-Crick and/or wobble pairs, are put in parentheses.

The secondary structure models chosen for prokaryotic and eukaryotic srRNAs are illustrated in Fig. 1 and Fig. 2 with structures applicable to *Escherichia coli* 16S rRNA and human 18S rRNA respectively. The basic folding pattern is essentially that proposed by Noller, Woese and collaborators (108,109) and is the same in both models. However, at certain locations the prokaryotic and eukaryotic models differ by the number of hairpins implanted on a multibranching loop. The helix numbering system (8) allocates a separate number to each helical area, which may consist of an uninterrupted helix, or a set of helix segments connected by bulge loops or interior loops. Helices or helical areas bear a different number only when separated by a multibranching loop (e.g. helices 8 and 9) or when separated by a single-stranded segment that does not form a loop (helices 2 and 30). A different number was also given to helices 1 and 2, thought to belong to a pseudoknot structure (110). Universal helices, i.e. those found commonly in eukaryotic as well as in prokaryotic srRNAs, are given a single number. Helices found only in

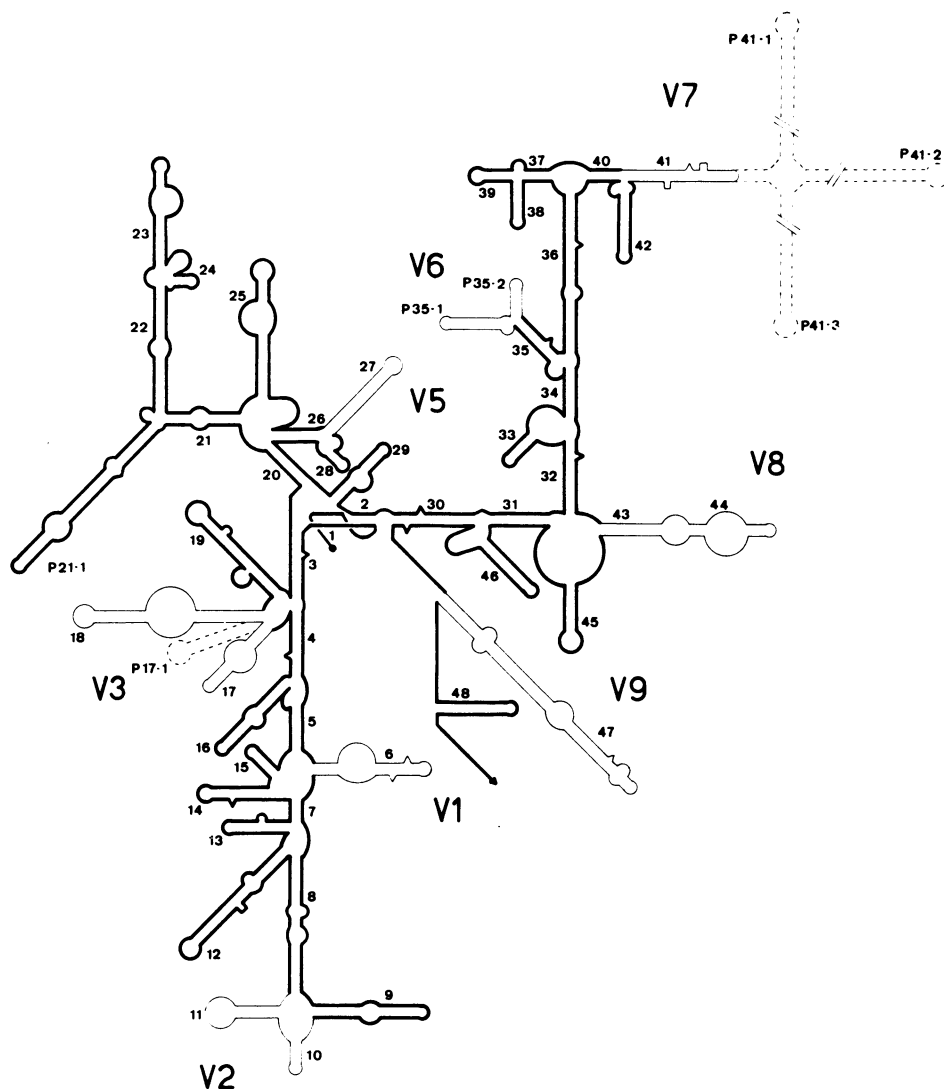


Fig.1. Secondary structure model for prokaryotic srRNAs. The 5'-terminus is symbolized by a filled circle and the 3'-terminus by an arrowhead. Helices are numbered in the order of occurrence from 5' to 3' terminus. Helices bearing a single number are common to the prokaryotic and eukaryotic (Fig.2) models. A number preceded by P points to a prokaryote-specific helix. Areas of relative constancy in sequence and helix length are drawn in bold lines, variable areas in thin lines. Eight variable areas are distinguished and numbered V1 to V9, V4 being absent in prokaryotic srRNAs. Helices drawn in broken lines are present in a minority of the known structures only. Archaeobacterial srRNAs follow the prokaryotic pattern except for helix 35, which is unbranched as in eukaryotes.

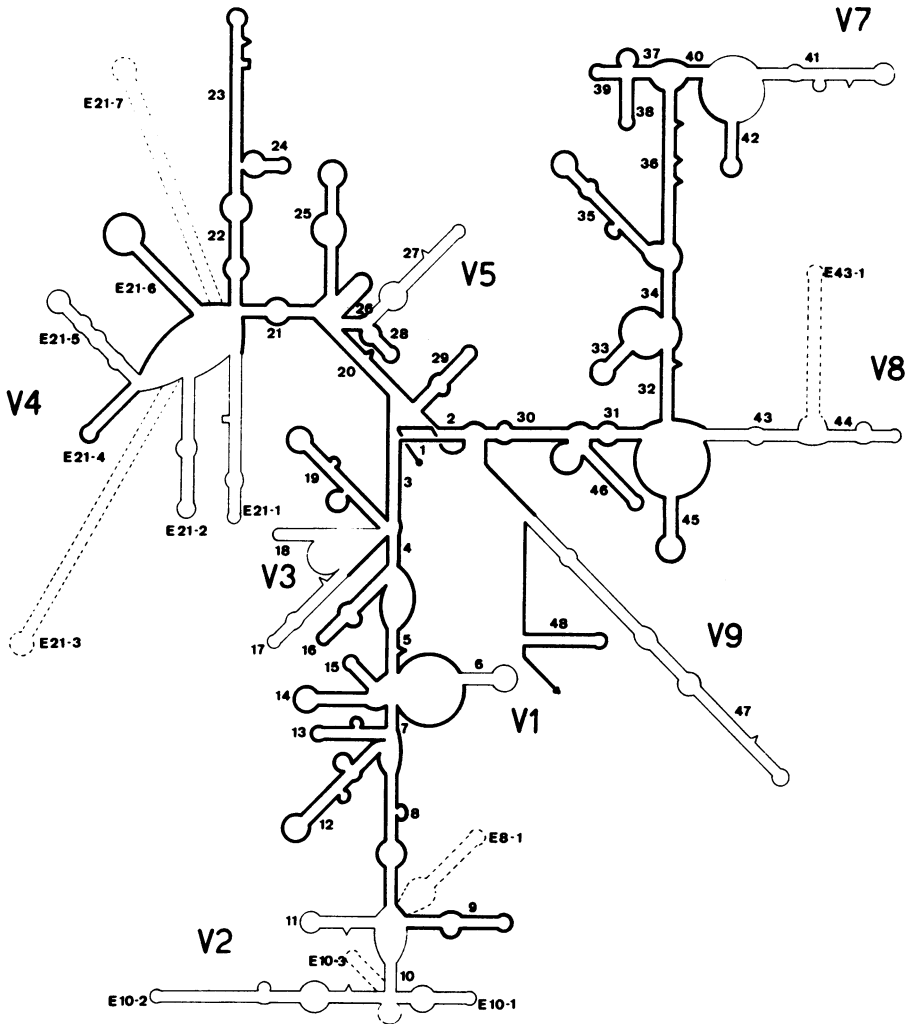


Fig.2. Secondary structure model for eukaryotic srRNAs.
 Symbols as in Fig.1. Helices with a number preceded by E are eukaryote-specific. Variable area V6 is missing in eukaryotic srRNAs.

prokaryotic srRNAs (srRNAs from archaebacteria, eubacteria, plastids and mitochondria) are given a composite number of the form Pa-b, where a is the number of the preceding universal helix and b is a serial number. Helices specific to eukaryotic srRNAs are similarly numbered Ea-b. As an example, helix E21-4 is the 4th of 7 eukaryote-specific helices that follow universal helix 21.

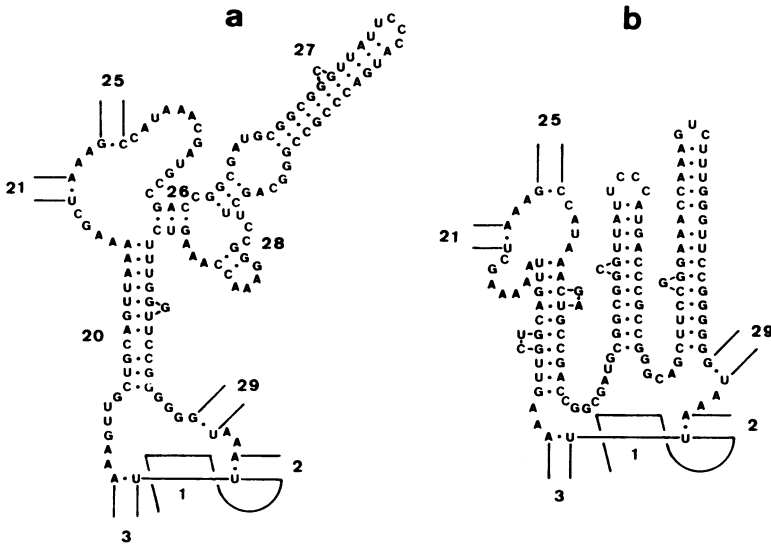


Fig.3. Alternative secondary structure topologies for eukaryotic srRNAs. Two different foldings are conceivable for the area comprised between helices 3, 21, 25, and 29 in eukaryotic srRNAs, illustrated here with the local sequence of human 18S rRNA. Topology (a) is the one chosen in the alignment.

The prokaryotic model (Fig.1) applies to archaebacteria as well as to eubacteria and organelles, with one exception: archaebacteria follow the eukaryotic pattern in having an unbranched helix 35 whereas in eubacteria and organelles this helix bears the branches P35-1 and P35-2. Mitochondrial srRNAs have aberrant secondary structures, the smaller ones missing several helices and the larger ones possessing extra helices with respect to the eubacterial model of Fig.1. Among the eukaryotic srRNAs, the most aberrant structure is that of *Vairimorpha necatrix* which misses several helices. Leaving these exceptions aside, the number of universal helices that we can distinguish at the moment is 48. This number has increased by 8 with respect to the previous compilation (107) and may still increase in the future as more sequences become available for comparative study and make possible a further refinement of the model.

In the alignment as well as in the secondary models it is possible to distinguish a number of areas where helix length and local sequence vary considerably among species. Nine of such variable areas are indicated on the secondary structure models of Fig. 1 and 2. Area V4 is specific to eukaryotic

srRNAs, area V6 to prokaryotic srRNAs, the remaining ones are common to both models.

Although we applied the same basic secondary structure model to eukaryotic and prokaryotic srRNAs (Fig. 1, 2) for the sake of uniformity, the reader should be aware that an alternative folding pattern has been proposed (8, 9, 107, 111, 112) for the area comprised between helices 3, 21, 25 and 29 in eukaryotic srRNAs. The two possible structures are illustrated in Fig. 3 a and b with the local sequence of human 18S rRNA. The choice of structure (a) in the alignment does not imply that we consider the correctness of one of the alternatives as proven.

AVAILABILITY OF THE DATA

It is our intention to update the present srRNA sequence compilation regularly and to make it available to interested scientists in a computer-readable form. The compilation can presently be obtained on 5.25", 360 Kbyte floppy disks (double sided, double density, 48 TPI) and on 5.25", 1.2 Mbyte floppy disks (double sided, high density, 96 TPI) for personal computers operating under MS-DOS version 3. In its present size the alignment can be accommodated on six 360 Kbyte disks or two 1.2 Mbyte disk which the applicants are asked to supply.

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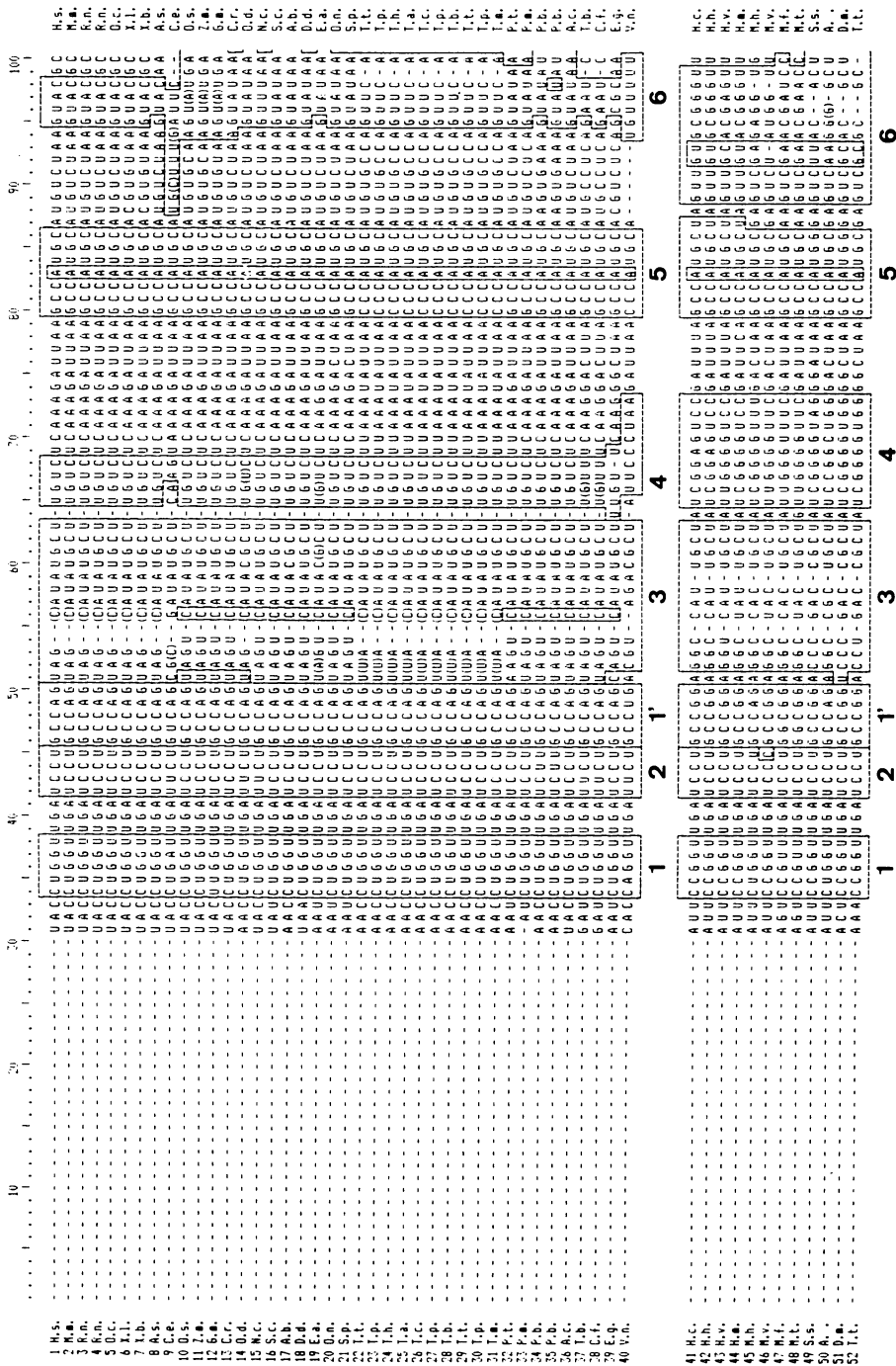
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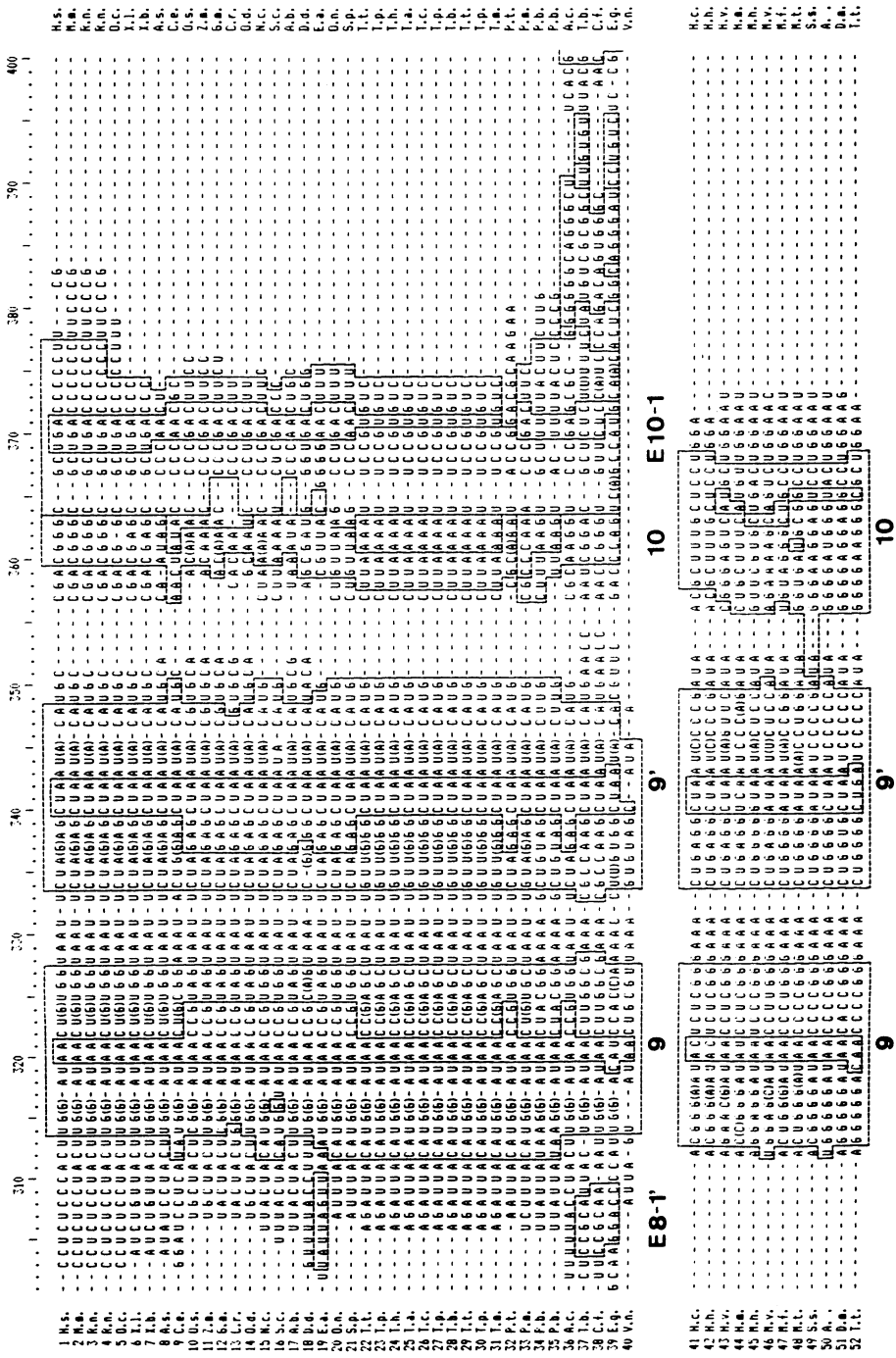
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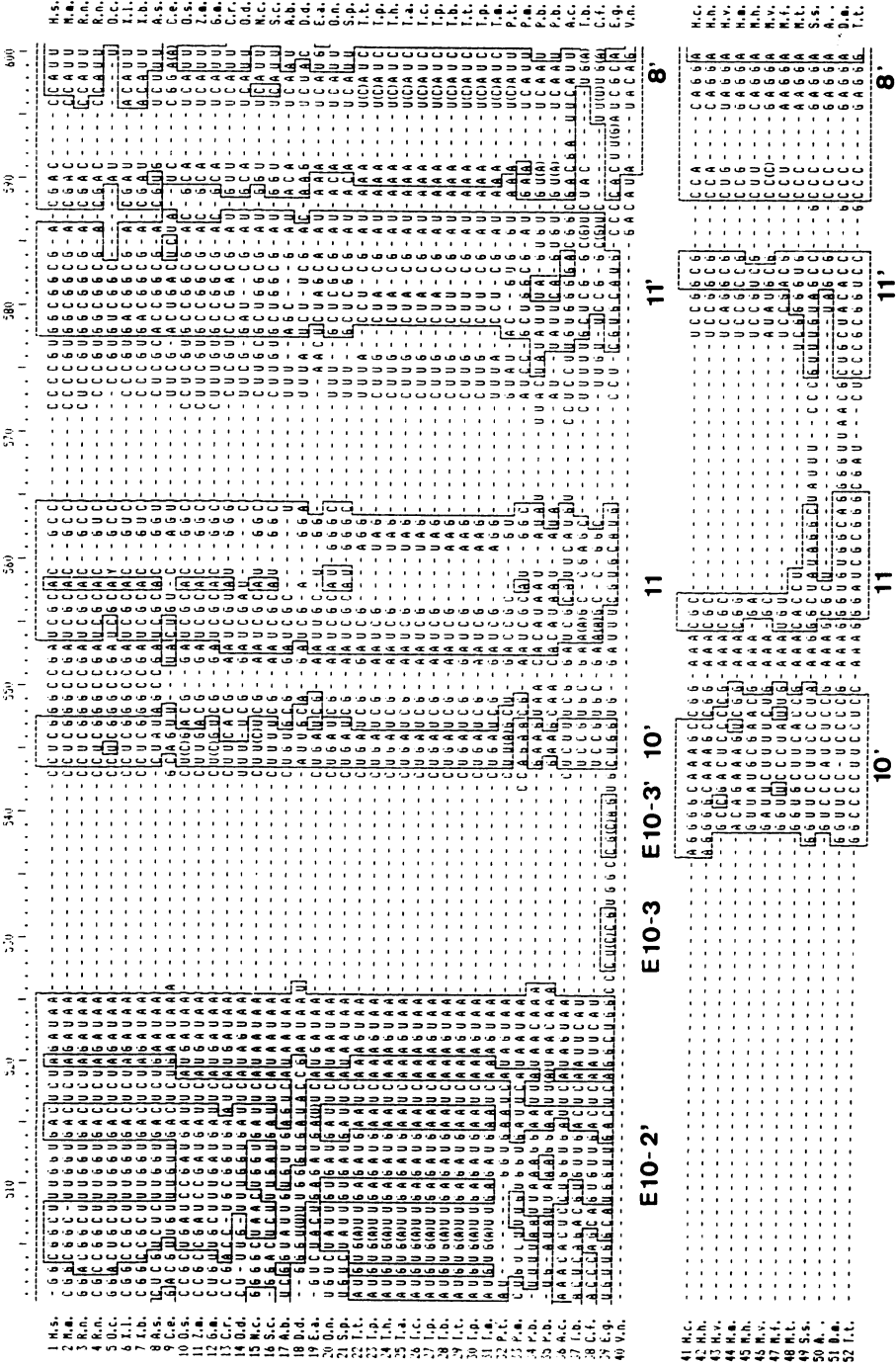
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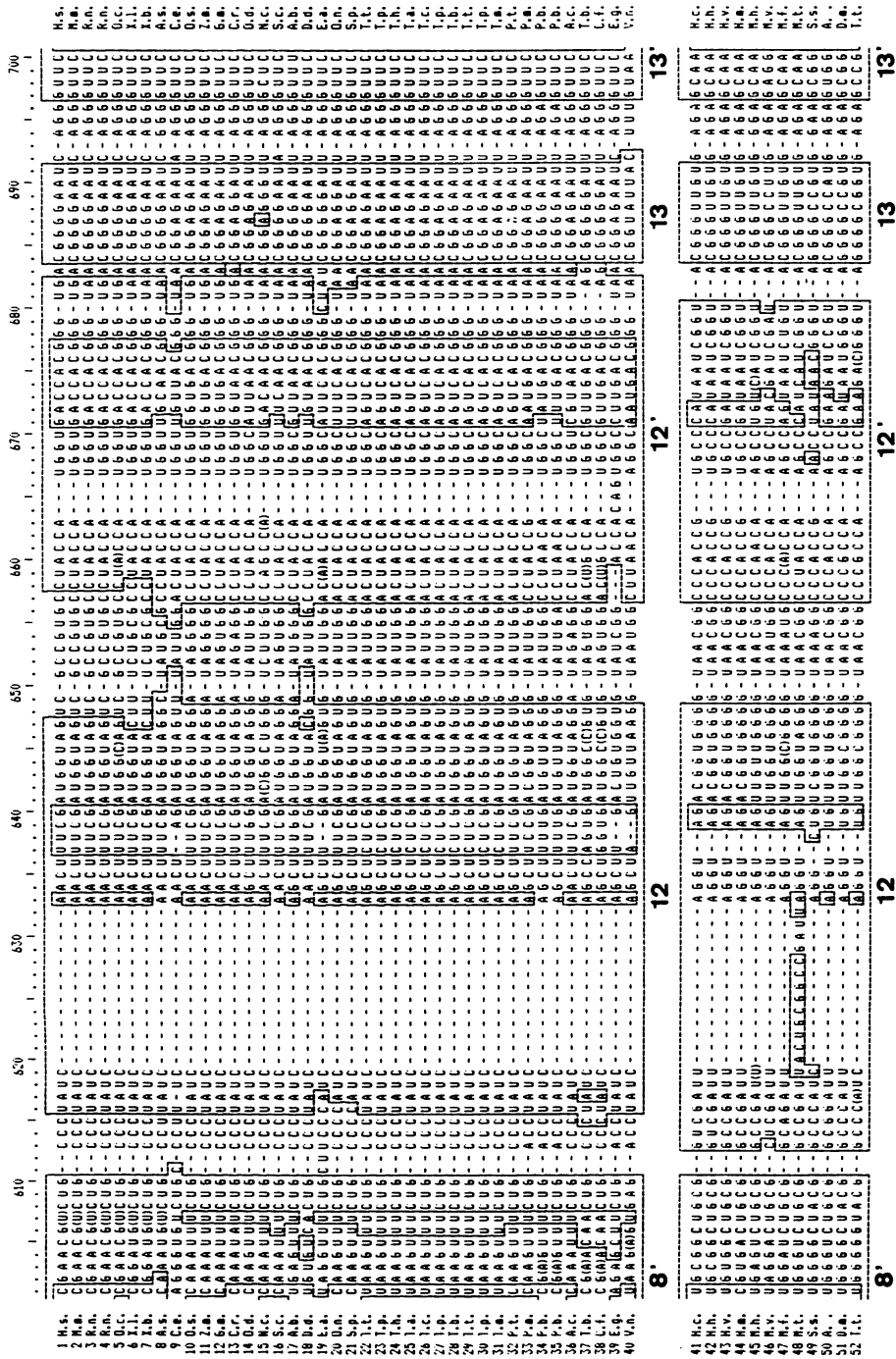
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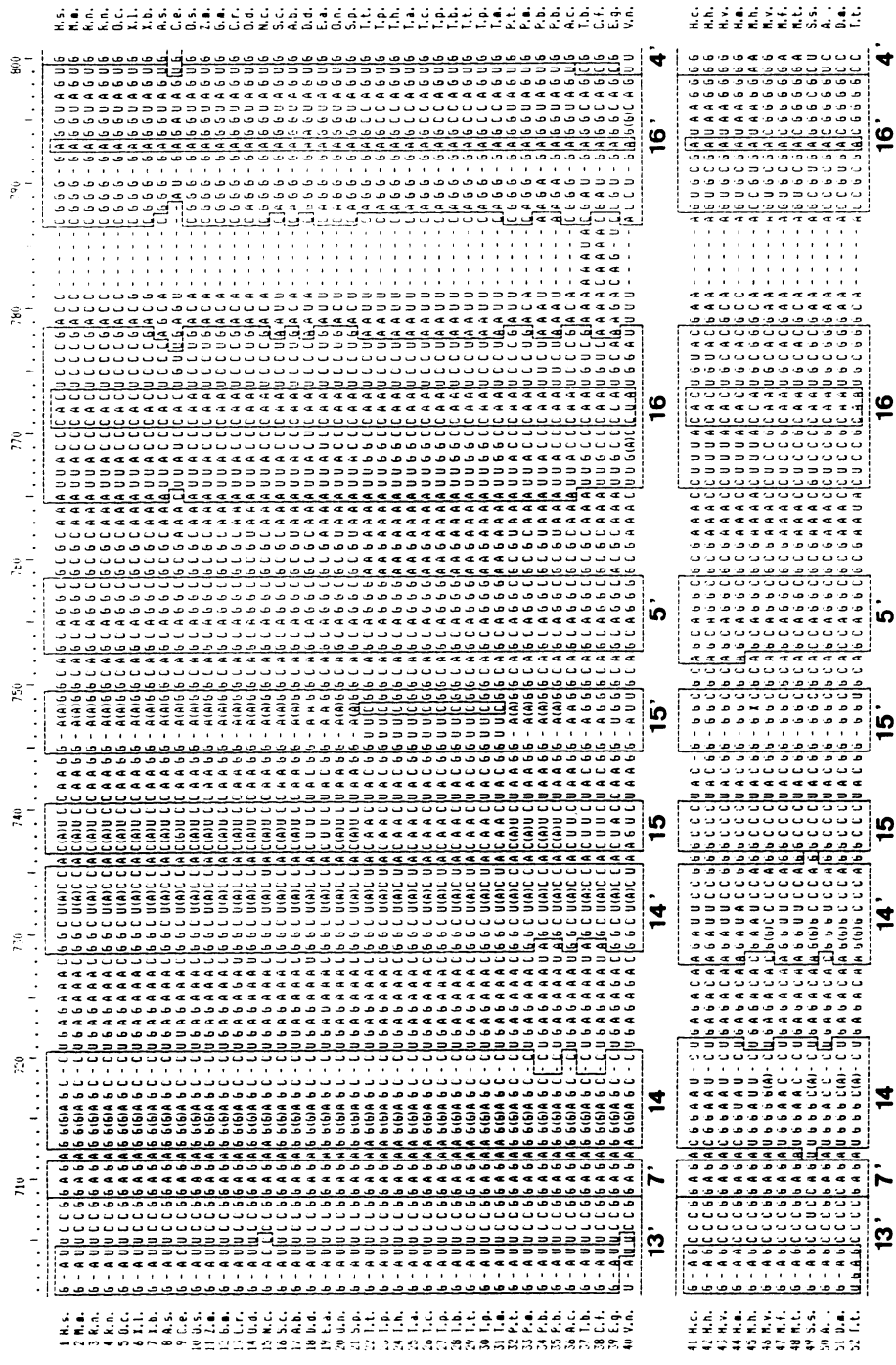
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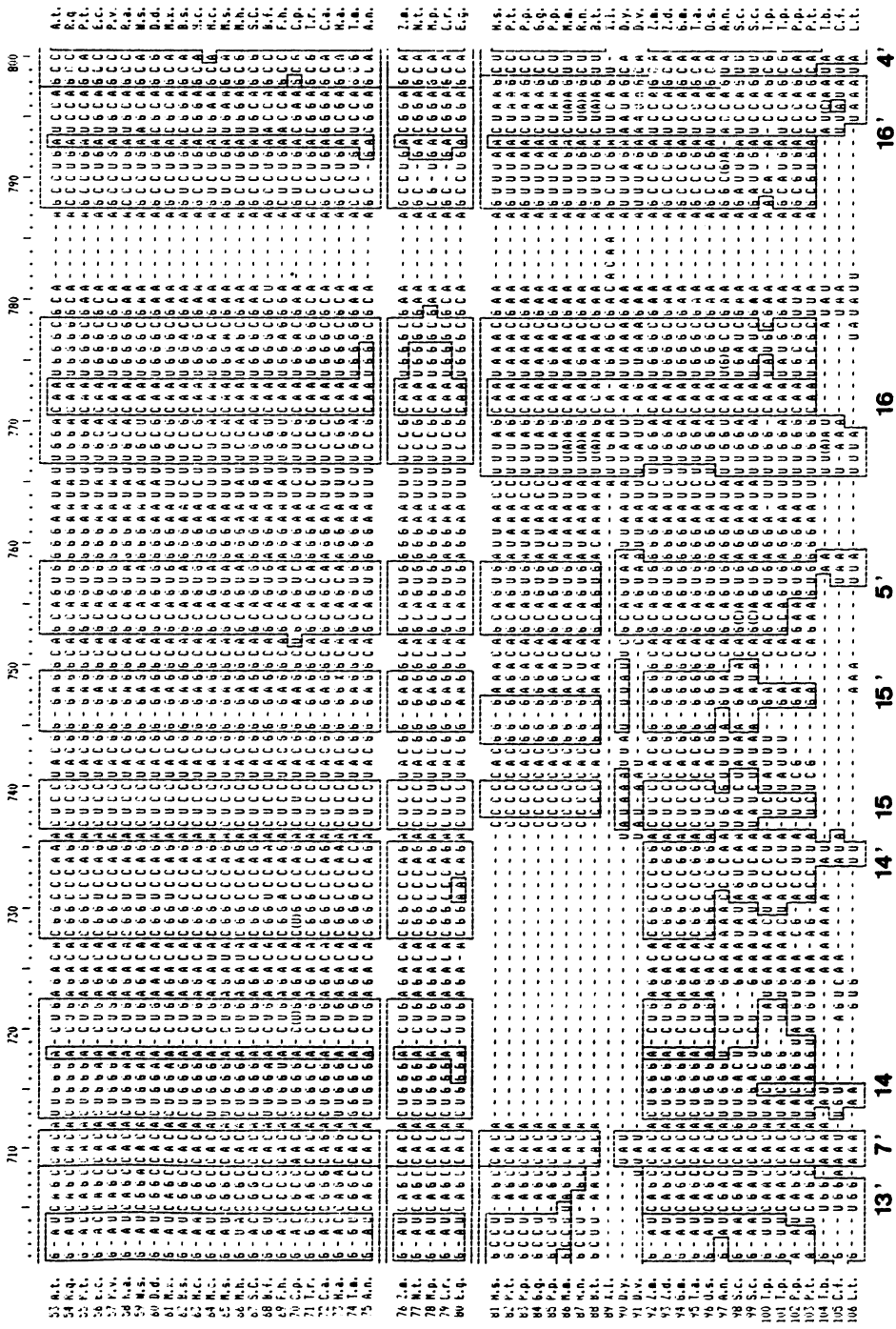












	910	920	930	940	950	960	970	980	990	1000	
1 M.A.	U	U	U	U	U	U	U	U	U	U	M.S.
2 M.A.	U	U	U	U	U	U	U	U	U	U	M.S.
3 M.A.	U	U	U	U	U	U	U	U	U	U	R.N.
4 M.A.	U	U	U	U	U	U	U	U	U	U	R.N.
5 U.C.	U	U	U	U	U	U	U	U	U	U	U.C.
6 I.I.	U	U	U	U	U	U	U	U	U	U	I.I.
7 I.B.	U	U	U	U	U	U	U	U	U	U	I.B.
8 M.S.	U	U	U	U	U	U	U	U	U	U	M.S.
9 L.S.	U	U	U	U	U	U	U	U	U	U	L.S.
10 U.S.	U	U	U	U	U	U	U	U	U	U	U.S.
11 I.A.	U	U	U	U	U	U	U	U	U	U	I.A.
12 U.A.	U	U	U	U	U	U	U	U	U	U	U.A.
13 D.A.	U	U	U	U	U	U	U	U	U	U	D.A.
14 D.S.	U	U	U	U	U	U	U	U	U	U	D.S.
15 M.C.	U	U	U	U	U	U	U	U	U	U	M.C.
16 S.C.	U	U	U	U	U	U	U	U	U	U	S.C.
17 A.B.	U	U	U	U	U	U	U	U	U	U	A.B.
18 D.B.	U	U	U	U	U	U	U	U	U	U	D.B.
19 E.A.	U	U	U	U	U	U	U	U	U	U	E.A.
20 D.A.	U	U	U	U	U	U	U	U	U	U	D.A.
21 S.P.	U	U	U	U	U	U	U	U	U	U	S.P.
22 I.L.	U	U	U	U	U	U	U	U	U	U	I.L.
23 I.P.	U	U	U	U	U	U	U	U	U	U	I.P.
24 I.A.	U	U	U	U	U	U	U	U	U	U	I.A.
25 I.S.	U	U	U	U	U	U	U	U	U	U	I.S.
26 I.C.	U	U	U	U	U	U	U	U	U	U	I.C.
27 I.B.	U	U	U	U	U	U	U	U	U	U	I.B.
28 I.S.	U	U	U	U	U	U	U	U	U	U	I.S.
29 I.A.	U	U	U	U	U	U	U	U	U	U	I.A.
30 I.P.	U	U	U	U	U	U	U	U	U	U	I.P.
31 I.B.	U	U	U	U	U	U	U	U	U	U	I.B.
32 P.L.	U	U	U	U	U	U	U	U	U	U	P.L.
33 P.A.	U	U	U	U	U	U	U	U	U	U	P.A.
34 P.S.	U	U	U	U	U	U	U	U	U	U	P.S.
35 P.B.	U	U	U	U	U	U	U	U	U	U	P.B.
36 M.C.	U	U	U	U	U	U	U	U	U	U	M.C.
37 L.C.	U	U	U	U	U	U	U	U	U	U	L.C.
38 L.S.	U	U	U	U	U	U	U	U	U	U	L.S.
39 S.S.	U	U	U	U	U	U	U	U	U	U	S.S.
40 V.B.	U	U	U	U	U	U	U	U	U	U	V.B.
41 M.C.	U	U	U	U	U	U	U	U	U	U	M.C.
42 M.A.	U	U	U	U	U	U	U	U	U	U	M.A.
43 M.V.	U	U	U	U	U	U	U	U	U	U	M.V.
44 M.B.	U	U	U	U	U	U	U	U	U	U	M.B.
45 M.S.	U	U	U	U	U	U	U	U	U	U	M.S.
46 M.V.	U	U	U	U	U	U	U	U	U	U	M.V.
47 M.L.	U	U	U	U	U	U	U	U	U	U	M.L.
48 M.L.	U	U	U	U	U	U	U	U	U	U	M.L.
49 S.S.	U	U	U	U	U	U	U	U	U	U	S.S.
50 A.	U	U	U	U	U	U	U	U	U	U	A.
51 D.A.	U	U	U	U	U	U	U	U	U	U	D.A.
52 I.L.	U	U	U	U	U	U	U	U	U	U	I.L.

	1310	1320	1330	1340	1350	1360	1370	1380	1390	1400	
1 M.S.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	H.S.
2 R.H.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	R.H.
3 R.H.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	R.H.
4 R.H.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	R.H.
5 D.C.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	D.C.
6 T.I.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	T.I.
7 T.B.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	T.B.
8 A.S.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	A.S.
9 C.S.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	C.S.
10 O.S.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	O.S.
11 Z.H.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	Z.H.
12 C.T.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	C.T.
13 G.C.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	G.C.
14 O.C.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	O.C.
15 A.S.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	A.S.
16 D.A.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	D.A.
17 E.A.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	E.A.
18 O.H.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	O.H.
19 U.H.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	U.H.
20 U.H.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	U.H.
21 S.P.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	S.P.
22 T.T.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	T.T.
23 T.B.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	T.B.
24 T.B.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	T.B.
25 T.C.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	T.C.
26 T.C.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	T.C.
27 T.P.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	T.P.
28 T.P.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	T.P.
29 T.P.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	T.P.
30 T.P.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	T.P.
31 T.P.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	T.P.
32 P.A.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	P.A.
33 P.A.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	P.A.
34 P.B.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	P.B.
35 P.B.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	P.B.
36 A.C.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	A.C.
37 T.B.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	T.B.
38 E.G.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	E.G.
39 E.G.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	E.G.
40 V.A.	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	CCUC	V.A.

E21-2

E21-2

	1310	1320	1330	1340	1350	1360	1370	1380	1390	1400	
53 A.L.											A.L.
54 R.G.											R.G.
55 P.L.											P.L.
56 E.C.											E.C.
57 P.V.											P.V.
58 K.A.											K.A.
59 M.S.											M.S.
60 D.G.											D.G.
61 M.L.											M.L.
62 B.S.											B.S.
63 M.C.											M.C.
64 M.C.											M.C.
65 M.S.											M.S.
66 B.B.											B.B.
67 S.C.											S.C.
68 B.L.											B.L.
69 F.A.											F.A.
70 C.P.											C.P.
71 L.F.											L.F.
72 C.A.											C.A.
73 M.A.											M.A.
74 T.A.											T.A.
75 M.H.											M.H.
76 L.M.											L.M.
77 M.L.											M.L.
78 M.P.											M.P.
79 L.F.											L.F.
80 E.G.											E.G.
81 M.S.											M.S.
82 F.L.											F.L.
83 P.P.											P.P.
84 B.G.											B.G.
85 P.P.											P.P.
86 M.A.											M.A.
87 M.P.											M.P.
88 L.L.											L.L.
89 L.L.											L.L.
90 B.V.											B.V.
91 B.V.											B.V.
92 L.M.											L.M.
93 L.G.											L.G.
94 S.M.											S.M.
95 T.A.											T.A.
96 D.S.											D.S.
97 A.H.											A.H.
98 S.C.											S.C.
99 S.C.											S.C.
100 L.P.											L.P.
101 P.P.											P.P.
102 P.P.											P.P.
103 P.P.											P.P.
104 L.B.											L.B.
105 C.F.											C.F.
106 L.L.											L.L.

	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	
1 M.s.	-	-	-	-	-	-	-	-	-	-	M.s.
2 M.h.	-	-	-	-	-	-	-	-	-	-	M.h.
3 R.n.	-	-	-	-	-	-	-	-	-	-	R.n.
4 R.n.	-	-	-	-	-	-	-	-	-	-	R.n.
5 O.C.	-	-	-	-	-	-	-	-	-	-	O.C.
6 T.I.	-	-	-	-	-	-	-	-	-	-	T.I.
7 T.b.	-	-	-	-	-	-	-	-	-	-	T.b.
8 A.s.	-	-	-	-	-	-	-	-	-	-	A.s.
9 C.e.	-	-	-	-	-	-	-	-	-	-	C.e.
10 T.s.	-	-	-	-	-	-	-	-	-	-	T.s.
11 T.s.	-	-	-	-	-	-	-	-	-	-	T.s.
12 S.h.	-	-	-	-	-	-	-	-	-	-	S.h.
13 C.C.	-	-	-	-	-	-	-	-	-	-	C.C.
14 O.d.	-	-	-	-	-	-	-	-	-	-	O.d.
15 M.C.	-	-	-	-	-	-	-	-	-	-	M.C.
16 S.C.	-	-	-	-	-	-	-	-	-	-	S.C.
17 A.b.	-	-	-	-	-	-	-	-	-	-	A.b.
18 D.d.	-	-	-	-	-	-	-	-	-	-	D.d.
19 E.a.	-	-	-	-	-	-	-	-	-	-	E.a.
20 D.n.	-	-	-	-	-	-	-	-	-	-	D.n.
21 S.p.	-	-	-	-	-	-	-	-	-	-	S.p.
22 S.p.	-	-	-	-	-	-	-	-	-	-	S.p.
23 T.C.	-	-	-	-	-	-	-	-	-	-	T.C.
24 T.b.	-	-	-	-	-	-	-	-	-	-	T.b.
25 T.a.	-	-	-	-	-	-	-	-	-	-	T.a.
26 T.C.	-	-	-	-	-	-	-	-	-	-	T.C.
27 T.p.	-	-	-	-	-	-	-	-	-	-	T.p.
28 T.b.	-	-	-	-	-	-	-	-	-	-	T.b.
29 T.C.	-	-	-	-	-	-	-	-	-	-	T.C.
30 T.p.	-	-	-	-	-	-	-	-	-	-	T.p.
31 T.a.	-	-	-	-	-	-	-	-	-	-	T.a.
32 P.C.	-	-	-	-	-	-	-	-	-	-	P.C.
33 P.h.	-	-	-	-	-	-	-	-	-	-	P.h.
34 P.h.	-	-	-	-	-	-	-	-	-	-	P.h.
35 P.h.	-	-	-	-	-	-	-	-	-	-	P.h.
36 A.A.	-	-	-	-	-	-	-	-	-	-	A.A.
37 T.b.	-	-	-	-	-	-	-	-	-	-	T.b.
38 C.I.	-	-	-	-	-	-	-	-	-	-	C.I.
39 E.p.	-	-	-	-	-	-	-	-	-	-	E.p.
40 V.n.	-	-	-	-	-	-	-	-	-	-	V.n.
41 M.C.	-	-	-	-	-	-	-	-	-	-	M.C.
42 M.h.	-	-	-	-	-	-	-	-	-	-	M.h.
43 M.v.	-	-	-	-	-	-	-	-	-	-	M.v.
44 M.h.	-	-	-	-	-	-	-	-	-	-	M.h.
45 M.h.	-	-	-	-	-	-	-	-	-	-	M.h.
46 M.v.	-	-	-	-	-	-	-	-	-	-	M.v.
47 M.C.	-	-	-	-	-	-	-	-	-	-	M.C.
48 M.C.	-	-	-	-	-	-	-	-	-	-	M.C.
49 S.s.	-	-	-	-	-	-	-	-	-	-	S.s.
50 A.	-	-	-	-	-	-	-	-	-	-	A.
51 D.h.	-	-	-	-	-	-	-	-	-	-	D.h.
52 T.C.	-	-	-	-	-	-	-	-	-	-	T.C.

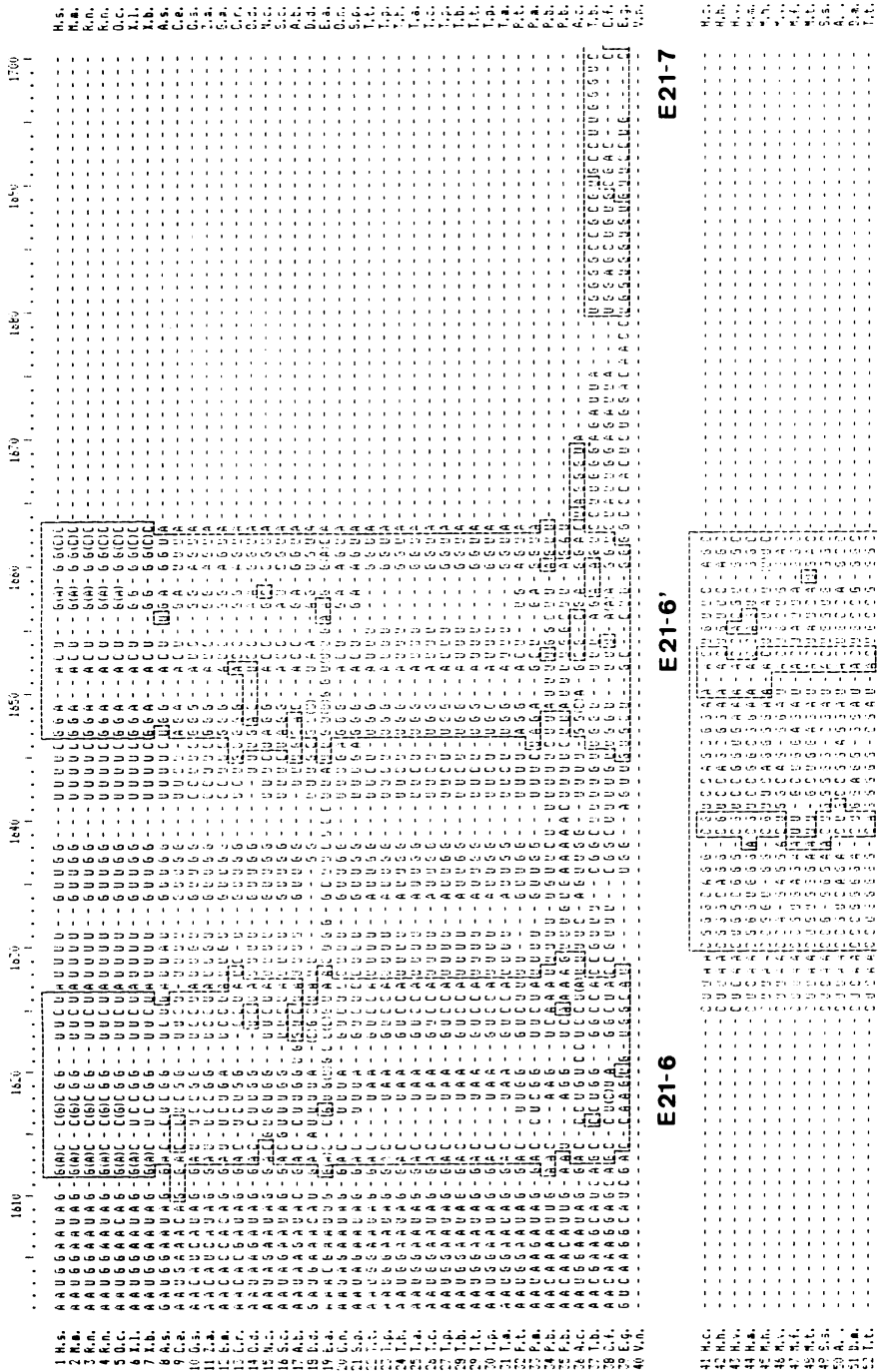
E21-3'

E21-3

E21-2'

53	Alt.	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	Alt.
54	R.o.											R.o.
55	P.t.											P.t.
56	E.c.											E.c.
57	P.v.											P.v.
58	R.a.											R.a.
59	M.s.											M.s.
60	D.d.											D.d.
61	H.z.											H.z.
62	M.s.											M.s.
63	M.c.											M.c.
64	M.c.											M.c.
65	M.s.											M.s.
66	H.b.											H.b.
67	S.C.											S.C.
68	B.f.											B.f.
69	F.h.											F.h.
70	C.p.											C.p.
71	T.r.											T.r.
72	C.a.											C.a.
73	H.a.											H.a.
74	T.a.											T.a.
75	R.h.											R.h.
76	Z.m.											Z.m.
77	M.t.											M.t.
78	H.p.											H.p.
79	C.r.											C.r.
80	E.g.											E.g.
81	H.s.											H.s.
82	P.t.											P.t.
83	P.p.											P.p.
84	G.g.											G.g.
85	P.p.											P.p.
86	H.h.											H.h.
87	H.h.											H.h.
88	T.t.											T.t.
89	D.v.											D.v.
90	D.v.											D.v.
91	B.v.											B.v.
92	Z.m.											Z.m.
93	Z.d.											Z.d.
94	G.m.											G.m.
95	T.a.											T.a.
96	O.s.											O.s.
97	A.h.											A.h.
98	S.c.											S.c.
99	S.c.											S.c.
100	T.p.											T.p.
101	P.p.											P.p.
102	P.p.											P.p.
103	P.p.											P.p.
104	T.b.											T.b.
105	C.t.											C.t.
106	L.t.											L.t.

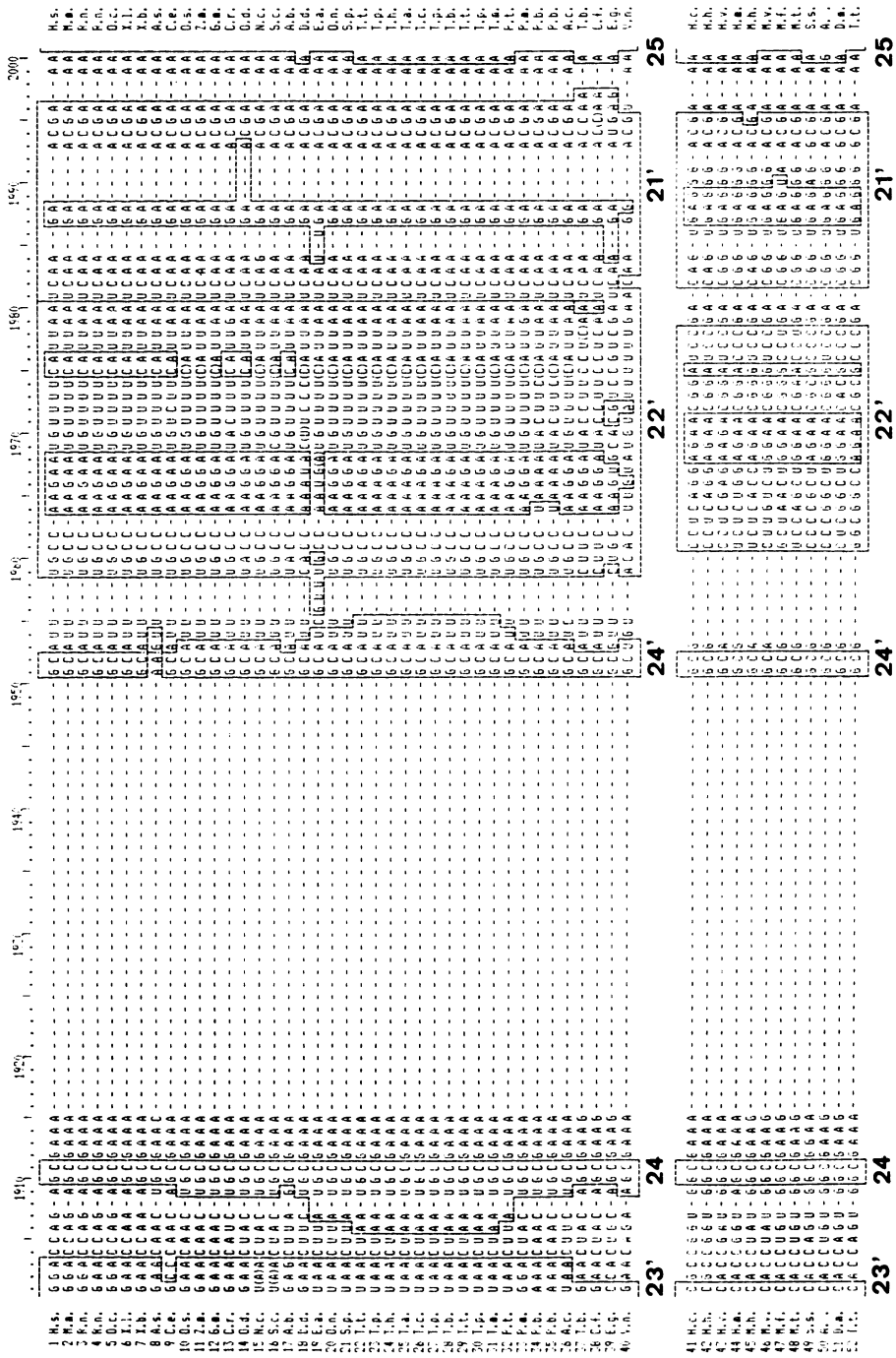
53 A.C.	1410	1450	1470	1546	1550	1560	1570	1590	1600	A.C.
54 K.R.	.....	.....	.....	.....	.....	.....	.....	.....	.....	K.R.
55 P.L.	.....	.....	.....	.....	.....	.....	.....	.....	.....	P.L.
56 G.C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	G.C.
57 P.V.	.....	.....	.....	.....	.....	.....	.....	.....	.....	P.V.
58 K.A.	.....	.....	.....	.....	.....	.....	.....	.....	.....	K.A.
59 M.S.	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.S.
60 D.J.	.....	.....	.....	.....	.....	.....	.....	.....	.....	D.J.
61 M.C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.C.
62 B.S.	.....	.....	.....	.....	.....	.....	.....	.....	.....	B.S.
63 W.C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	W.C.
64 M.C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.C.
65 M.C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.C.
66 M.C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.C.
67 S.C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	S.C.
68 M.H.	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.H.
69 B.F.	.....	.....	.....	.....	.....	.....	.....	.....	.....	B.F.
70 F.H.	.....	.....	.....	.....	.....	.....	.....	.....	.....	F.H.
71 C.P.	.....	.....	.....	.....	.....	.....	.....	.....	.....	C.P.
72 T.C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.C.
73 C.A.	.....	.....	.....	.....	.....	.....	.....	.....	.....	C.A.
74 M.A.	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.A.
75 T.M.	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.M.
76 R.M.	.....	.....	.....	.....	.....	.....	.....	.....	.....	R.M.
77 M.L.	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.L.
78 M.P.	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.P.
79 C.T.	.....	.....	.....	.....	.....	.....	.....	.....	.....	C.T.
80 E.G.	.....	.....	.....	.....	.....	.....	.....	.....	.....	E.G.
81 M.S.	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.S.
82 P.L.	.....	.....	.....	.....	.....	.....	.....	.....	.....	P.L.
83 P.P.	.....	.....	.....	.....	.....	.....	.....	.....	.....	P.P.
84 S.G.	.....	.....	.....	.....	.....	.....	.....	.....	.....	S.G.
85 P.P.	.....	.....	.....	.....	.....	.....	.....	.....	.....	P.P.
86 M.A.	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.A.
87 M.H.	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.H.
88 T.C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.C.
89 D.V.	.....	.....	.....	.....	.....	.....	.....	.....	.....	D.V.
90 D.V.	.....	.....	.....	.....	.....	.....	.....	.....	.....	D.V.
91 D.V.	.....	.....	.....	.....	.....	.....	.....	.....	.....	D.V.
92 S.M.	.....	.....	.....	.....	.....	.....	.....	.....	.....	S.M.
93 T.M.	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.M.
94 M.A.	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.A.
95 T.A.	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.A.
96 O.S.	.....	.....	.....	.....	.....	.....	.....	.....	.....	O.S.
97 M.A.	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.A.
98 S.C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	S.C.
99 S.C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	S.C.
100 T.P.	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.P.
101 P.P.	.....	.....	.....	.....	.....	.....	.....	.....	.....	P.P.
102 P.P.	.....	.....	.....	.....	.....	.....	.....	.....	.....	P.P.
103 P.P.	.....	.....	.....	.....	.....	.....	.....	.....	.....	P.P.
104 T.C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.C.
105 C.J.	.....	.....	.....	.....	.....	.....	.....	.....	.....	C.J.
106 L.L.	.....	.....	.....	.....	.....	.....	.....	.....	.....	L.L.

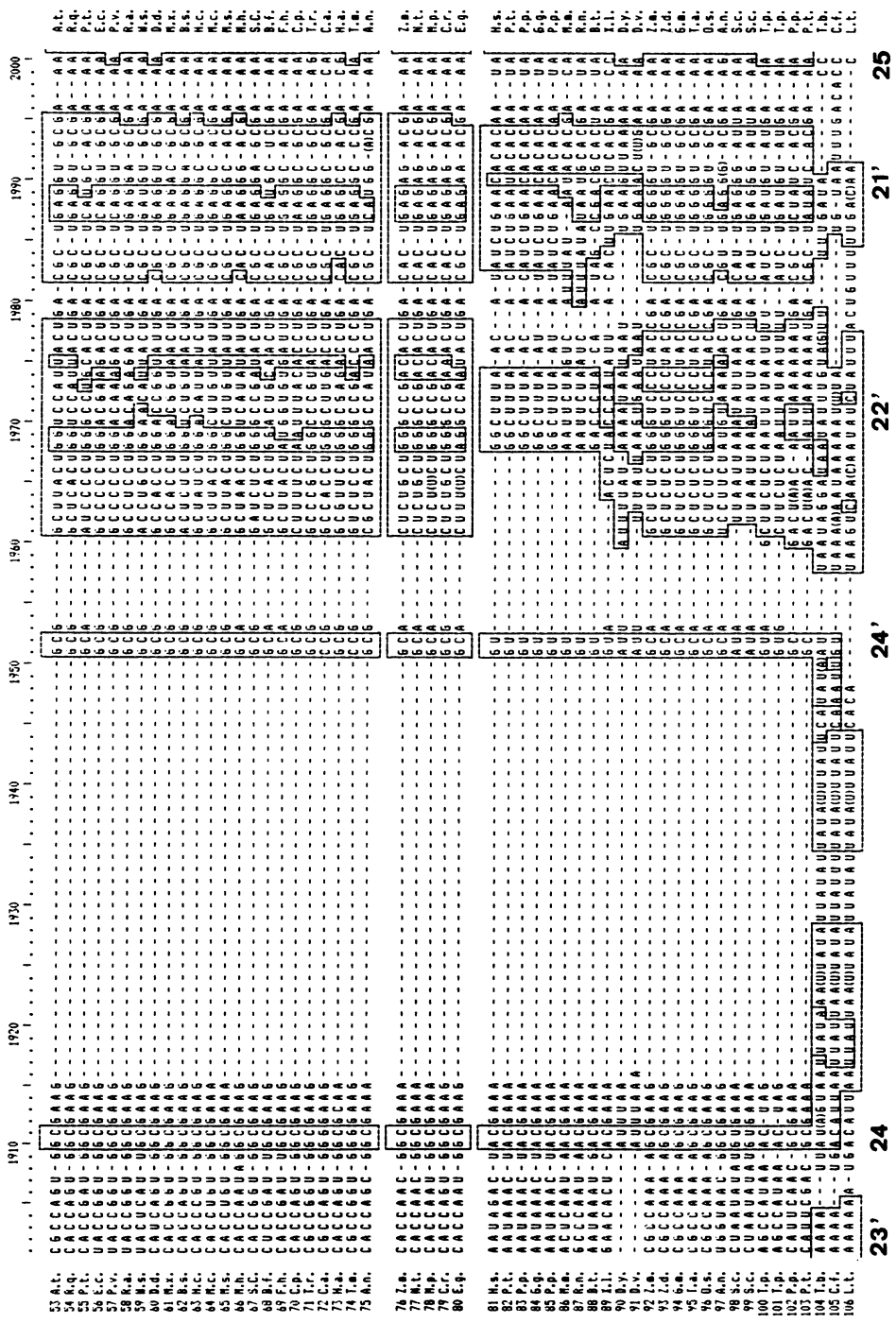


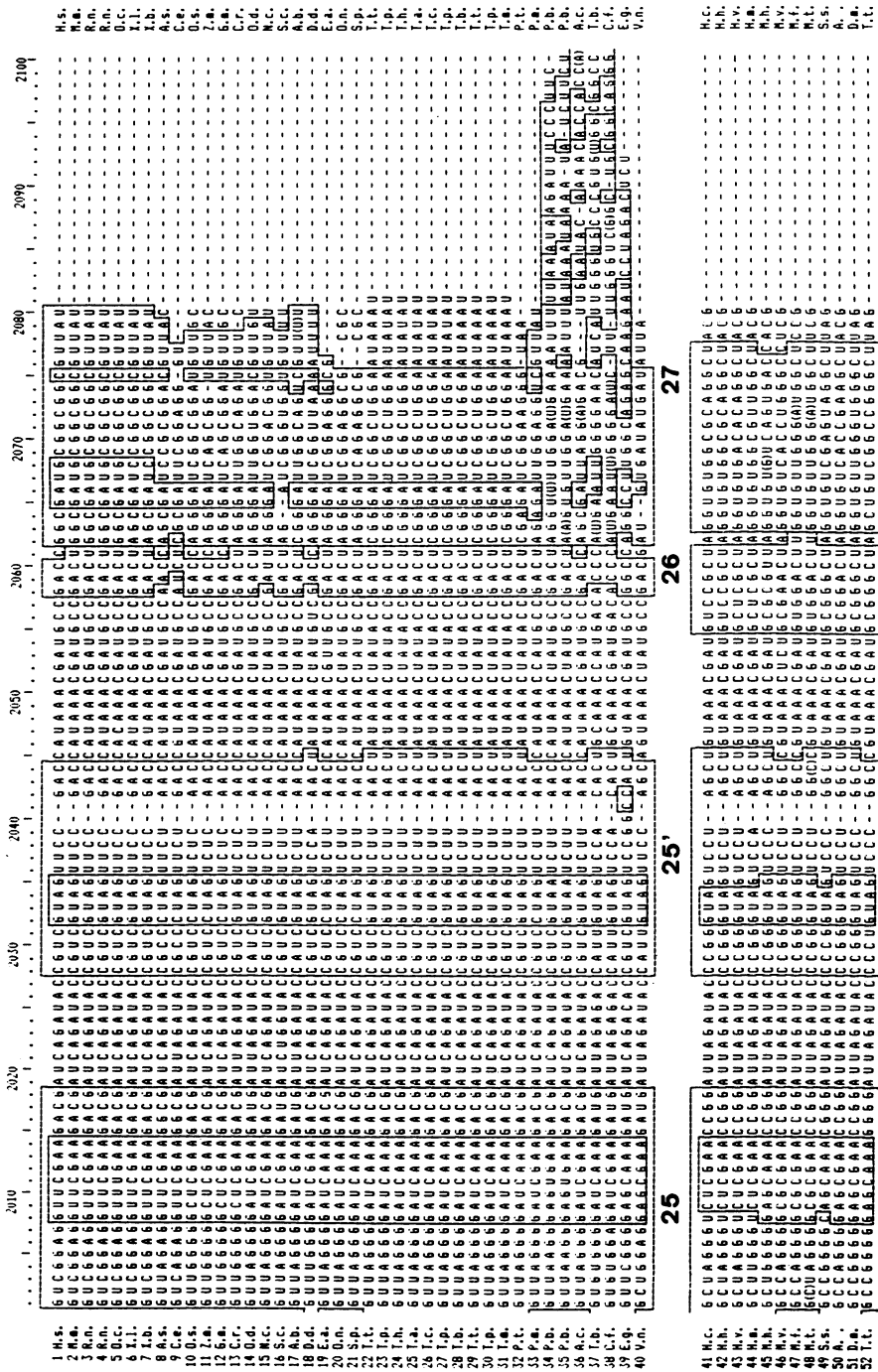
	1710	1720	1730	1740	1750	1760	1770	1780	1790	1800
1 H.S.										
2 M.A.										
3 K.D.										
4 M.D.										
5 R.C.										
6 U.C.										
7 L.L.										
8 A.S.										
9 C.R.										
10 O.S.										
11 Z.M.										
12 G.A.										
13 C.T.										
14 O.D.										
15 M.C.										
16 S.C.										
17 A.B.										
18 D.D.										
19 E.A.										
20 S.M.										
21 T.L.										
22 T.P.										
23 L.H.										
24 T.A.										
25 T.C.										
26 T.C.										
27 L.P.										
28 L.B.										
29 T.C.										
30 T.P.										
31 T.A.										
32 P.C.										
33 F.A.										
34 P.B.										
35 P.B.										
36 A.C.										
37 T.D.										
38 C.T.										
39 E.P.										
40 V.N.										
1 H.S.										
2 M.A.										
3 K.D.										
4 M.D.										
5 R.C.										
6 U.C.										
7 L.L.										
8 A.S.										
9 C.R.										
10 O.S.										
11 Z.M.										
12 G.A.										
13 C.T.										
14 O.D.										
15 M.C.										
16 S.C.										
17 A.B.										
18 D.D.										
19 E.A.										
20 S.M.										
21 T.L.										
22 T.P.										
23 L.H.										
24 T.A.										
25 T.C.										
26 T.C.										
27 L.P.										
28 L.B.										
29 T.C.										
30 T.P.										
31 T.A.										
32 P.C.										
33 F.A.										
34 P.B.										
35 P.B.										
36 A.C.										
37 T.D.										
38 C.T.										
39 E.P.										
40 V.N.										

E21-7

E21-7







53	Alt.	2110	2120	2130	2140	2150	2160	2170	2180	2190	2200	Alt.
54	K-q.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	K-q.
55	P.L.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	P.L.
56	E.C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	E.C.
57	P.v.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	P.v.
58	R.a.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	R.a.
59	M.S.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.S.
60	M.H.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.H.
61	B.S.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	B.S.
62	H.C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	H.C.
64	M.C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.C.
65	M.S.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.S.
66	M.H.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.H.
67	S.L.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	S.L.
68	B.F.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	B.F.
69	F.h.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	F.h.
70	C-p.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C-p.
71	T.r.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.r.
72	C.a.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C.a.
73	M.a.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.a.
74	M.a.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.a.
75	B.h.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	B.h.
76	L.a.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	L.a.
77	M.C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.C.
78	C-p.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C-p.
79	C.r.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C.r.
80	E-p.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	E-p.
81	M.S.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.S.
82	P.L.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	P.L.
83	P-p.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	P-p.
84	P-p.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	P-p.
85	M.S.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.S.
86	M.S.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	M.S.
87	R.M.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	R.M.
88	S.L.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	S.L.
89	L.L.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	L.L.
90	D.v.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	D.v.
91	D.v.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	D.v.
92	L.a.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	L.a.
93	L.d.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	L.d.
94	G.a.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	G.a.
95	L.a.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	L.a.
96	D.S.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	D.S.
97	C.M.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C.M.
98	S.C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	S.C.
99	S.C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	S.C.
100	T.C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.C.
101	T.P.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.P.
102	P.P.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	P.P.
103	P.L.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	P.L.
104	T.b.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.b.
105	L.L.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	L.L.
106	L.L.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	L.L.

	2310	2320	2330	2340	2350	2360	2370	2380	2390	2700
1 M.G.										
2 M.G.										
3 R.G.										
4 R.G.										
5 O.C.										
6 T.L.										
7 T.G.										
8 A.G.										
9 C.G.										
10 C.G.										
11 T.G.										
12 G.G.										
13 C.G.										
14 O.G.										
15 M.G.										
16 S.G.										
17 A.B.										
18 U.G.										
19 G.A.										
20 O.G.										
21 S.G.										
22 T.G.										
23 T.G.										
24 T.G.										
25 T.G.										
26 T.G.										
27 T.G.										
28 T.G.										
29 T.G.										
30 T.G.										
31 T.G.										
32 P.G.										
33 P.G.										
34 P.G.										
35 P.G.										
36 A.C.										
37 C.G.										
38 C.G.										
39 C.G.										
40 V.G.										
41 M.G.										
42 M.G.										
43 M.G.										
44 M.G.										
45 M.G.										
46 M.V.										
47 M.V.										
48 M.V.										
49 S.S.										
50 A.										
51 D.G.										
52 T.L.										

	2610	2620	2630	2640	2650	2660	2670	2680	2690	2700
53 A.L.										
54 R.Q.										
55 P.L.										
56 E.C.										
57 P.V.										
58 M.A.										
59 H.S.										
60 M.D.										
61 M.S.										
62 M.S.										
63 H.C.										
64 H.C.										
65 M.S.										
66 M.H.										
67 S.C.										
68 B.L.										
69 F.H.										
70 C.P.										
71 T.C.										
72 C.A.										
73 M.A.										
74 M.A.										
75 R.H.										
76 Z.A.										
77 M.C.										
78 M.P.										
79 L.C.										
80 E.G.										
81 M.S.										
82 P.L.										
83 P.D.										
84 S.G.										
85 M.S.										
86 M.S.										
87 R.O.										
88 B.L.										
89 T.L.										
90 D.V.										
91 D.V.										
92 Z.A.										
93 Z.G.										
94 G.M.										
95 T.A.										
96 O.S.										
97 R.H.										
98 S.C.										
99 S.C.										
100 T.C.										
101 T.D.										
102 P.D.										
103 P.L.										
104 T.B.										
105 C.L.										
106 L.L.										

P41-1

P41-1'

P41-1

P41-2

	2710	2720	2730	2740	2750	2760	2770	2780	2790	2800	
53	A.G.										A.G.
54	P.G.										P.G.
55	E.C.										E.C.
56	P.V.										P.V.
57	M.S.										M.S.
58	B.S.										B.S.
59	R.S.										R.S.
60	H.S.										H.S.
61	M.S.										M.S.
62	K.S.										K.S.
63	N.C.										N.C.
64	R.C.										R.C.
65	S.C.										S.C.
66	T.C.										T.C.
67	F.S.										F.S.
68	C.P.										C.P.
69	L.C.										L.C.
70	G.A.										G.A.
71	M.A.										M.A.
72	H.A.										H.A.
73	K.A.										K.A.
74	N.A.										N.A.
75	R.A.										R.A.
76	L.A.										L.A.
77	M.L.										M.L.
78	H.P.										H.P.
79	C.P.										C.P.
80	E.P.										E.P.
81	M.S.										M.S.
82	P.L.										P.L.
83	P.P.										P.P.
84	G.P.										G.P.
85	P.P.										P.P.
86	M.A.										M.A.
87	A.A.										A.A.
88	B.L.										B.L.
89	L.L.										L.L.
90	D.V.										D.V.
91	L.A.										L.A.
92	L.A.										L.A.
93	L.A.										L.A.
94	L.A.										L.A.
95	L.A.										L.A.
96	L.A.										L.A.
97	L.A.										L.A.
98	S.C.										S.C.
99	S.C.										S.C.
100	L.P.										L.P.
101	L.P.										L.P.
102	P.P.										P.P.
103	P.L.										P.L.
104	L.B.										L.B.
105	C.L.										C.L.
106	L.L.										L.L.

P41-2'

P41-2

1 H.S.	2900	H.S.
2 M.A.	2900	M.S.
3 R.M.	2900	R.M.
4 R.M.	2900	R.M.
5 O.C.	2900	O.C.
6 X.L.	2900	X.L.
7 L.B.	2900	L.B.
8 A.S.	2900	A.S.
9 C.G.	2900	C.G.
10 O.S.	2900	O.S.
11 Z.M.	2900	Z.M.
12 C.M.	2900	C.M.
13 U.C.	2900	U.C.
14 U.S.	2900	U.S.
15 M.C.	2900	M.C.
16 S.C.	2900	S.C.
17 A.B.	2900	A.B.
18 D.D.	2900	D.D.
19 E.A.	2900	E.A.
20 O.M.	2900	O.M.
21 S.P.	2900	S.P.
22 T.L.	2900	T.L.
23 T.P.	2900	T.P.
24 T.M.	2900	T.M.
25 T.C.	2900	T.C.
26 T.B.	2900	T.B.
27 T.C.	2900	T.C.
28 T.B.	2900	T.B.
29 T.C.	2900	T.C.
30 T.P.	2900	T.P.
31 T.M.	2900	T.M.
32 P.L.	2900	P.L.
33 P.M.	2900	P.M.
34 P.B.	2900	P.B.
35 P.B.	2900	P.B.
36 A.C.	2900	A.C.
37 T.B.	2900	T.B.
38 C.L.	2900	C.L.
39 C.G.	2900	C.G.
40 V.R.	2900	V.R.
41 M.C.	2900	M.C.
42 M.M.	2900	M.M.
43 M.M.	2900	M.M.
44 M.M.	2900	M.M.
45 M.M.	2900	M.M.
46 M.V.	2900	M.V.
47 M.F.	2900	M.F.
48 M.L.	2900	M.L.
49 S.S.	2900	S.S.
50 A.	2900	A.
51 D.M.	2900	D.M.
52 T.L.	2900	T.L.

	2810	2820	2830	2840	2850	2860	2870	2880	2890	2900
51 A.t.										
52 B.g.										
53 P.p.										
54 E.c.										
55 S.c.										
57 P.v.										
58 H.a.										
59 M.b.										
60 D.g.										
61 M.x.										
62 S.b.										
63 H.c.										
64 H.c.										
65 H.a.										
66 H.c.										
67 F.h.										
69 F.h.										
70 L.b.										
71 T.c.										
72 C.a.										
73 H.a.										
74 T.a.										
75 A.n.										
76 L.a.										
77 M.c.										
78 H.p.										
79 C.r.										
80 E.g.										
81 H.s.										
82 P.t.										
83 P.p.										
84 S.g.										
85 P.p.										
86 H.a.										
87 R.n.										
88 S.t.										
89 T.t.										
90 B.v.										
91 B.v.										
92 L.b.										
93 L.g.										
94 T.a.										
95 T.a.										
96 O.b.										
97 A.n.										
98 S.c.										
99 S.c.										
100 T.p.										
101 T.p.										
102 P.p.										
103 P.t.										
104 T.a.										
105 C.r.										
106 L.t.										

P41-3

P41-2'

	2910	2920	2930	2940	2950	2960	2970	2980	2990	3000		
1 M.S.											U C G G C G U	H.S.
2 M.M.											C G A G C G U	M.S.
3 R.n.											C C A G C G U	R.n.
4 R.n.											C G A G C G U	R.n.
5 O.C.											C C A G C G U	O.C.
6 I.I.											C C A G C G U	I.I.
7 I.b.											C C A G C G U	I.b.
8 A.S.											C C A G C G U	A.S.
9 C.e.											C C A G C G U	C.e.
10 U.S.											C C A G C G U	U.S.
11 S.A.											C C A G C G U	S.A.
12 C.M.											C C A G C G U	C.M.
13 O.D.											C C A G C G U	O.D.
14 S.C.											C C A G C G U	S.C.
15 M.C.											C C A G C G U	M.C.
16 S.C.											C C A G C G U	S.C.
17 A.b.											C C A G C G U	A.b.
18 D.d.											C C A G C G U	D.d.
19 E.a.											C C A G C G U	E.a.
20 U.n.											C C A G C G U	U.n.
21 S.p.											C C A G C G U	S.p.
22 T.C.											C C A G C G U	T.C.
23 T.p.											C C A G C G U	T.p.
24 T.b.											C C A G C G U	T.b.
25 T.a.											C C A G C G U	T.a.
26 T.c.											C C A G C G U	T.c.
27 T.d.											C C A G C G U	T.d.
28 T.e.											C C A G C G U	T.e.
29 T.f.											C C A G C G U	T.f.
30 T.g.											C C A G C G U	T.g.
31 T.h.											C C A G C G U	T.h.
32 P.L.											C C A G C G U	P.L.
33 P.M.											C C A G C G U	P.M.
34 P.b.											C C A G C G U	P.b.
35 P.c.											C C A G C G U	P.c.
36 A.C.											C C A G C G U	A.C.
37 I.D.											C C A G C G U	I.D.
38 C.T.											C C A G C G U	C.T.
39 V.H.											C C A G C G U	V.H.
40 V.H.											C C A G C G U	V.H.

41

41 M.C.											U C G G C G U	M.C.
42 M.b.											U C G G C G U	M.b.
43 M.a.											U C G G C G U	M.a.
44 M.d.											U C G G C G U	M.d.
45 M.e.											U C G G C G U	M.e.
46 M.f.											U C G G C G U	M.f.
47 M.g.											U C G G C G U	M.g.
48 M.h.											U C G G C G U	M.h.
49 S.S.											U C G G C G U	S.S.
50 A.											U C G G C G U	A.
51 D.A.											U C G G C G U	D.A.
52 T.C.											U C G G C G U	T.C.

41

	2910	2920	2930	2940	2950	2960	2970	2980	2990	3000	
53 A.t.											A.t.
54 R.g.											U
55 P.t.											K.g.
56 E.c.											P.t.
57 P.v.											E.c.
58 K.a.											A
59 M.s.											A.A
60 D.d.											A
61 R.a.											R.a.
62 B.b.											B.b.
63 M.c.											M.c.
64 W.h.											W.h.
65 M.b.											M.b.
66 S.c.											S.c.
68 B.f.											B.f.
69 F.h.											F.h.
70 C.p.											C.p.
71 T.r.											T.r.
72 G.a.											G.a.
73 H.a.											H.a.
74 T.b.											T.b.
75 A.n.											A.n.
76 Z.m.											Z.m.
77 M.L.											M.L.
78 M.P.											M.P.
79 C.F.											C.F.
80 E.g.											E.g.
81 H.s.											H.s.
82 P.L.											P.L.
83 P.D.											P.D.
84 S.G.											S.G.
85 P.P.											P.P.
86 R.A.											R.A.
87 R.n.											R.n.
88 E.L.											E.L.
89 D.L.											D.L.
91 D.V.											D.V.
92 L.B.											L.B.
93 L.D.											L.D.
94 G.M.											G.M.
95 T.A.											T.A.
96 O.S.											O.S.
97 A.n.											A.n.
98 S.C.											S.C.
99 S.C.											S.C.
100 T.p.											T.p.
101 T.p.											T.p.
102 P.p.											P.p.
103 T.c.											T.c.
104 T.c.											T.c.
105 C.f.											C.f.
106 L.b.											L.b.

P41-3

P41-3'

41'

