T A B I S 2 0 1 0

Theoretical Approaches to Bio-Information Systems

Institute of Physics, Belgrade

BOOK OF ABSTRACTS

Belgrade 20-21. 05. 2010.

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A SYSTEMIC-CHEMICAL APPROACH TO THE GENETIC CODE

Miloje M. Rakočević

Abstract

This communication presents several key results from my researches of the genetic code. All of these results support the hypothesis on a complete genetic code, which I expressed explicit, in an article in the 2004th year [J. Theoret. Biol. 229 (2004) 221-234]; complete code, in the sense that the genetic code was in pre-biotic times and spaces as it is today, consisting from four amino bases and 20 amino acids.

A SYSTEMIC-CHEMICAL APPROACH TO THE GENETIC CODE

Miloje M. Rakočević

(www. rakocevcode.rs)

TABIS

20-21.05.2010

Belgrade

ESSAI D'UNE SYSTÈME DES ÉLÉMENTS

D'APRÉS LEURS POIDS ATOMIQUES ET FONCTIONS CHIMIQUES,

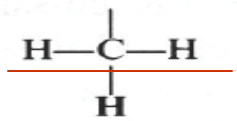
par D. Mendeleeff,

profess. de l'Univers. à S-Pétersbourg.

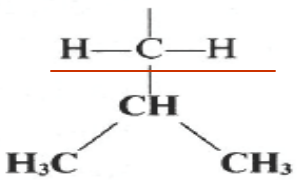
			Ti = 50	Zr = 90	? = 180.	
			V = 51	Nb = 94	Ta = 182.	
			Cr = 52	Mo = 96	W = 186.	
			Mn = 55	Rh = 104,4	Pt = 197,4.	
			Fe = 56	Ru = 104,4	Ir = 198.	
			Ni = Co = 59	Pl = 106,6	Os = 199.	
H = 1			Cu = 63,4	Ag = 108	Hg = 200.	
	Be = 9,4	Mg = 24	Zn = 65,2	Cd = 112		
	B = 11	Al = 27,4	? = 68	Ur = 116	Au = 197?	
	C = 12	Si = 28	? = 70	Sn = 118		
	N = 14	P = 31	As = 75	Sb = 122	Bi = 210?	
	O = 16	S = 32	Se = 79,4	Te = 128?		
	F = 19	Cl = 35,5	Br = 80	I = 127		
Li = 7	Na = 23	K = 39	Rb = 85,4	Cs = 133	Tl = 204.	
		Ca = 40	Sr = 87,6	Ba = 137	Pb = 207.	
		? = 45	Ce = 92			
		?Er = 56	La = 94			
		?Yt = 60	Di = 95			
		?In = 75,6	Th = 118?			

$18\frac{III}{I}69$

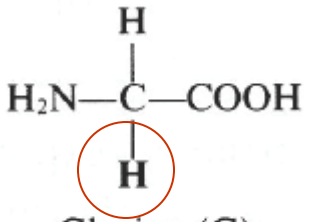
Popov, E.M, *Intern. J. Quant. Chem.*, 16 (1979)
Rakočević & Jokić, *J. Theor. Biol.*, 183 (1996)



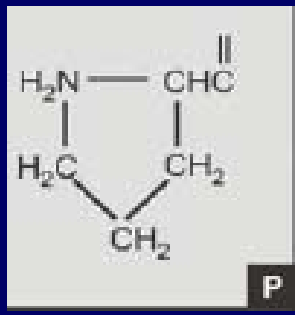
Alanine (A)

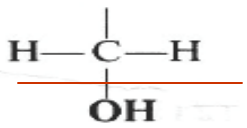


Leucine (L)

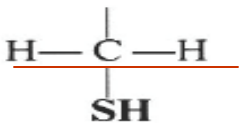


Glycine (G)

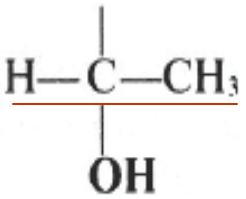




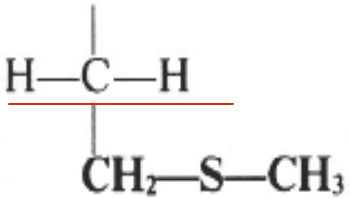
Serine (S)



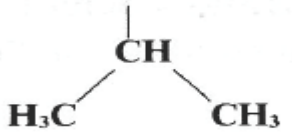
Cysteine (C)



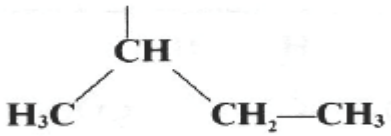
Threonine (T)



Methionine (M)



Valine (V)



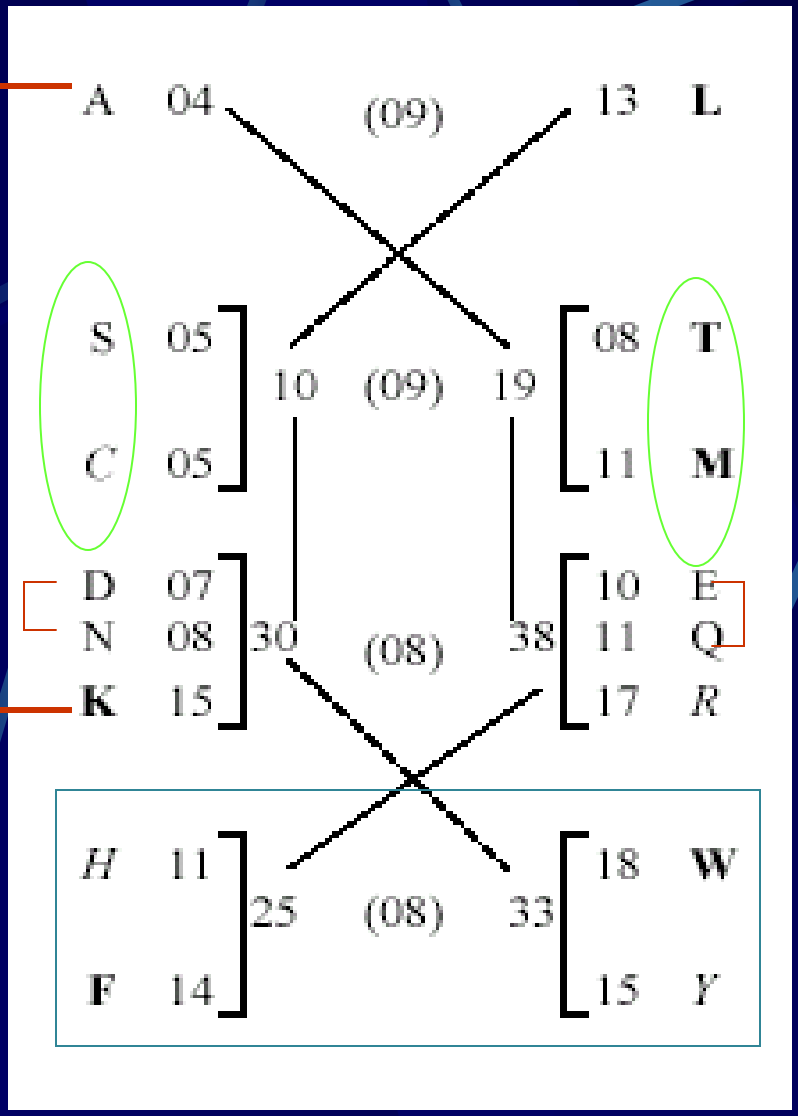
Isoleucine (I)

CONSTITUTIONS

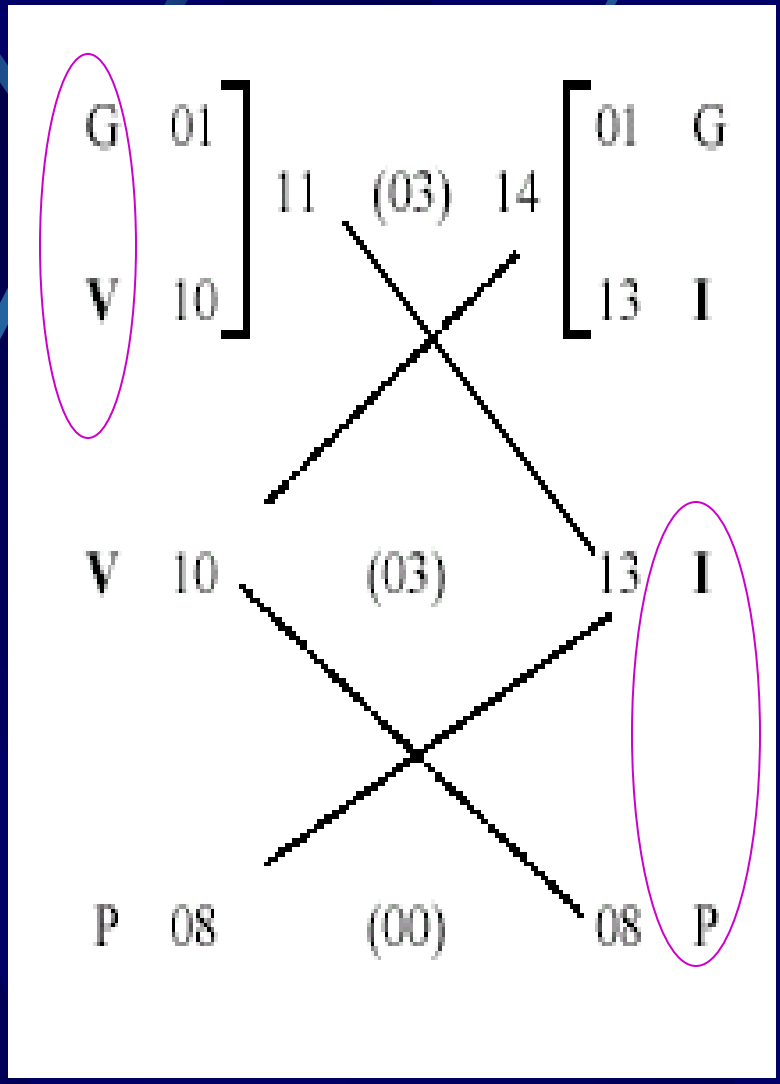
Non-contact AAs

Contact AAs

Alanine stereochemical type



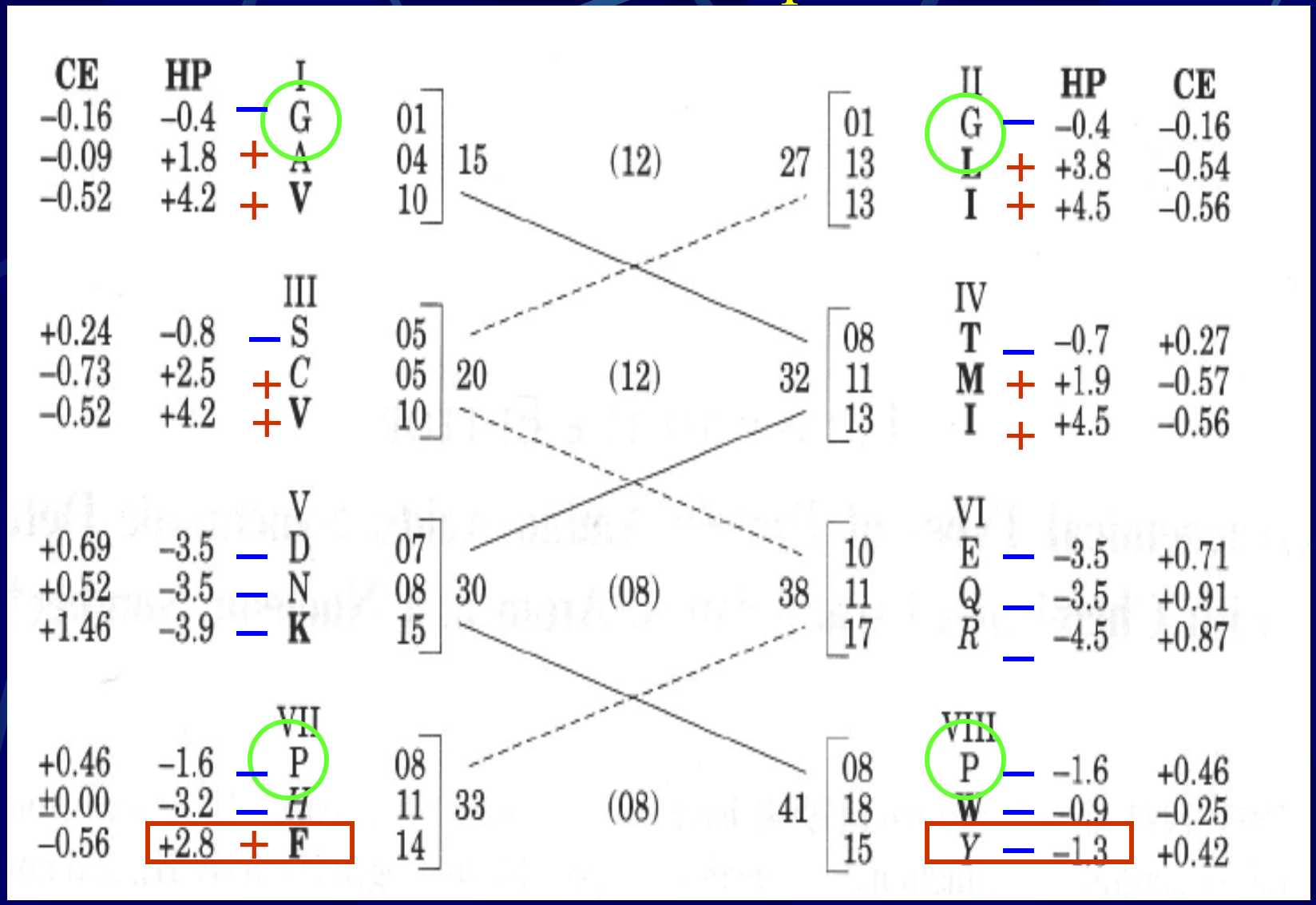
Three types: G, P, V



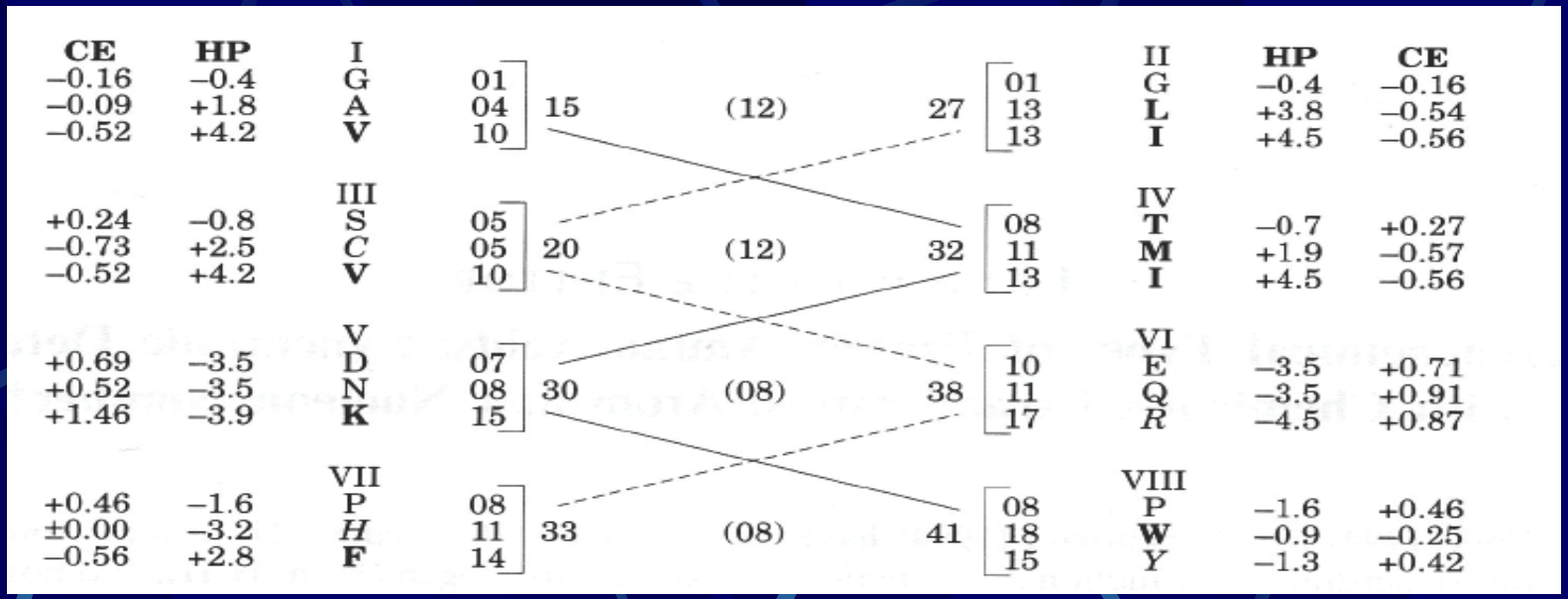
Non-contact AAs

Contact AAs

12 doublets / **8** triplets



zigzag 118 / 118



The order of involvement of amino acid precursors in biosynthesis paths

1. 3-Phosphoglycerate	G	•	•	•	•	•
2. Pyruvate	A	L	V	•	•	•
3. Oxaloacetate	•	•	I	•	•	•
1. 3-Phosphoglycerate	S	*C*	•	•	•	•
2. Pyruvate	•	•	V	•	•	•
3. Oxaloacetate	T	M	I	D	N	K
				⋮	⋮	⋮
4. 2-Oxoglutarate	•	•	P	E	Q	*R*
5. Ribose-5-phosphate	•	•	*H*	•	•	•
6. Phosphoenolpyruvate plus eritrose-4-phosphate	•	•	W	F	*Y*	•

Relations to 6 types of precursors

If there are x singlets, in order to produce doublets (y) and triplets (z) at the same time;

Doublets, with two splittings
Triplets, with three splittings

Then,
$x = 24; y = 12; z = 8$

Atom number within 61 AAs molecules (side chain / whole mollecule)

1st lett.	2nd letter: U		2nd letter: C		2nd letter: A		2nd letter: G		3rd lett.
U	UUU	F II	UCU	S II	UAU	Y I	UGU	C I	U
	UUC		UCC		UAC		UGC		C
	UUA	L I	UCA		UAA	CT	UGA	CT W I	A
	UUG		UCG		UAG		UGG		G
C	CUU	L I	CCU	P II	CAU	H II	CGU	R I	U
	CUC		CCC		CAC		CGC		C
	CUA		CCA		CAA	Q I	CGA		A
	CUG		CCG		CAG		CGG		G
A	AUU	Ile I	ACU	T II	AAU	N II	AGU	S II	U
	AUC		ACC		AAC		AGC		C
	AUA	M I	ACA		AAA	K II	AGA	R I	A
	AUG		ACG		AAG		AGG		G
G	GUU	V I	GCU	A II	GAU	D II	GGU	G II	U
	GUC		GCC		GAC		GGC		C
	GUA		GCA		GAA	E I	GGA		A
	GUG		GCG		GAG		GGG		G

(non-p) 22 / 222 / 420 // (polar) 39 / 372 / 723

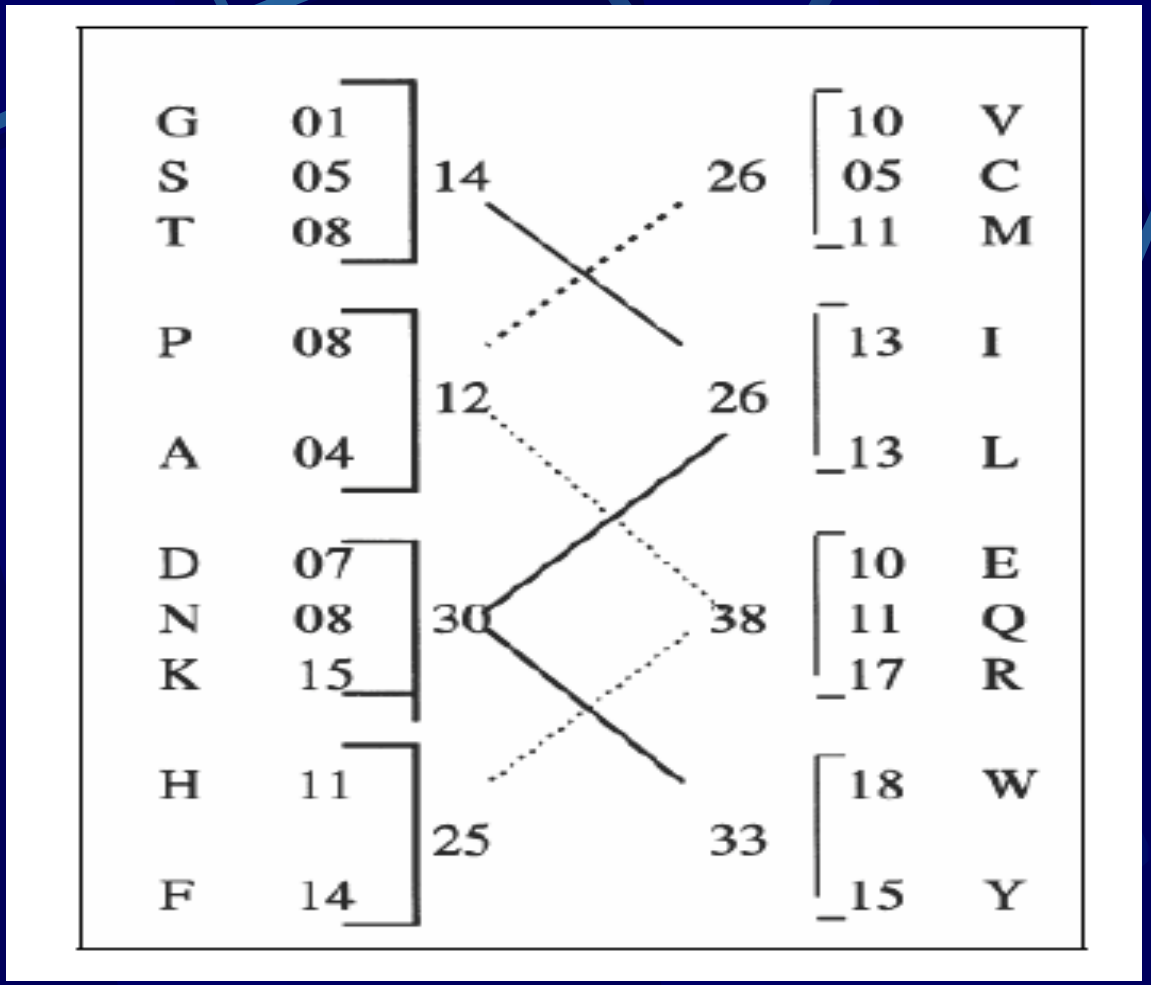
(outer) 21 / 232 / 421 // (inner) 40 / 362 / 722

Hydropathy (Kyte & Doolittle, 1982)

Two classes of AAs in relation to two classes of enzymes aminoacyl-tRNA synthetases

Class II

Smaller mollecules



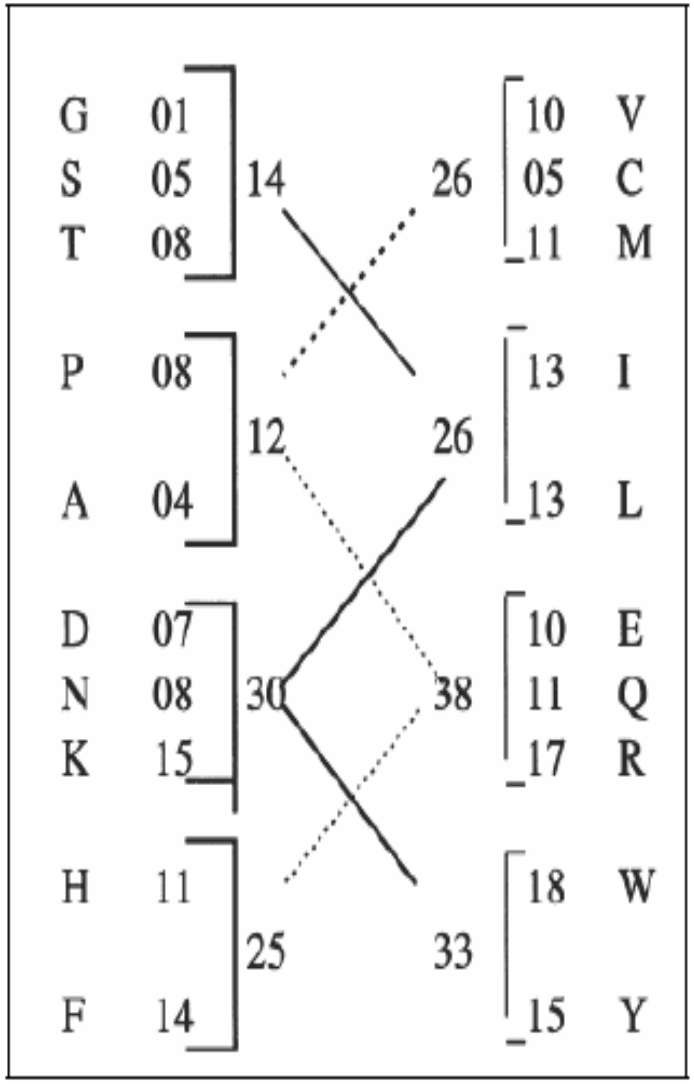
Class I

Larger mollecules

81

123

(102+1 / 102-1)



D – E – R – K – H/W – Y – F

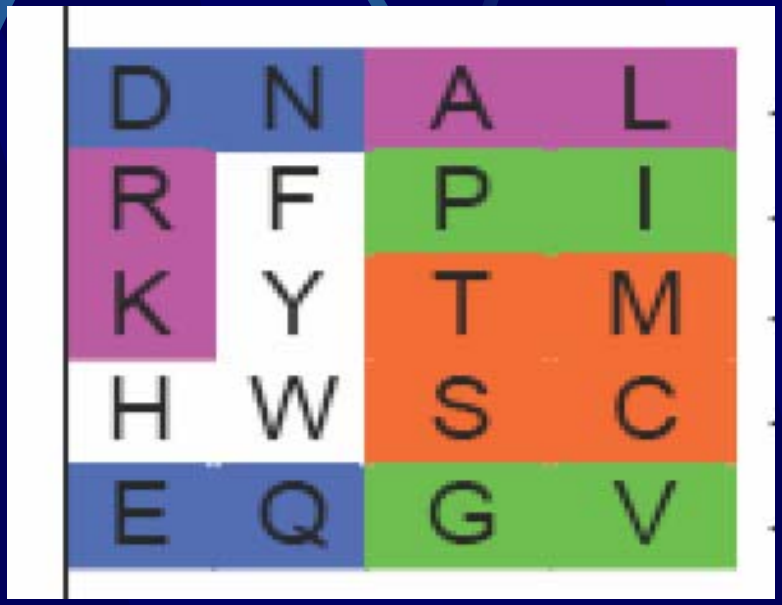
N – Q – F – Y – W

D – R – K – H – E

N – F – Y – W – Q

A – P – T – S – G

L – I – M – C – V



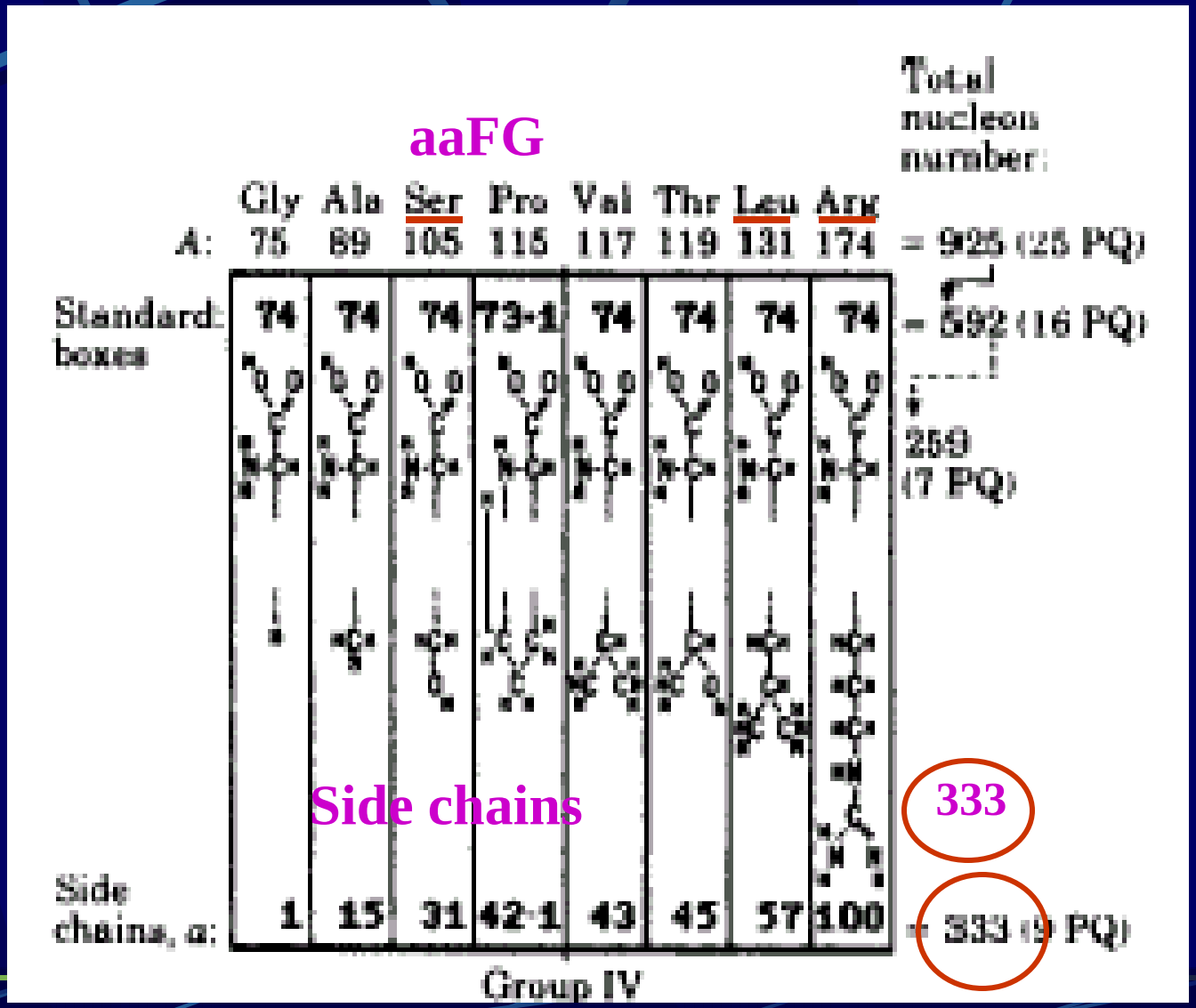
Shcherbak, *J. Theor. Biol.* (1994), 166

Nucleon number in eight four-codon AAs: (degeneration IV)
8 heads + 8 bodies

$3^2 \times 37 = 333$ (259)

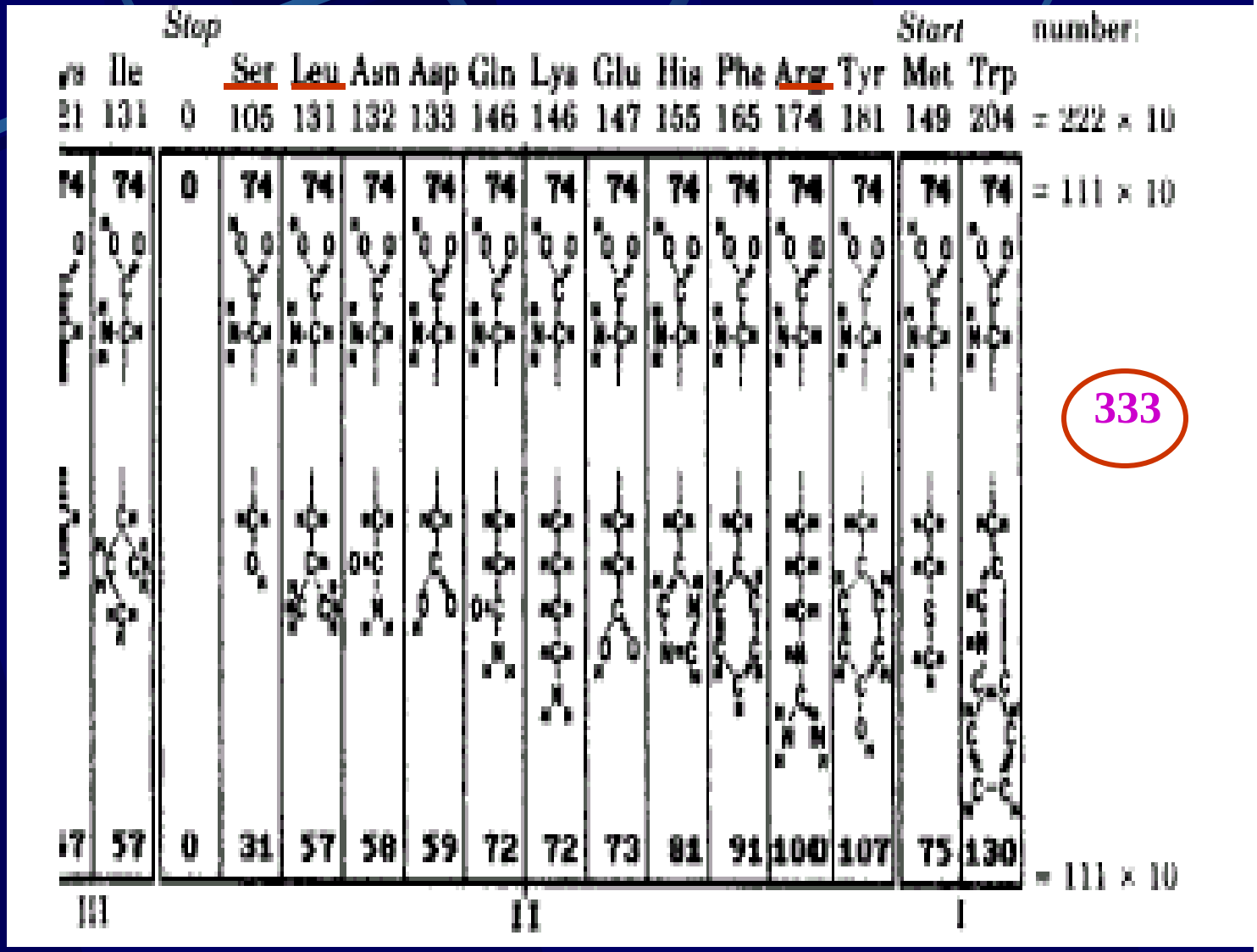
$4^2 \times 37 = 592$

$5^2 \times 37 = 925$



Shcherbak, *J. Theor. Biol.* (1994), 166

Nucleon number in 15 non-four-codon AAs: (degeneration I, II, III)
8 heads +
8 bodies



012 MOLECULES 888 NUCLEONS			
UU F L	UC S	UA Y	UG C W
CU L	CC P	CA H Q	CG R
AU I M	AC T	AA N K	AG S R
GU V	GC A	GA D E	GG G
011 MOLECULES 555 NUCLEONS			

1110 + 333 = 1443

888 + 555 = 1443

1443 x 6 = 8658

(7770+0888)

Shcherbak, *J. Theor. Biol.* (1994), 166

0	1	2	3	4	5	6	7	8	9
000	037	074	111	148	185	222	259	296	333
000	370	407	444	481	518	555	592	629	666
000	703	740	777	814	851	888	925	962	999

01 x 037 = 037
10 x 037 = 370
19 x 037 = 703

01 x 038 = 038
10 x 038 = 380
19 x 037 = 722

ESSAI D'UNE SYSTÈME DES ÉLÉMENTS

D'APRÉS LEURS POIDS ATOMIQUES ET FONCTIONS CHIMIQUES,

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H = 1			Cu = 63,4	Ag = 108	Hg = 200.
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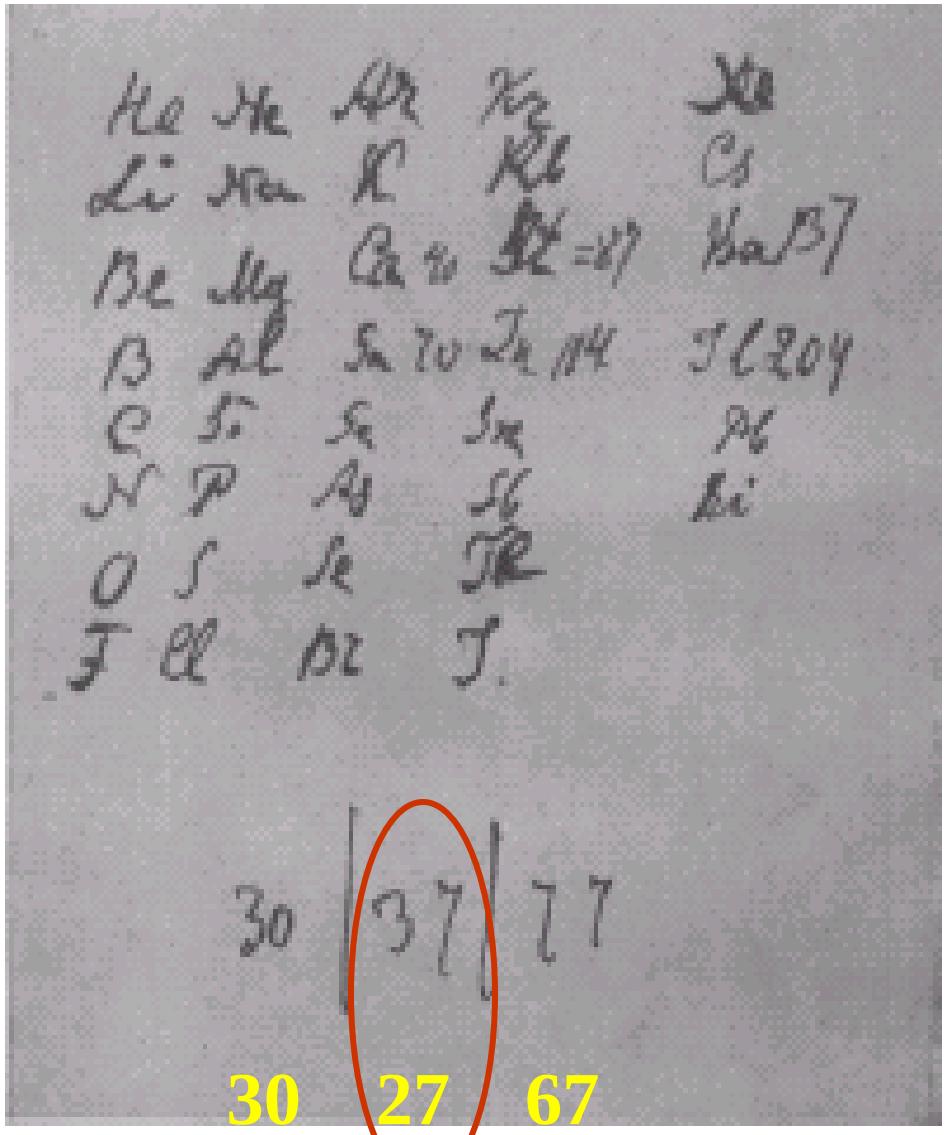
	N = 14	P = 31	As = 75	Sb = 122	Bi = 210?
	O = 16	S = 32	Se = 79,4	Te = 128?	
	F = 19	Cl = 35,5	Br = 80	I = 127	
Li = 7	Na = 23	K = 39	Rb = 85,4	Cs = 133	Tl = 204.
		Ca = 40	Sr = 87,6	Ba = 137	Pb = 207.
		? = 45	Ce = 92		
		?Er = 56	La = 94		
		?Yt = 60	Di = 95		
		?In = 75,6	Th = 118?		

$18\frac{III}{I}69$

Mendeleev's curiosity



40 87 137

70 114 204

30 27 67

30 27 67

. . . as a new curiosity

V. Shcherbak		D. Alighieri (La Divina Commedia)
13_{04}	(07)	130 (7, 8)
	12	
25_{07}	(19)	142(2,5,14);151(4,13);115(6,11);133 (9);124(15)
	18	
37_{10}	(37)	136 (1, 3, 10, 16, **17**)
	24	
49_{13}	(61)	139 (12)
...		(First 17 cantos of “Inferno”)

01_{01}	(01)
	06
13_{04}	(07)
	12
25_{07}	(19)
...	

Rakočević, *J. Theor. Biol.* (2004), 229

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Journal of Theoretical Biology 229 (2004) 221–234

Journal of Theoretical Biology

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A harmonic structure of the genetic code

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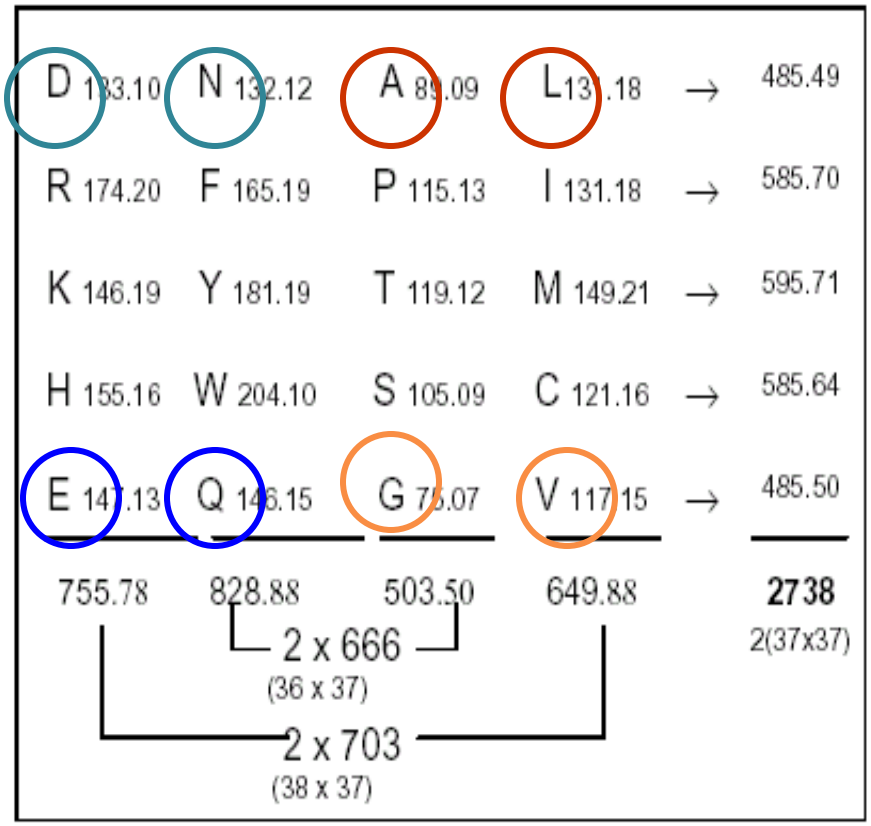
Received 7 October 2003; received in revised form 19 March 2004; accepted 26 March 2004

Multiples of number 037 still once!

Table 1a.



485

586

596

586

485

298

298

$37^2 \pm 00$

$37^2 \pm 37^1$

Table 1a.

D 133.10	N 132.12	A 89.09	L 131.18	→	485.49
R 174.20	F 165.19	P 115.13	I 131.18	→	585.70
K 146.19	Y 181.19	T 119.12	M 149.21	→	595.71
H 155.16	W 204.10	S 105.09	C 121.16	→	585.64
E 147.13	Q 146.15	G 75.07	V 117.15	→	485.50
755.78	828.88	503.50	649.88		**2738**

2 x 666
(36 x 37)

2 x 703
(38 x 37)

2(37x37)

485

586

298

596 **298**

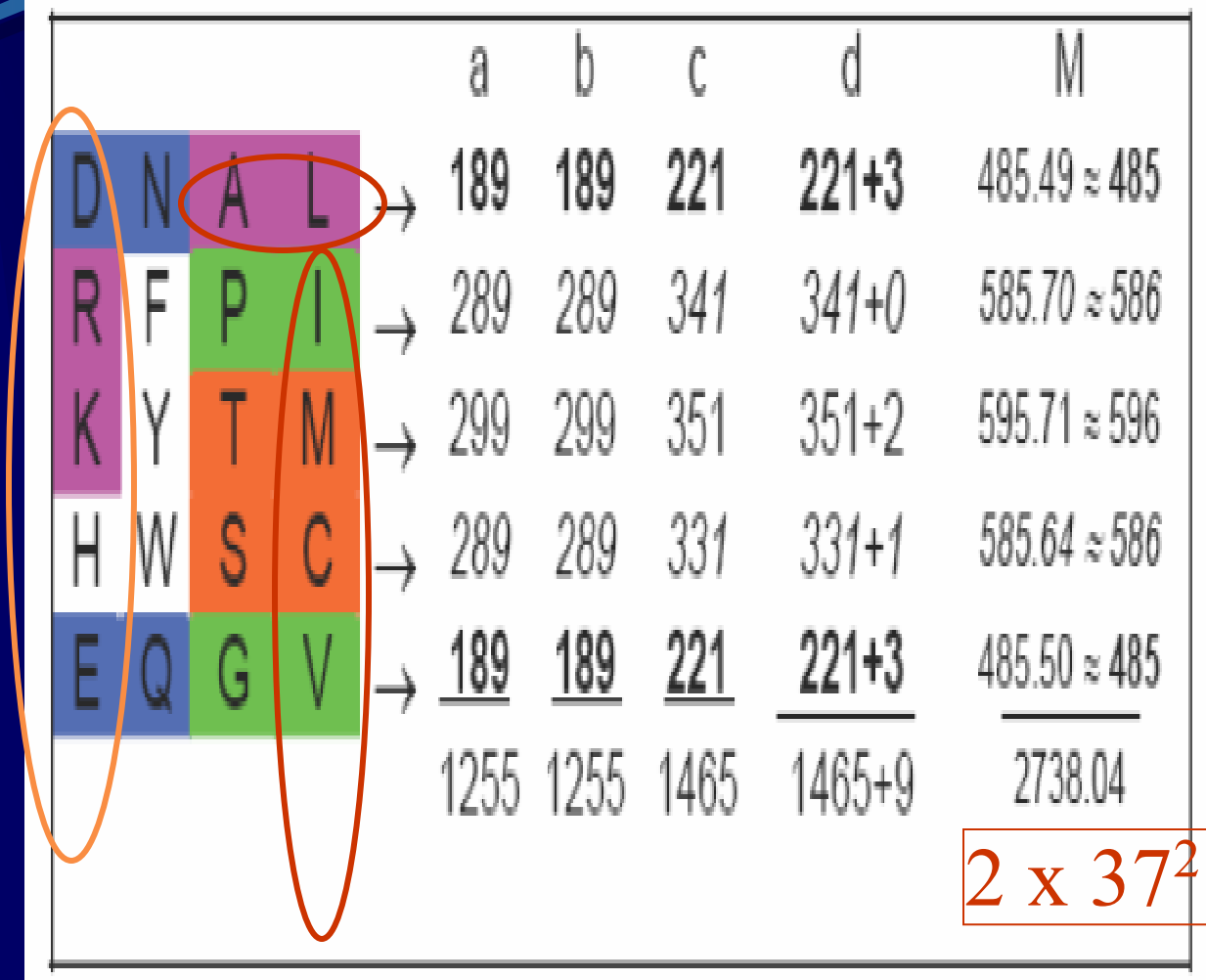
$37^2 \pm 00$

586

485

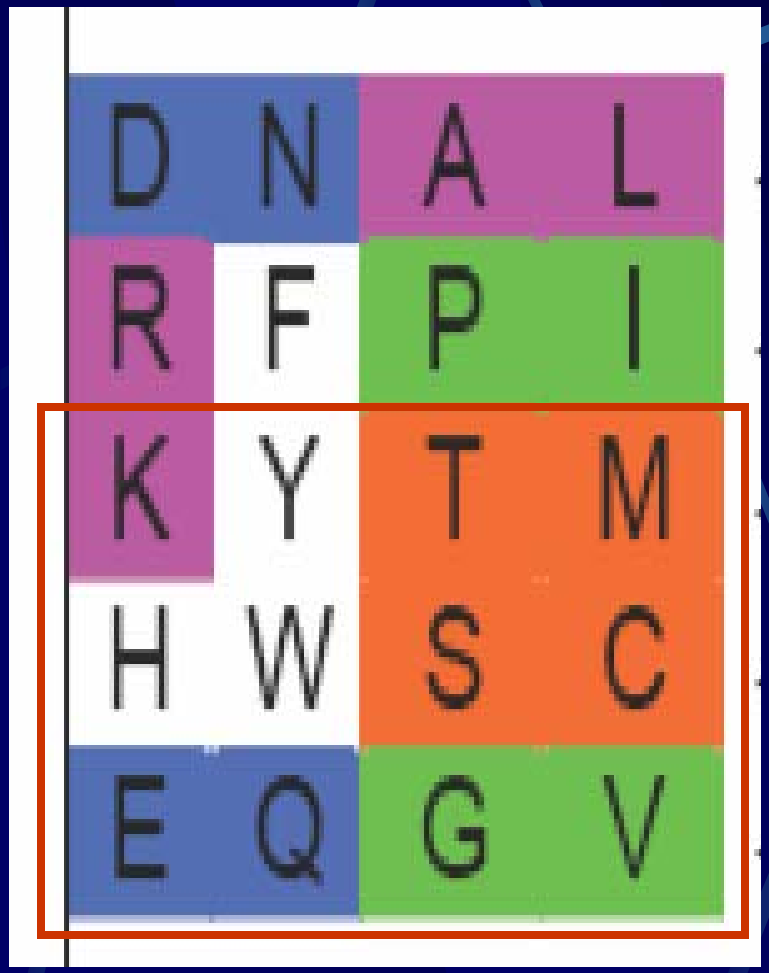
$37^2 \pm 37^1$

Nuclides
a = b
(first, lightest, with most abundance)
c – least abundance
d – last, heaviest



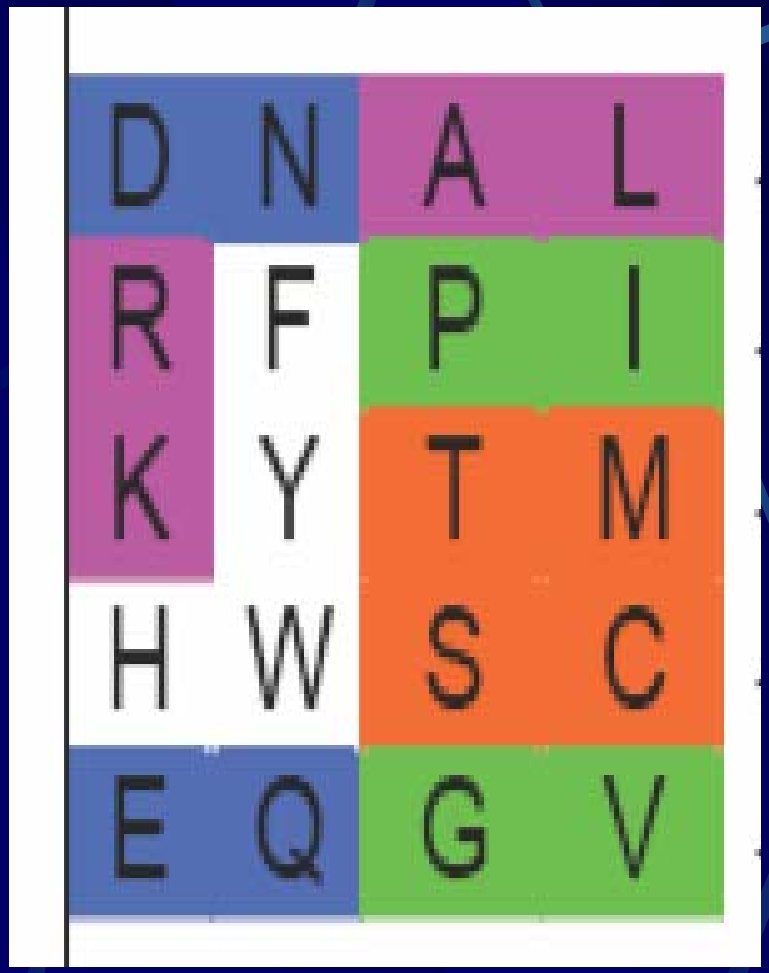
	a	b	c	d	M
D N A L →	189	189	221	221+3	485.49 ≈ 485
R F P I →	289	289	341	341+0	585.70 ≈ 586
K Y T M →	299	299	351	351+2	595.71 ≈ 596
H W S C →	289	289	331	331+1	585.64 ≈ 586
E Q G V →	189	189	221	221+3	485.50 ≈ 485
	1255	1255	1465	1465+9	2738.04

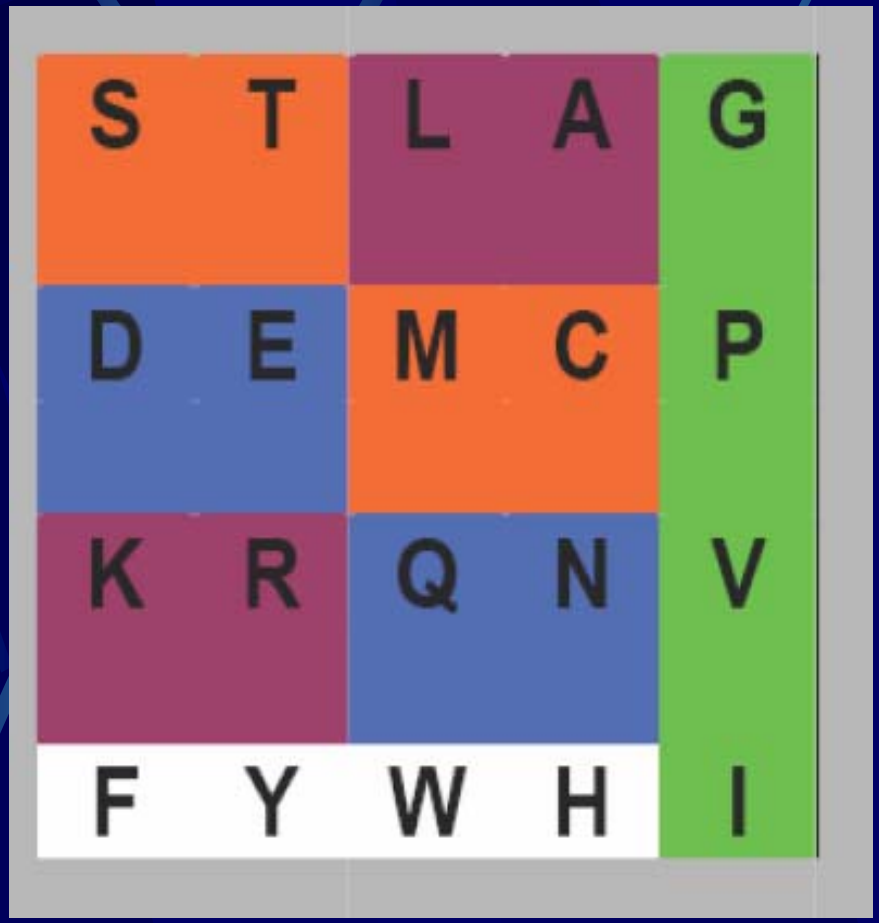
2×37^2



					Π	C	
K	Y	T	M	→	27	9	
							2
H	W	S	C	→	33	11	
							1
E	Q	G	V	→	36	12	
							2
D	N	A	L	→	42	14	
							1
R	F	P	I	→	45	15	

Explanation in the text.





Harmonic structures od amino acid code ("first" & "second")

Contact AAs

Aliphatic AAs

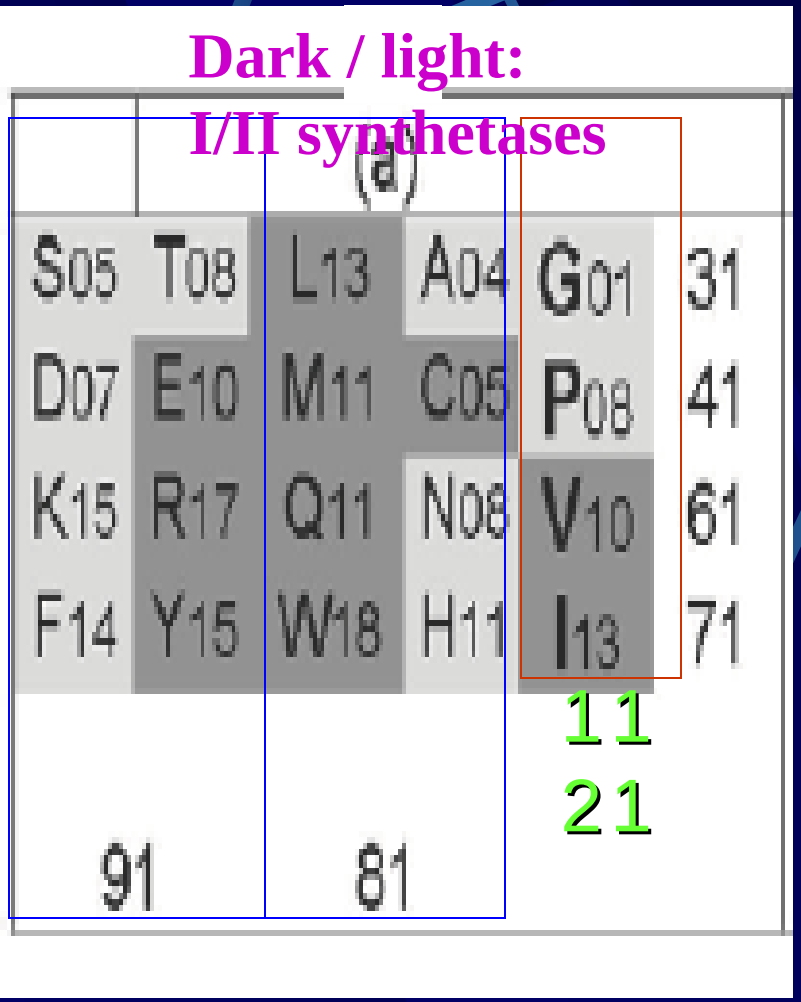
Chalogene

Dicaroxylic + amides

Aromatic AAs

The Little Gauss' algoritam

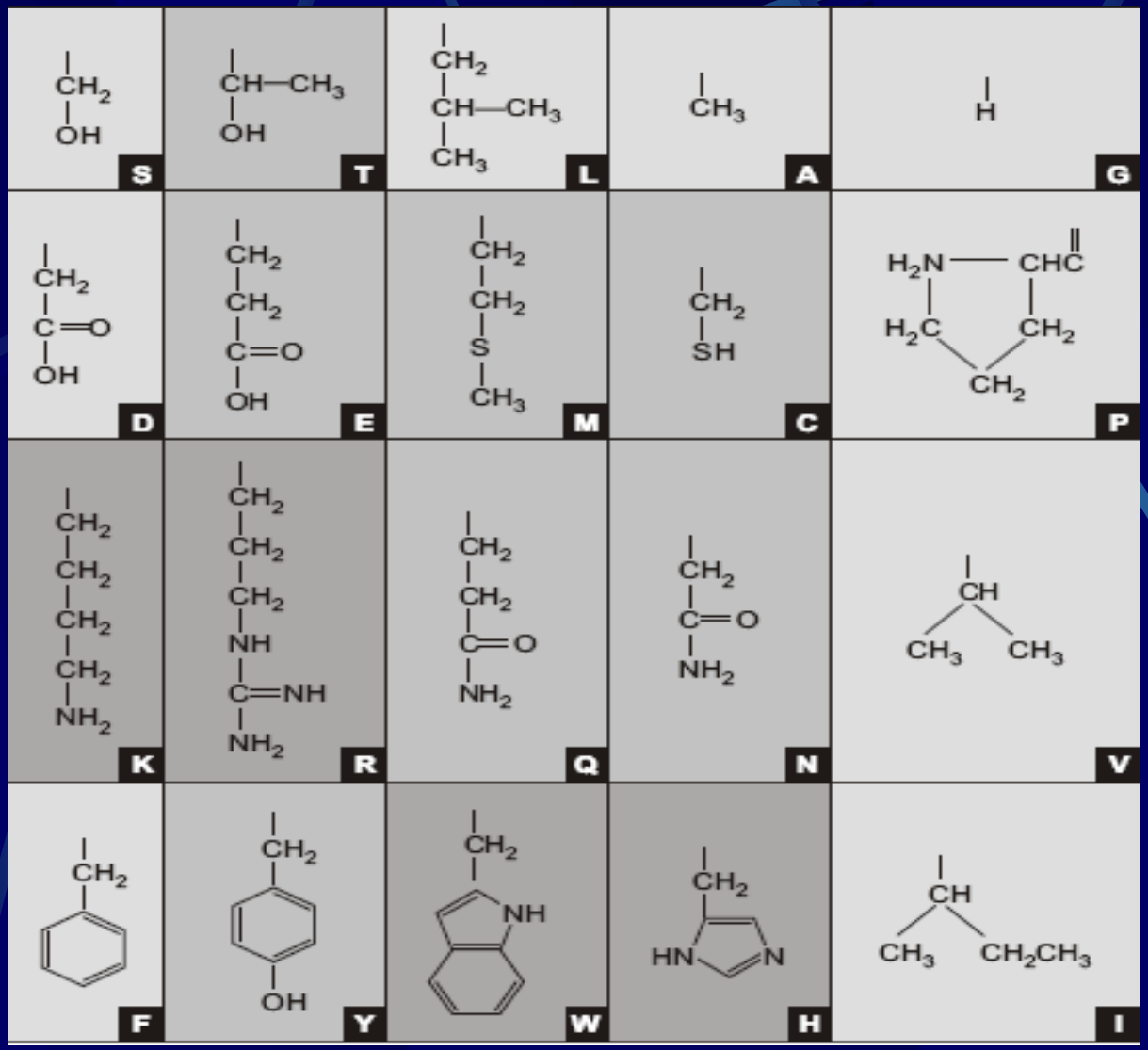
Dark / light:
I/II synthetases



01+101	11+91	21+81	31+71	41+61
02+100	12+90	22+80	32+70	42+60
03+099	13+89	23+79	33+69	43+59
04+098	14+88	24+78	34+68	44+58
05+097	15+87	25+77	35+67	45+57
06+096	16+86	26+76	36+66	46+56
07+095	17+85	27+75	37+65	47+55
08+094	18+84	28+74	38+64	48+54
09+093	19+83	29+73	39+63	49+53
10+092	20+82	30+72	40+62	50+52

("second") without 51

without 51



(31)

41

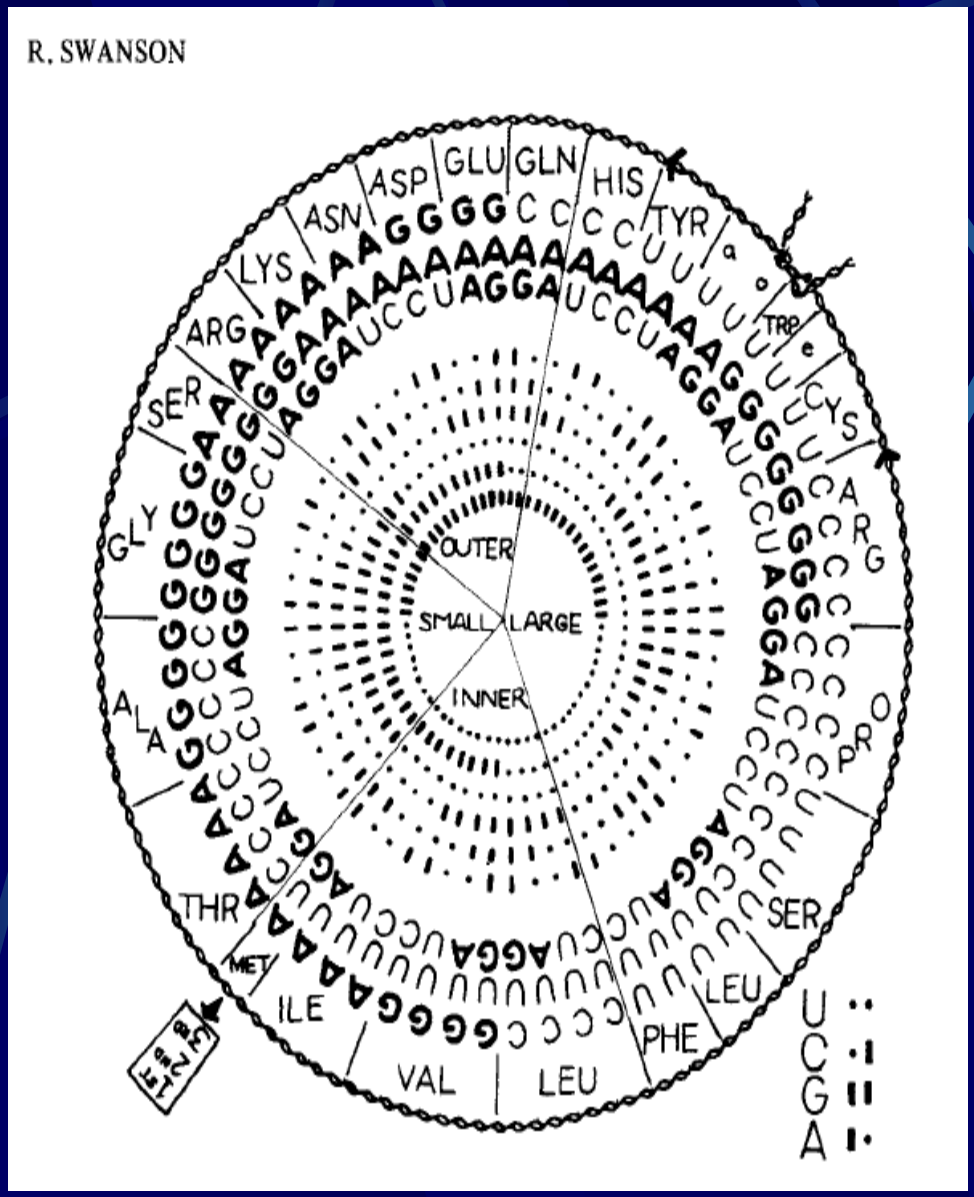
61

71

91

81

(32)


R. SWANSON
OUTER
SMALL
LARGE
INNER
LYS
ASN
ASP
GLU
GLN
HIS
TYR
TRP
CYS
ARG
SER
GLY
ALA
PRO
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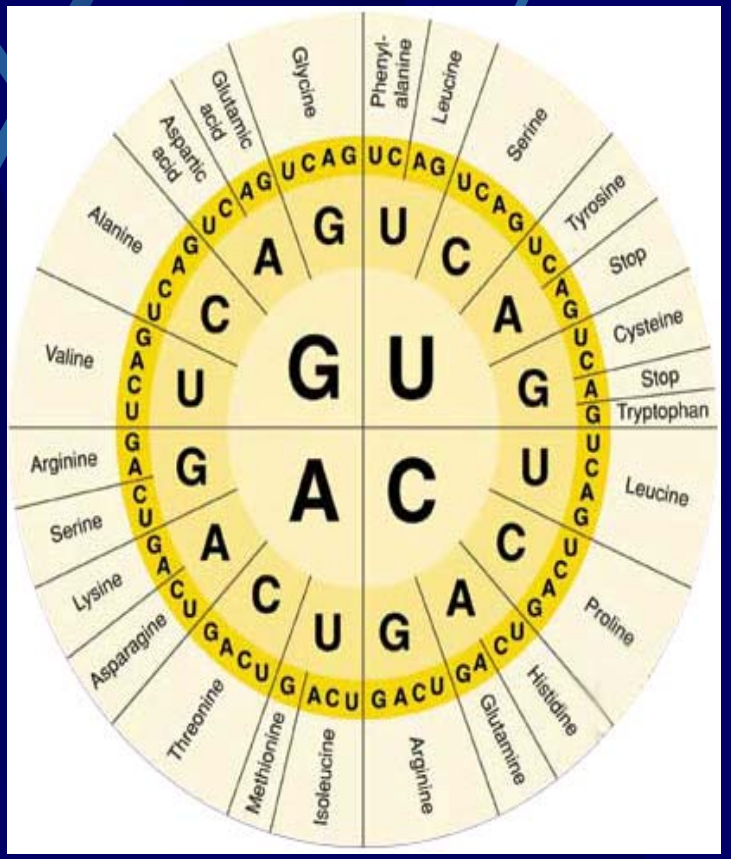
ILE
VAL
LEU
PHE
LEU
U
C
G
A


Glycine
Glutamic acid
Aspartic acid
Alanine
Valine
Arginine
Serine
Lysine
Asparagine
Threonine
Methionine
Isoleucine
Phenyl-alanine
Leucine
Serine
Tyrosine
Stop
Cysteine
Stop
Tryptophan
Leucine
Proline
Histidine
Glutamine
Arginine
U
C
A
G

Rakočević, M.M., *Biosystems*, 46, 1998

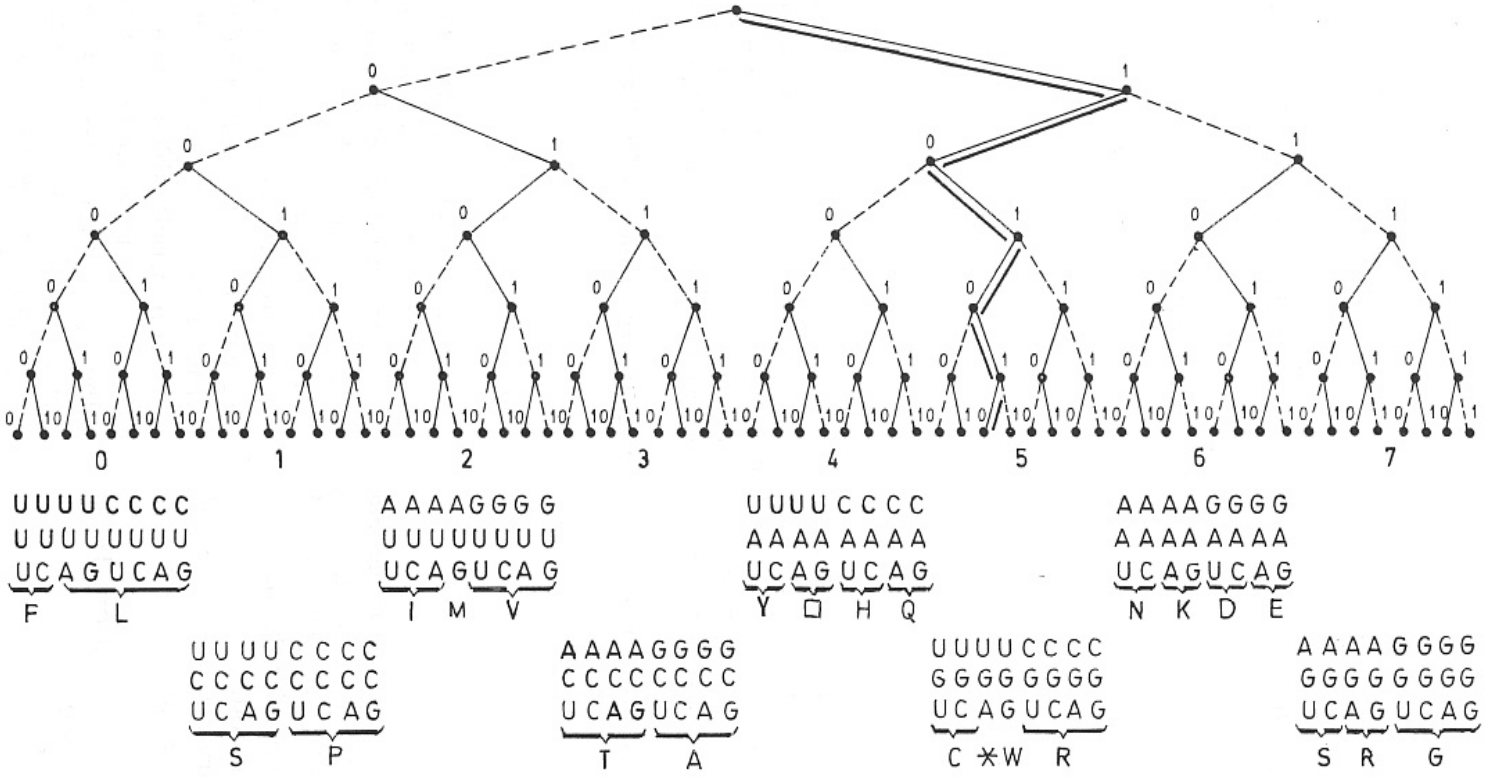


Fig. 1. Genetic code as a binary-coc
and vice versa. The dotted lines: t
corresponding to the 'Golden mean

Φ^0	Φ^1	Φ^2	Φ^3	Φ^4	$\Phi^{5\text{-}7}$	Φ^8	Φ^9
G	Q	T	P	S	L	L	F
63	39-38	25-24	15-14	10-09	06-02	02-01	01-00
63	38.94	24.06	14.87	9.19	5.68 – 2.17	1.34	0.83

to three hydrogen bonds
stest) changes; the route
UAG.

. . . more than a curiosity

1st lett.	2nd letter								3rd lett.
	U		*C*		*A*		*G*		
U	00. UUU	F	16. UCU	S	32. UAU	Y	48. UGU	C	*U*
	01. UUC		17. UCC		33. UAC		49. UGC		*C*
	02. UUA	L	18. UCA		34. UAA	CT	50. UGA	CT W	*A*
	03. UUG		19. UCG		35. UAG		51. UGG		*G*
C	04. CUU	L	20. CCU	P	36. CAU	H	52. CGU	R	*U*
	05. CUC		21. CCC		37. CAC		53. CGC		*C*
	06. CUA		22. CCA		38. CAA	Q	54. CGA		*A*
	07. CUG		23. CCG		39. CAG		55. CGG		*G*
A	08. AUU	I	24. ACU	T	40. AAU	N	56. AGU	S	*U*
	09. AUC		25. ACC		41. AAC		57. AGC		*C*
	10. AUA		26. ACA		42. AAA	K	58. AGA	R	*A*
	11. AUG	M	27. ACG		43. AAG		59. AGG		*G*
G	12. GUU	V	28. GCU	A	44. GAU	D	60. GGU	G	*U*
	13. GUC		29. GCC		45. GAC		61. GGC		*C*
	14. GUA		30. GCA		46. GAA	E	62. GGA		*A*
	15. GUG		31. GCG		47. GAG		63. GGG		*G*

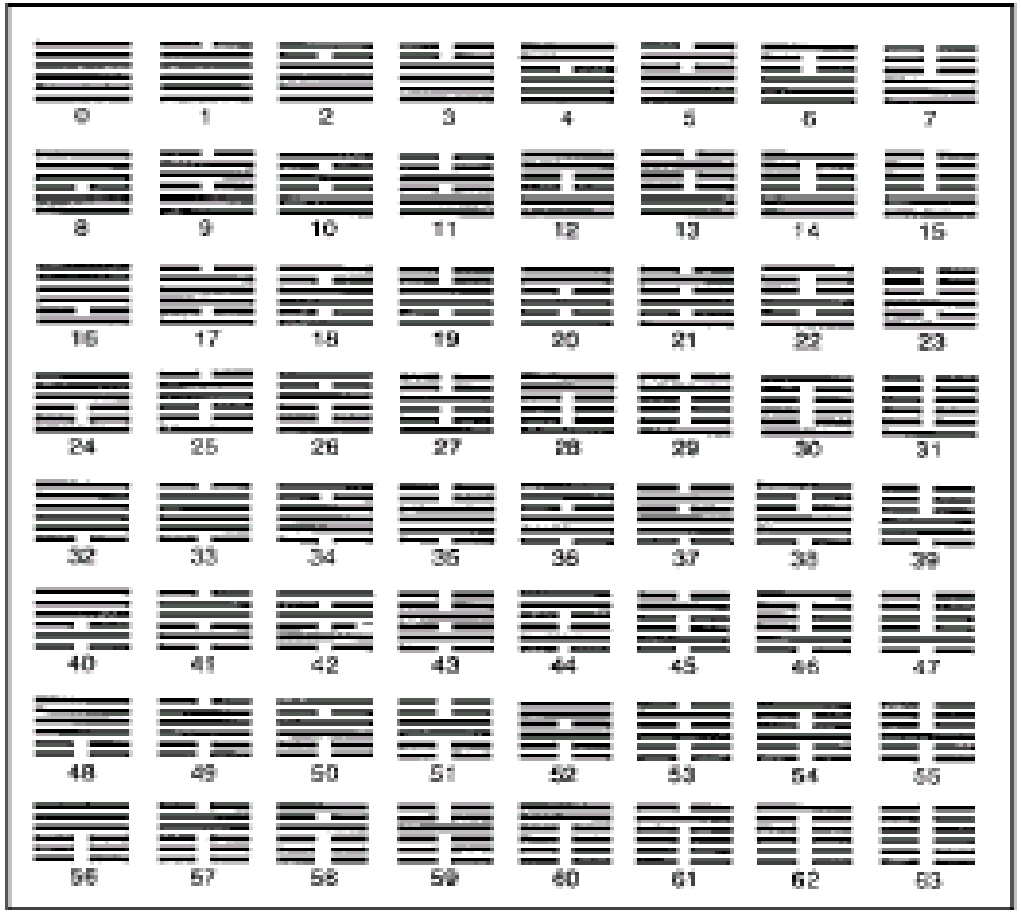
6

28

496

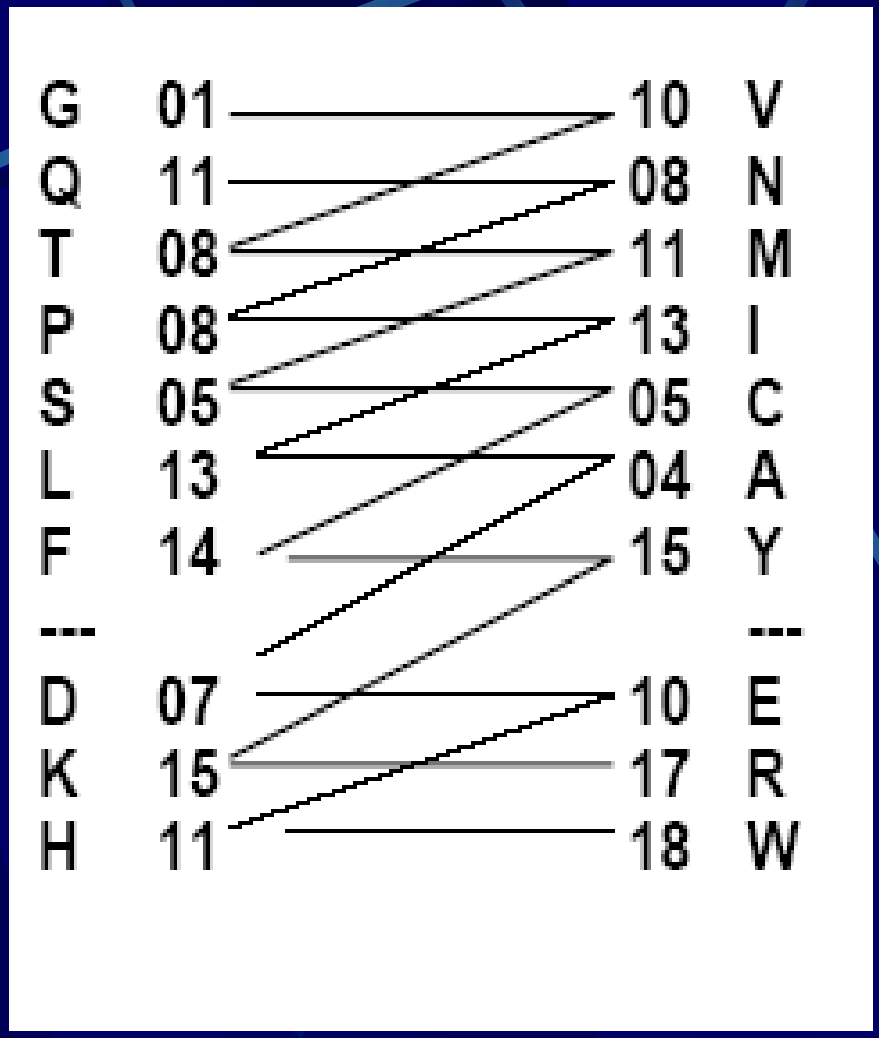
8128

. . . a curiosity more



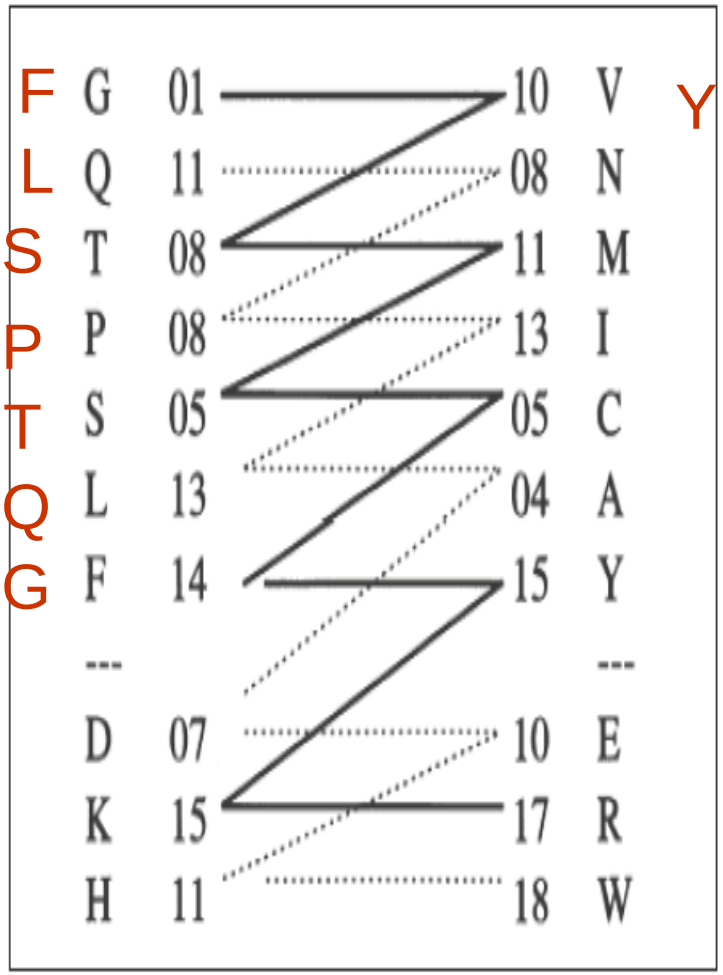
I Cing:
64 hexagmams

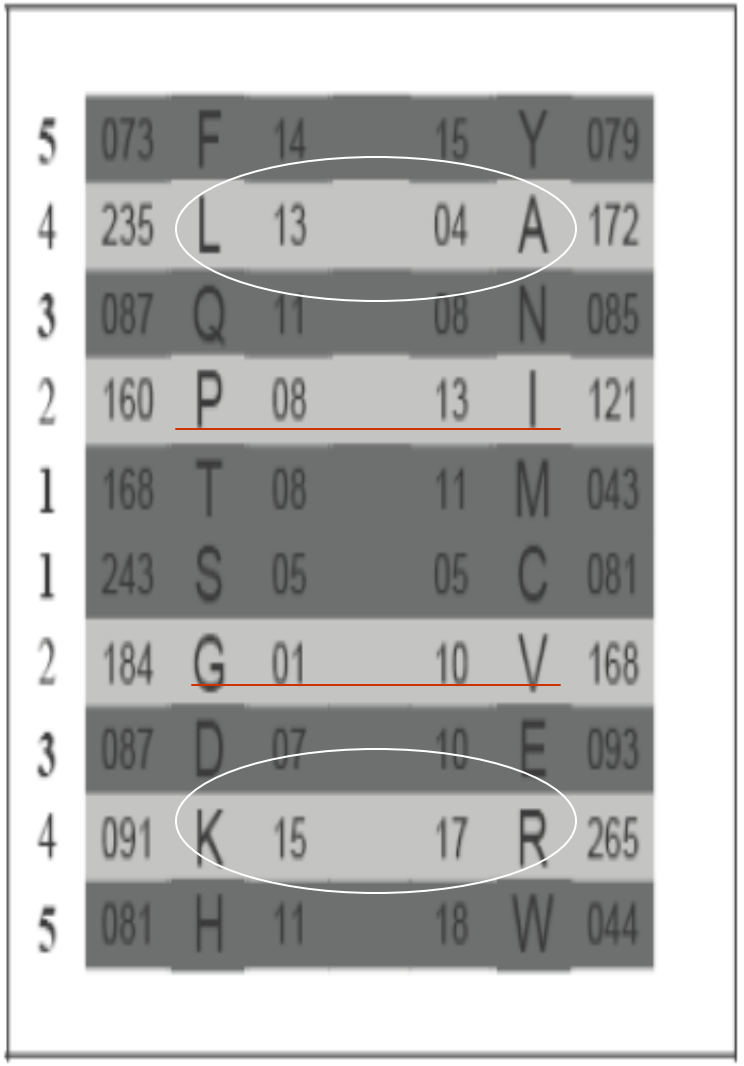
60



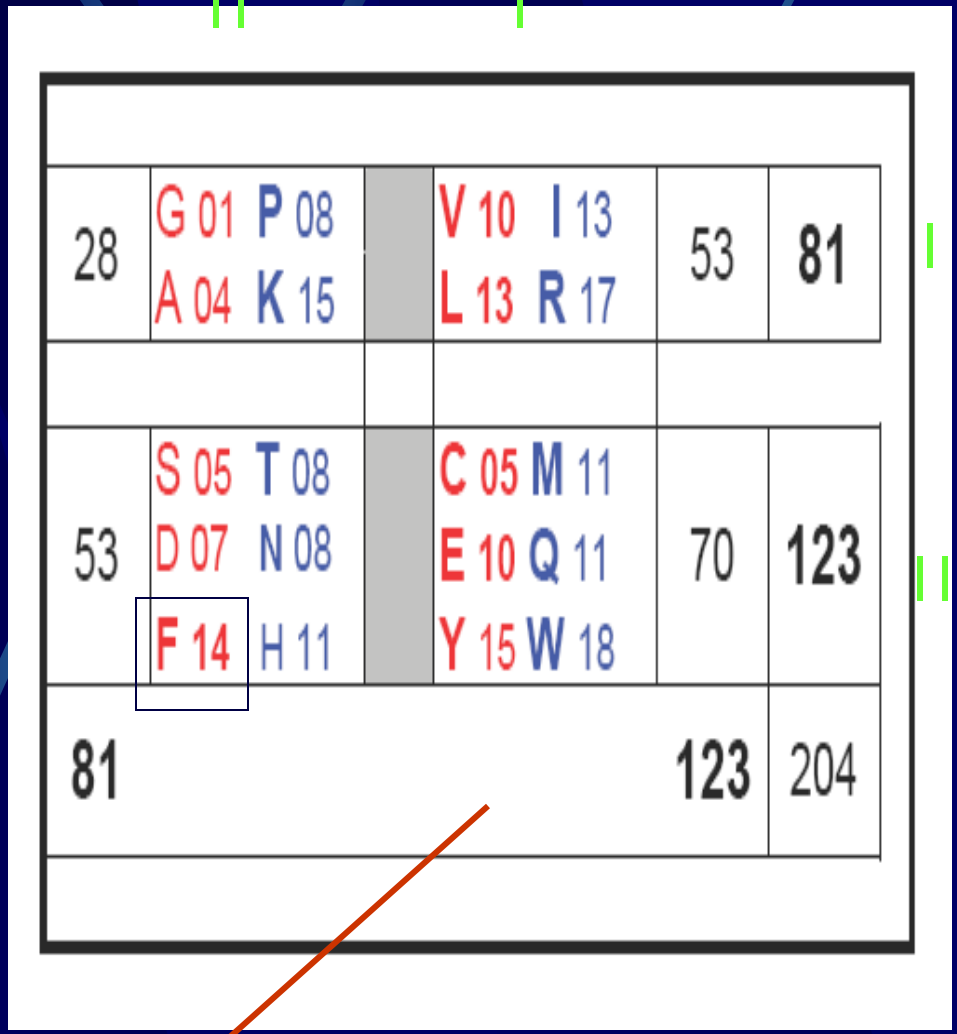
60
+
(1 X 6)

60 + (1 x 6) + (2 x 6)


F G 01 10 V Y
L Q 11 08 N
S T 08 11 M
P P 08 13 I
T S 05 05 C
Q L 13 04 A
G F 14 15 Y
--- ---
D 07 10 E
K 15 17 R
H 11 18 W


5 073 F 14 15 Y 079
4 235 L 13 04 A 172
3 087 Q 11 08 N 085
2 160 P 08 13 I 121
1 168 T 08 11 M 043
1 243 S 05 05 C 081
2 184 G 01 10 V 168
3 087 D 07 10 E 093
4 091 K 15 17 R 265
5 081 H 11 18 W 044

5	073	F	14	15	Y	079
4	235	L	13	04	A	172
3	087	Q	11	08	N	085
2	160	P	08	13	I	121
1	168	T	08	11	M	043
1	243	S	05	05	C	081
2	184	G	01	10	V	168
3	087	D	07	10	E	093
4	091	K	15	17	R	265
5	081	H	11	18	W	044



Two classes of AAs in relation to two classes of enzymes aminoacyl-tRNA synthetases

(23+23) – (05 + 30) = 11

102 **102**

(27+40) – (26 + 30) = 11

05 / 23 // 23 / 30					
28	G 01 P 08 A 04 K 15		V 10 I 13 L 13 R 17	53	81
53	S 05 T 08 D 07 N 08 F 14 H 11		C 05 M 11 E 10 Q 11 Y 15 W 18	70	123
81				123	204
26 / 27 // 30 / 40					