

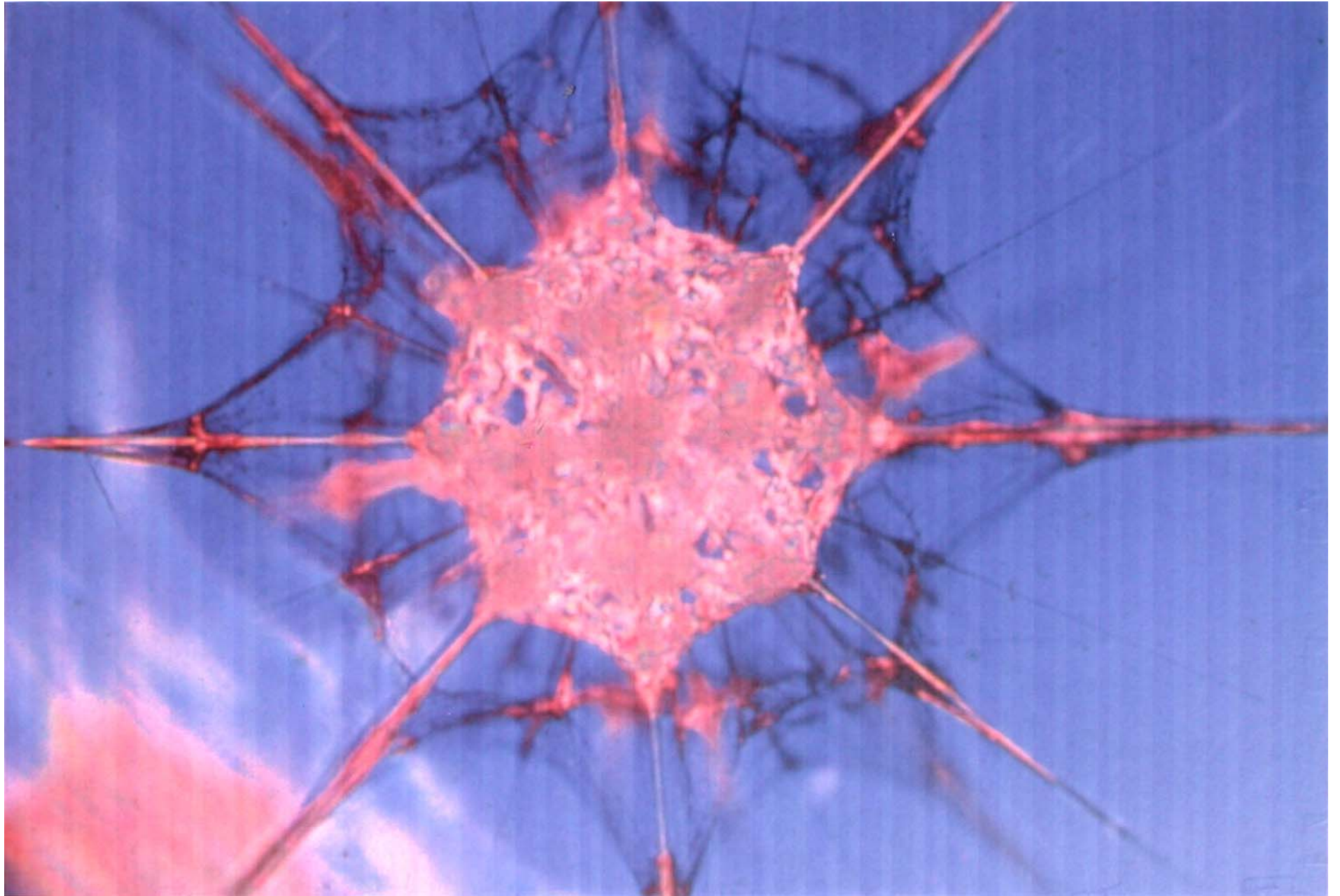
# **THE PERIODIC TABLE OF THE POLYHEDRA AND THE LATTICE UNIVERSE**

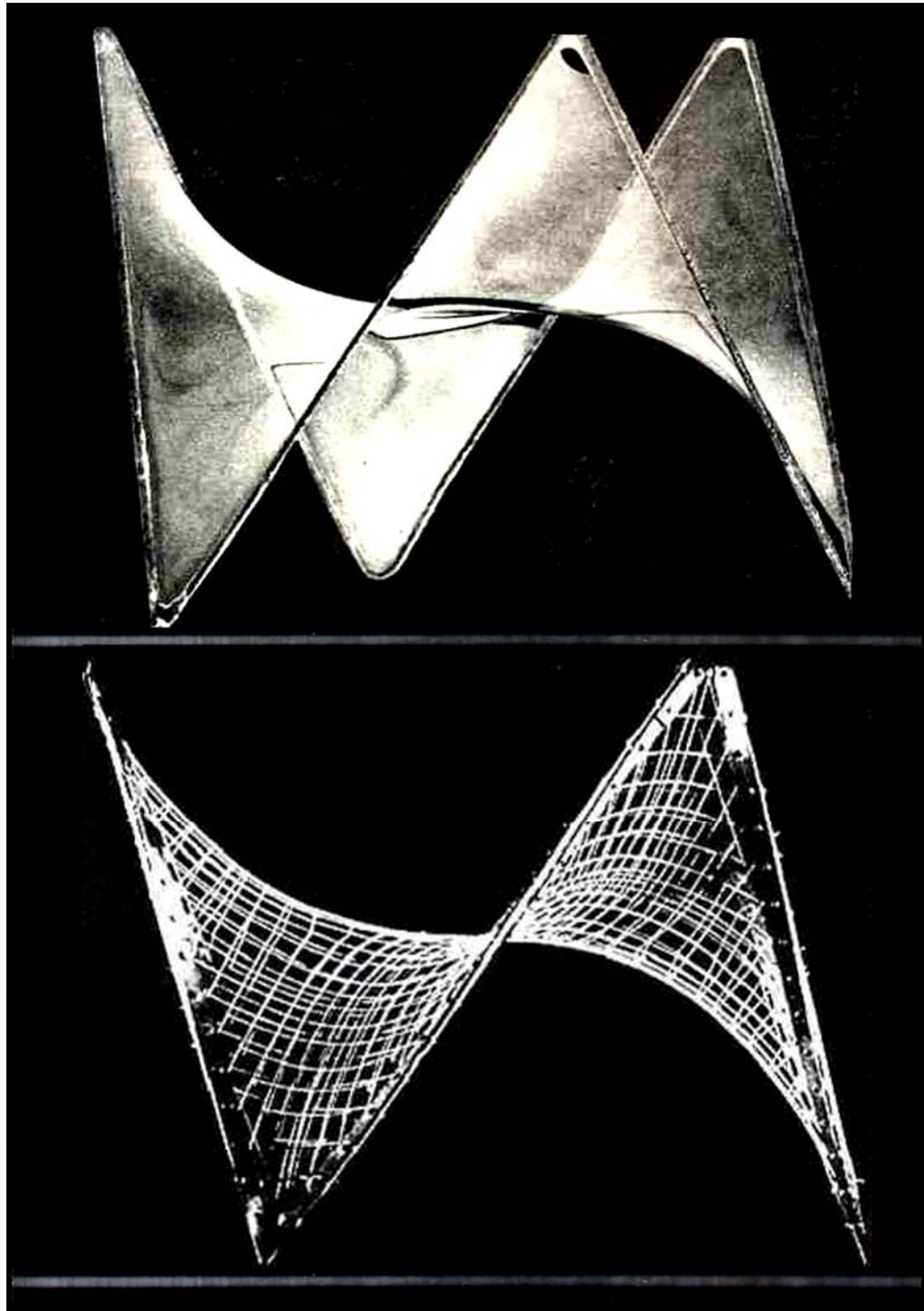
**Prof. Michael Burt**

**Technion, I.I.T. – Israel**

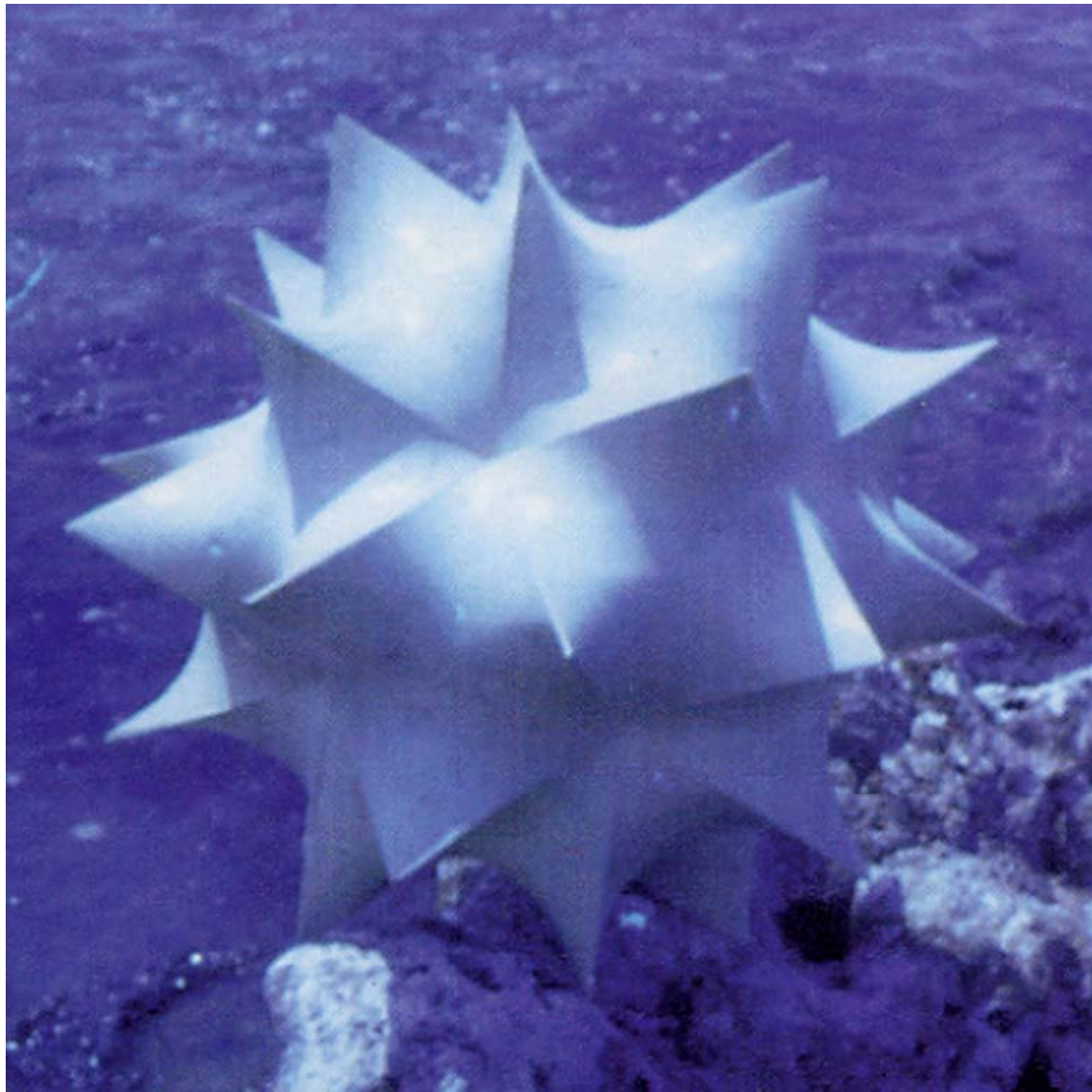
## B

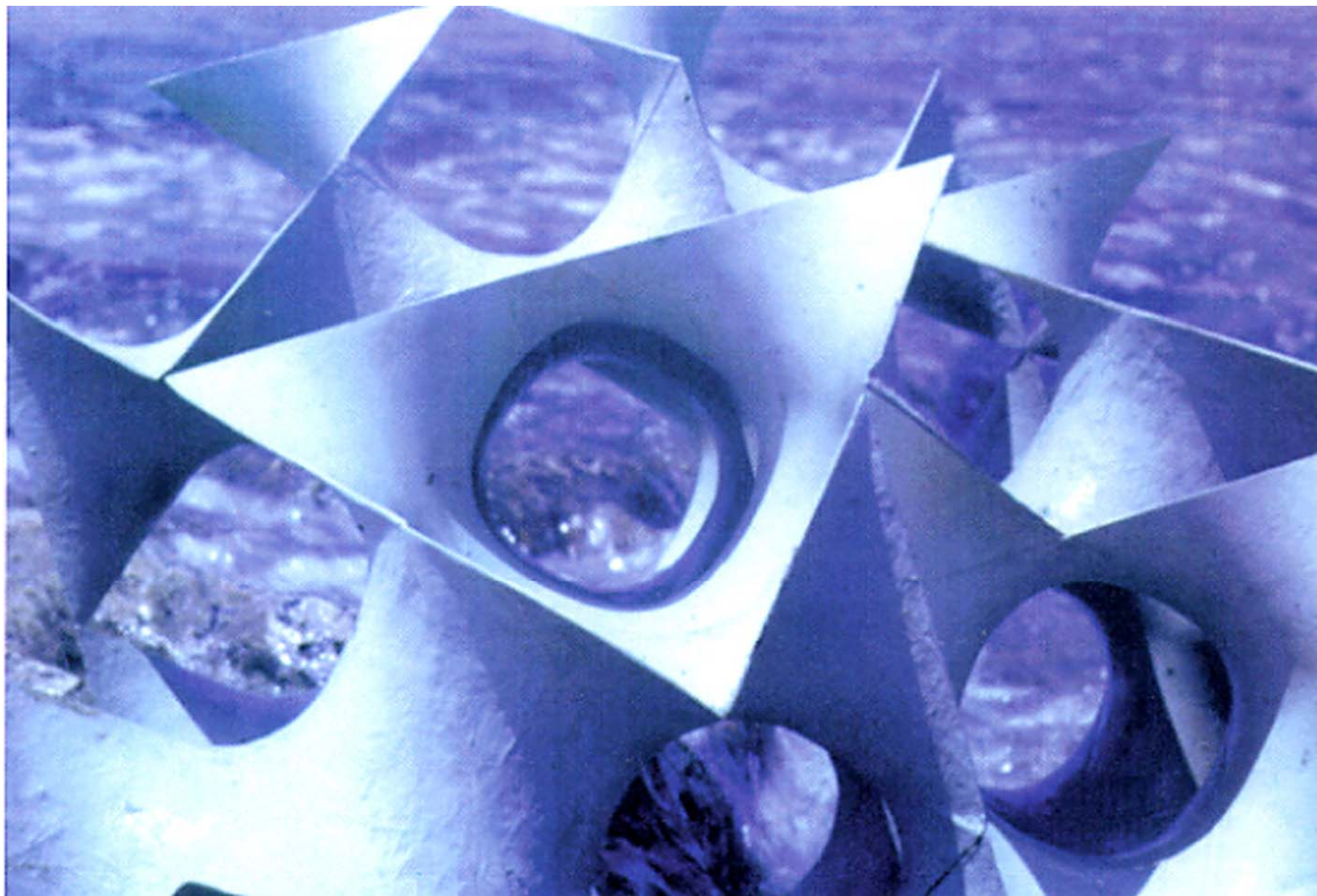
“Our study of natural form”, the essence of morphology, “is part of that wider science of form which deals with the forms assumed by nature under all aspects and conditions, and in a still wider sense, with **forms which are theoretically imaginable**”.....(On Growth and Form – D'Arcy Thompson), "Theoretically" to imply that we are dealing with causal- rational forms.



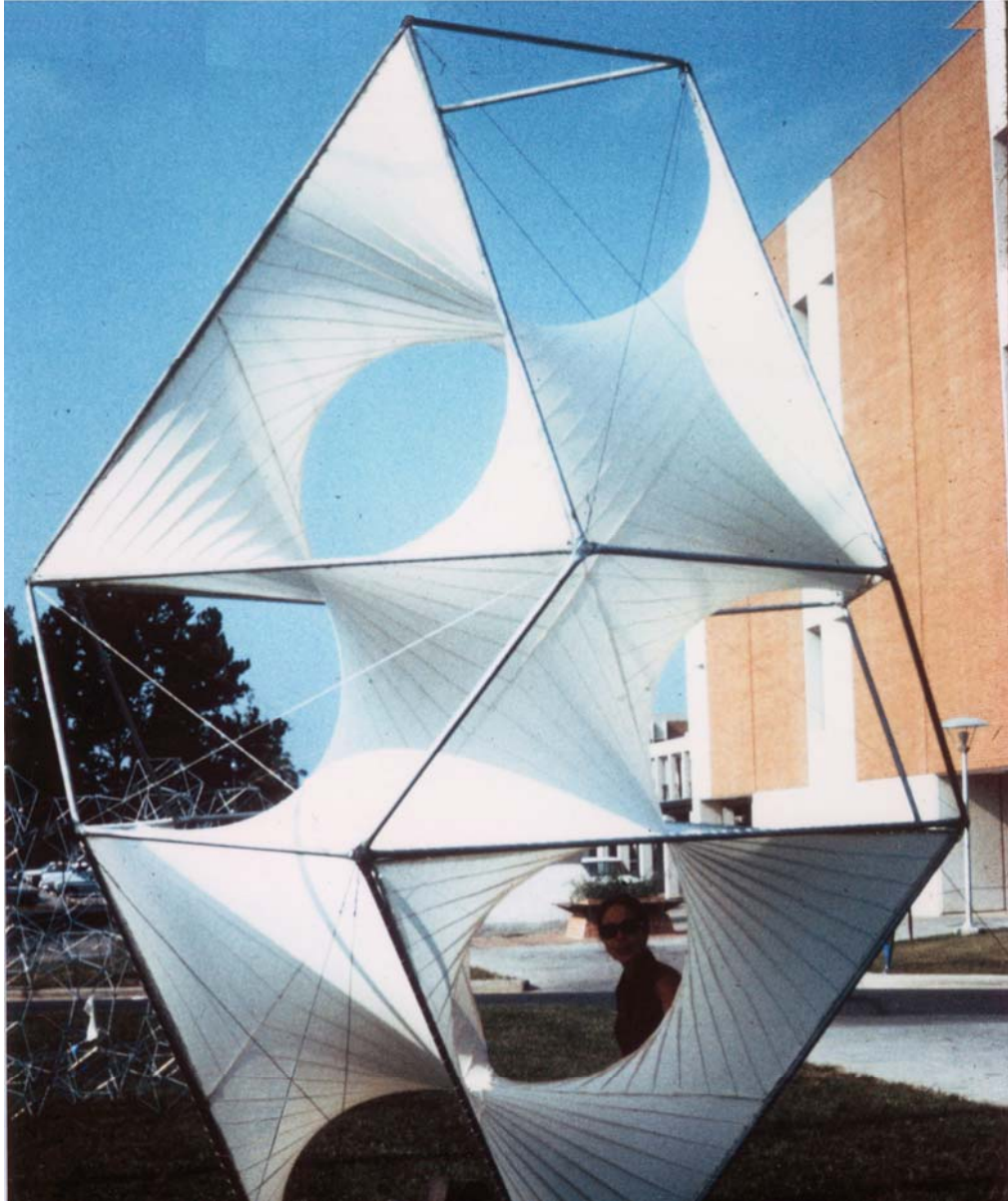


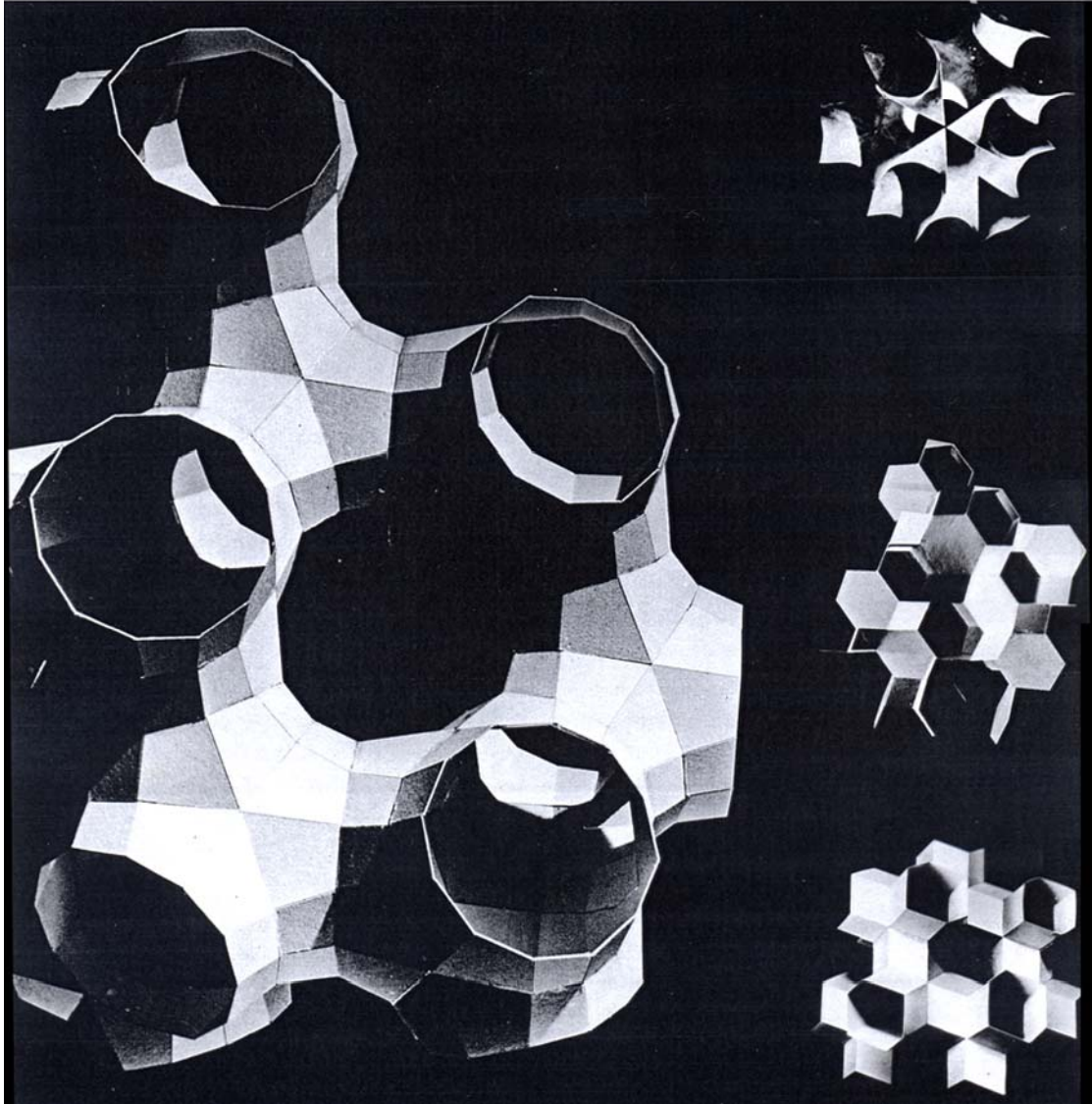


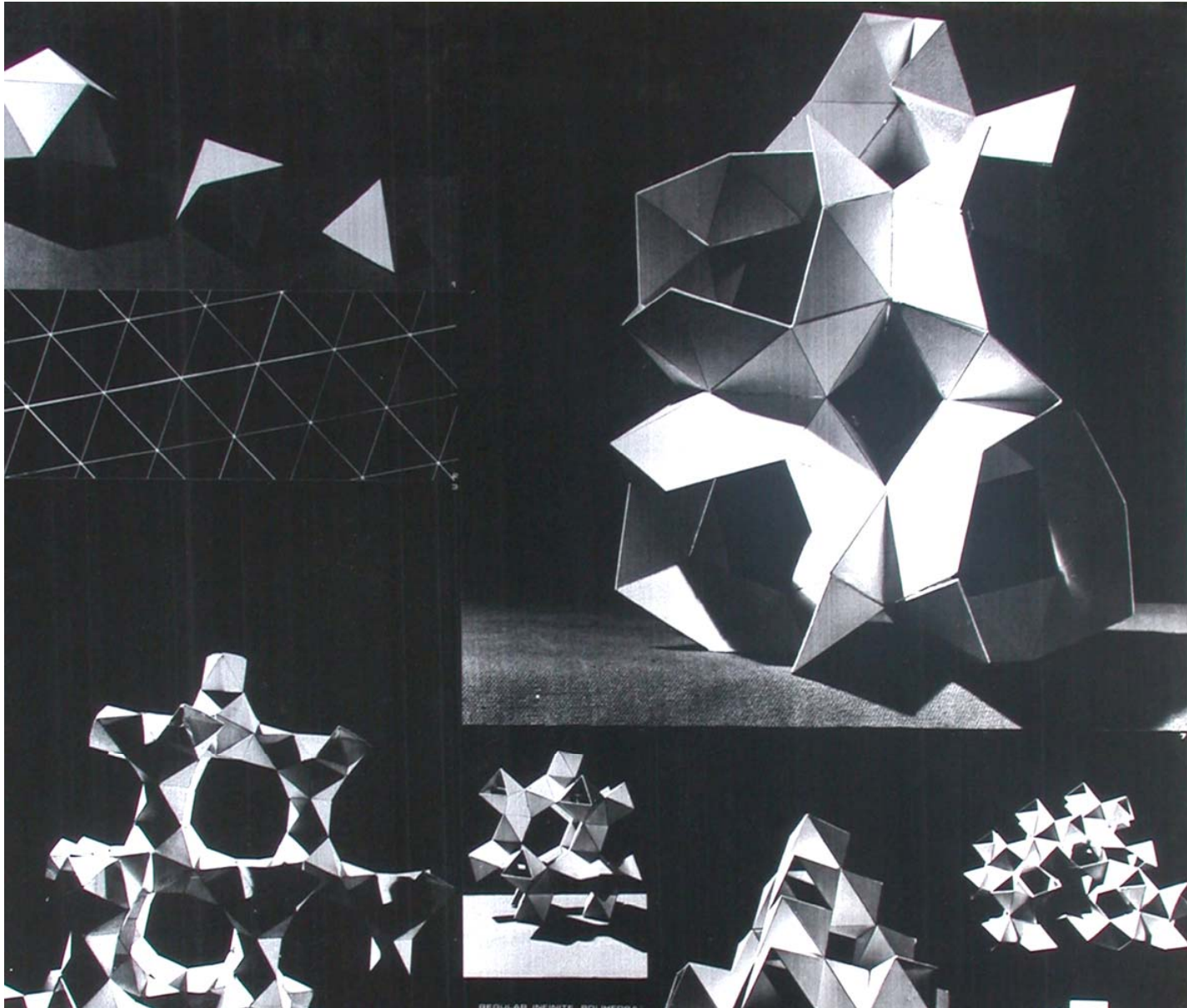




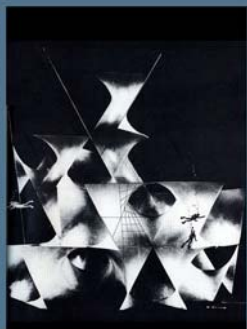
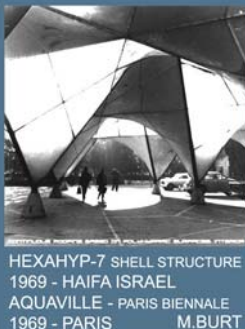
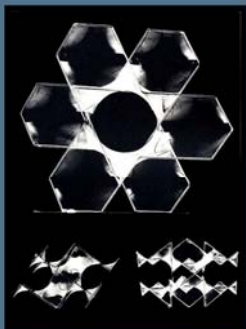








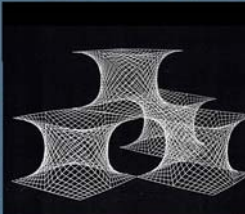




HEXAHYP-7 SHELL STRUCTURE  
1969 - HAIFA ISRAEL  
AQUAVILLE - PARIS BIENNALE  
1969 - PARIS  
M.BURT

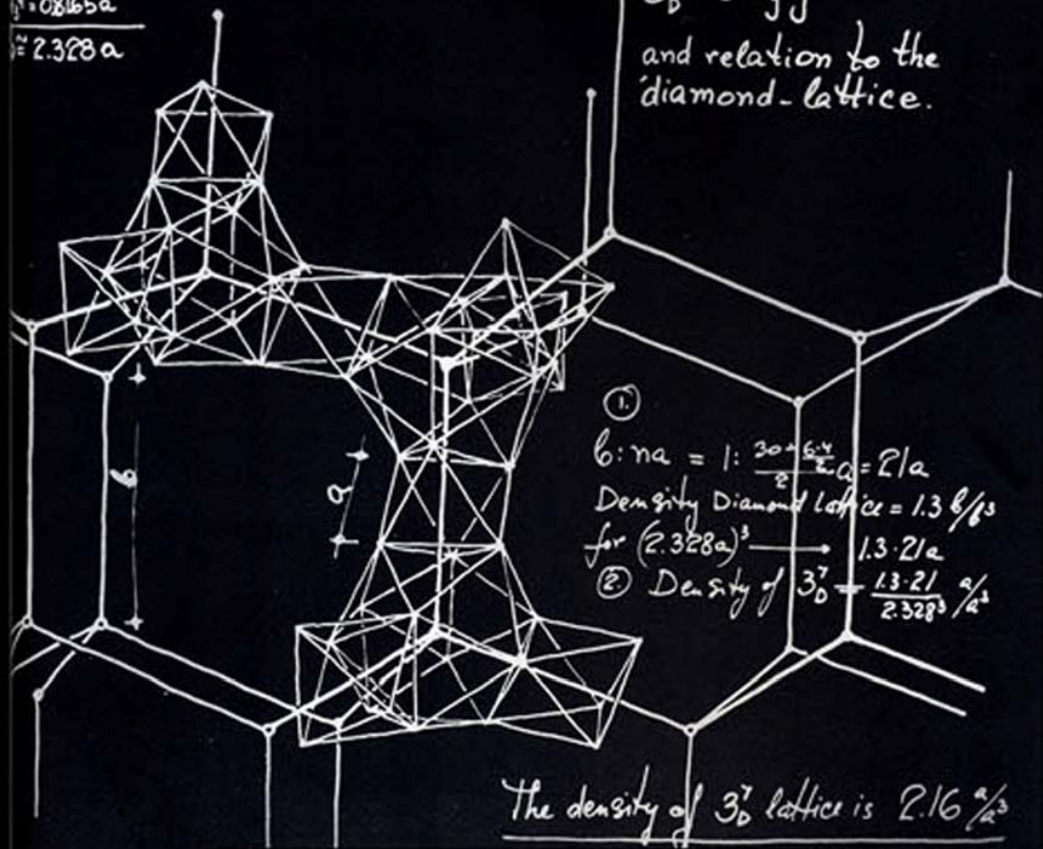


PREVIOUS RESEARCH EFFORTS ON THE THEME OF  
HYPERBOLIC SURFACES AND INFINITE POLYHEDRA  
AND APPLICATIONS TO LIGHT-WEIGHT STRUCTURES



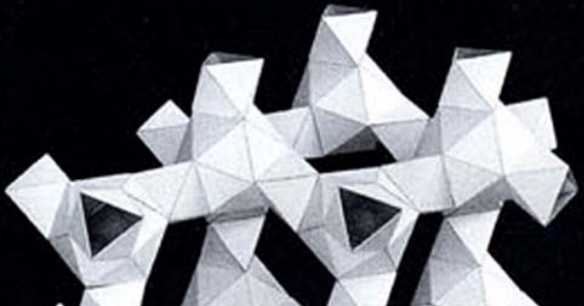
$$\begin{aligned} &= 1.5116a \\ &= 0.8165a \\ \hline &= 2.328a \end{aligned}$$

$3_0^7$ - configuration  
and relation to the  
diamond-lattice.



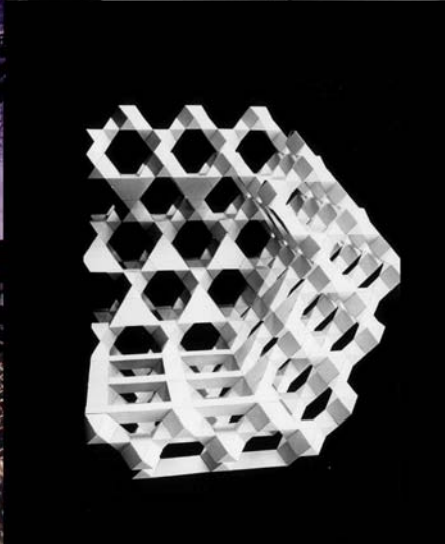
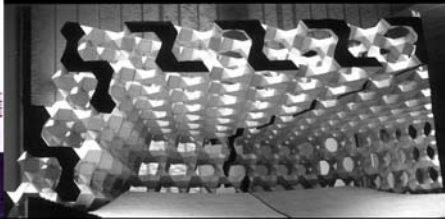
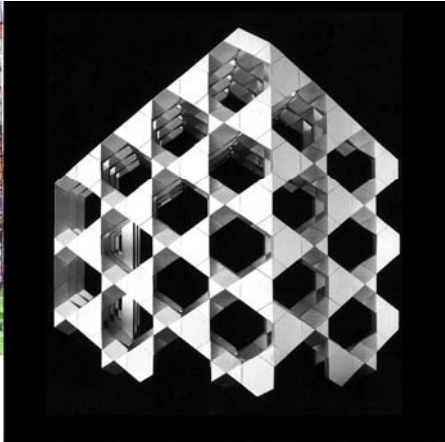
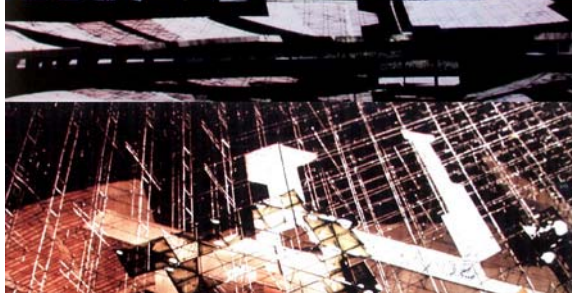
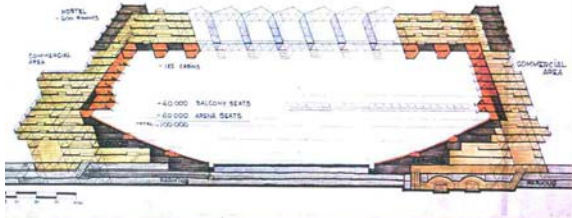
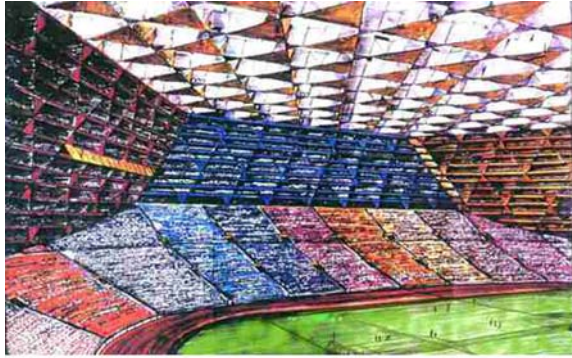
①  
 $b:na = 1: \frac{20 \cdot 6^4}{2} \cdot a = 21a$   
 Density Diamond lattice =  $1.3 \frac{g}{cm^3}$   
 for  $(2.328a)^3 \rightarrow 1.3 \cdot 21a$   
 ② Density of  $3_0^7 = \frac{1.3 \cdot 21}{2.328^3} \frac{g}{a^3}$

The density of  $3_0^7$  lattice is  $2.16 \frac{g}{a^3}$

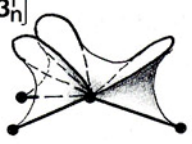


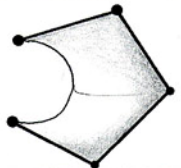
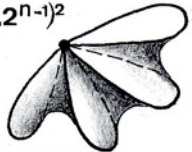
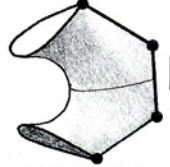

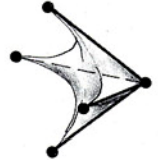









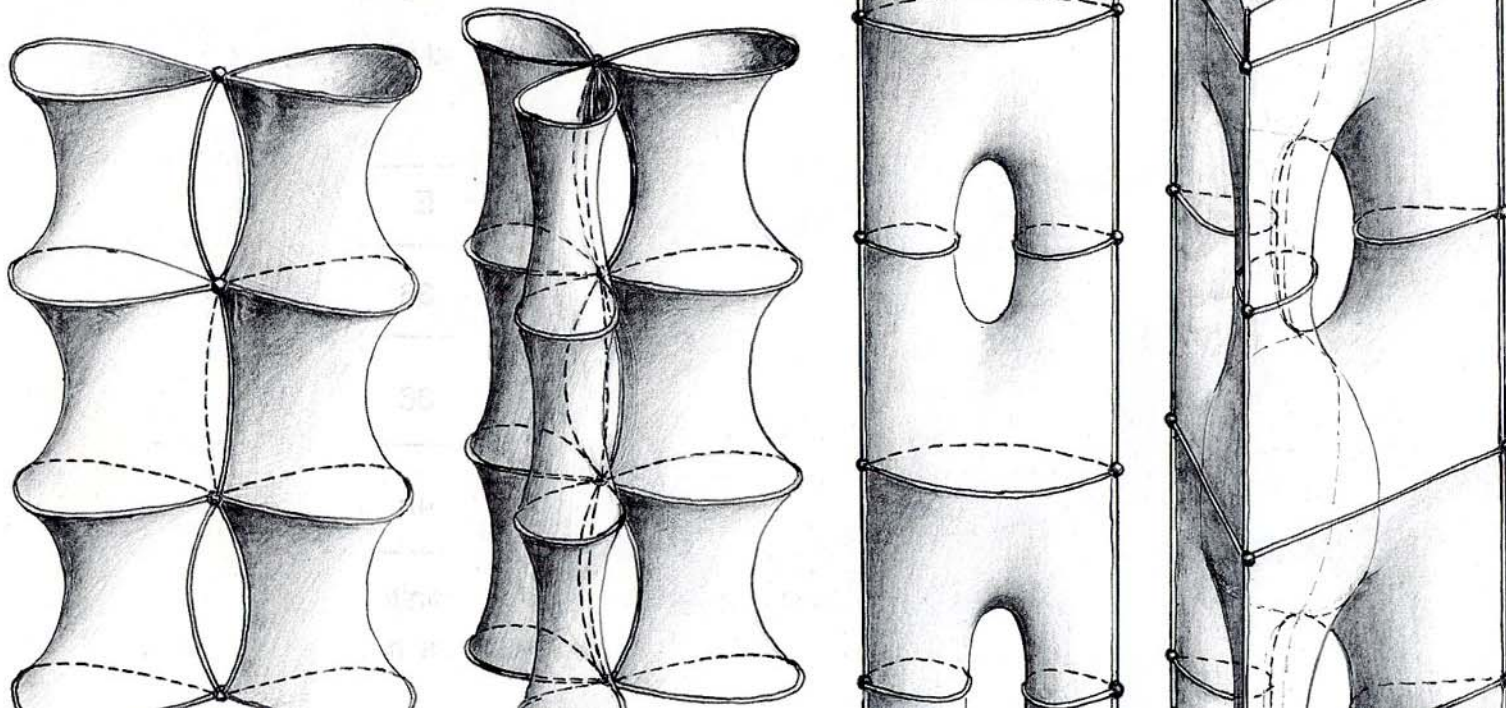


Floral polyhedra,  
families within the  $g=0$   
domain arranged  
according to their dual  
pairs.

	SELF-DUAL FAMILY	$[(3^2n)_1^1; 3h]$	
	$n^2$ DIHEDRONS	$2^n$ - POLYDIGONS	
	$[(2n)_{n-1}^2; (2n)_2^1]$	$(1.2^{n-1})^2$	
	$[(2n.4)_n^2; 1(2n.4)_2^2]$	$[3\frac{1}{2}; (3.2^n. 3)_2^1]$	
	$(2n)_1^1; 2n_h^1$	$(1.n)^n$	
	$(3n)_h^1; (3n)_{2n}^1$	$(1.4^2)^n$	



Periodic Floral Infinite Polyhedra.





networks, as polyhedral tessellation configurations,  
give rise to some familiar binding relations:

$$\sum_{\text{av.}} F = 2E = \sum_{\text{av.}} V ;$$

$$\sum_{\text{av.}} (2\pi - \sum \alpha_{\text{av.}}) = 4\pi(1 - g)$$

$$V - E + F = 2(1 - g)$$

- Descartes's theorem;

- Euler's theorem;

H-2

## Definitions

**Polygonal region** of order  $n$ , for  $n \geq 1$ , is a point set, topologically equivalent to a circular disc with a boundary divided into  $n$  edges by set of  $n$  vertices. It may have curved edges, maybe non-planar and two edges of the same length may be matched (Stewart) [4].

Polyhedral map drawing on a sponge surface must lead to polygonal regions which may constitute, under a suitable topological transformation, a single polygonal region.

**Polyhedron-P** is a connected, unbounded 2-dimensional manifold, formed by a set of simply connected polygonal regions of order  $n$ , for  $n \geq 1$ , arranged such that each edge of each region is matched with exactly one other edge of the same, or another region and vertices are matched only as required by the matching of edges. It implies that one and the same, or two, and no more than two distinct polygonal regions (faces) meet at each edge. The restriction on vertex matching in the definition means there is only one circuit of polygonal regions at each vertex of P.

WHAT'S NEXT ?

WHERE TO LOOK FOR  
MEANINGFULL NEW FORMS?

YOU DO NOT CRAWL INTO  
DARK CORNERS OR HOLES  
TO LOOK FOR SOMETHING  
UNLESS YOU HAVE A THEORY  
THAT IT MIGHT BE THERE!

I BUILT A LOOKING GLASS  
AND A THEORY WHERE



# Mendeleev's Periodic Table of the Elements.

## PERIODIC TABLE OF THE ELEMENTS

Table of Selected Radioactive Isotopes

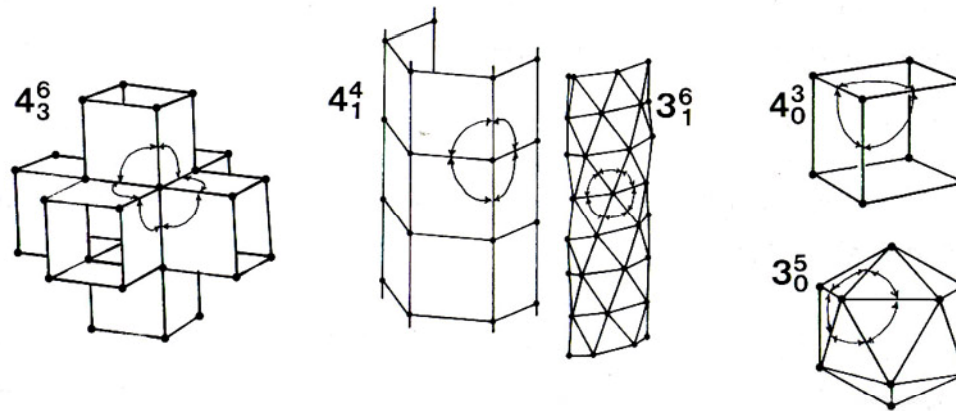
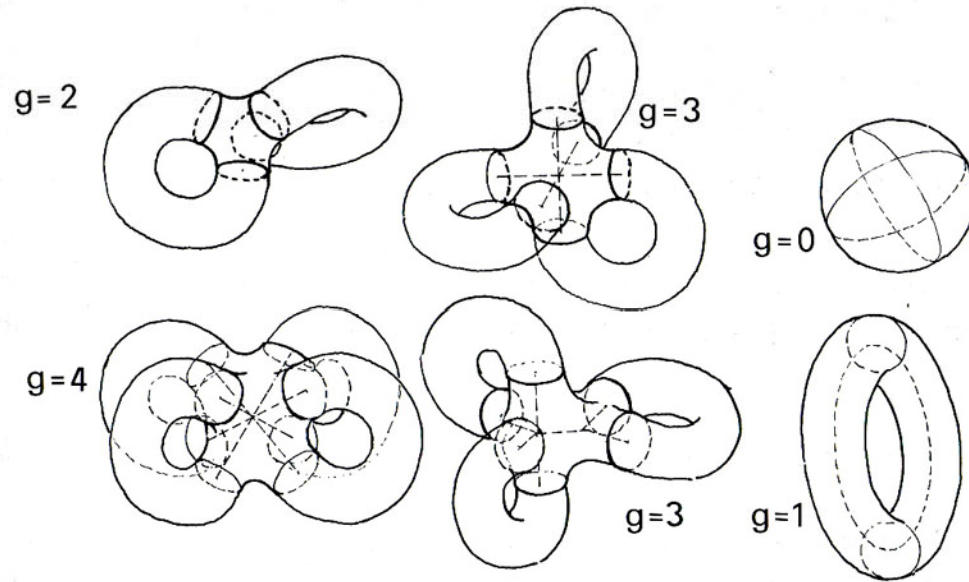
GROUP IA		GROUP IIA										GROUP IIB										GROUP IVB										GROUP VB										GROUP VIB										GROUP VIIB										GROUP VIII																							
1 1.0079 H Hydrogen	2 4.0026 He Helium	3 6.941 Li Lithium	4 9.01218 Be Beryllium	5 10.81 B Boron	6 12.011 C Carbon	7 14.0067 N Nitrogen	8 15.9994 O Oxygen	9 18.998403 F Fluorine	10 20.179 Ne Neon	11 22.98977 Na Sodium	12 24.305 Mg Magnesium	13 26.98154 Al Aluminum	14 28.0855 Si Silicon	15 30.97376 P Phosphorus	16 32.06 S Sulfur	17 35.453 Cl Chlorine	18 39.948 Ar Argon	19 39.0983 K Potassium	20 40.08 Ca Calcium	21 44.9559 Sc Scandium	22 47.90 Ti Titanium	23 50.9415 V Vanadium	24 51.996 Cr Chromium	25 54.9380 Mn Manganese	26 55.847 Fe Iron	27 58.9332 Co Cobalt	28 58.707 Ni Nickel	29 63.546 Cu Copper	30 65.38 Zn Zinc	31 69.723 Ga Gallium	32 72.59 Ge Germanium	33 74.9216 As Arsenic	34 78.96 Se Selenium	35 79.904 Br Bromine	36 83.80 Kr Krypton	37 85.4678 Rb Rubidium	38 87.62 Sr Strontium	39 88.9059 Y Yttrium	40 91.22 Zr Zirconium	41 92.9064 Nb Niobium	42 95.94 Mo Molybdenum	43 98.90625 Tc Technetium	44 101.07 Ru Ruthenium	45 101.065 Rh Rhodium	46 106.4 Pd Palladium	47 106.905 Ag Silver	48 112.41 Cd Cadmium	49 114.82 In Indium	50 118.69 Sn Tin	51 121.757 Sb Antimony	52 127.60 Te Tellurium	53 126.905 I Iodine	54 131.30 Xe Xenon	55 132.9054 Cs Cesium	56 137.33 Ba Barium	57 138.9055 La Lanthanum	58 178.49 Ce Cerium	59 180.9479 Pr Praseodymium	60 187.9016 Nd Neodymium	61 188.90784 Pm Promethium	62 190.23 Sm Samarium	63 194.90764 Eu Europium	64 197.22 Gd Gadolinium	65 198.90693 Tb Terbium	66 200.59 Dy Dysprosium	67 204.37 Ho Holmium	68 207.2 Er Erbium	69 208.9804 Tm Thulium	70 208.9804 Yb Ytterbium	71 208.9804 Lu Lutetium	72 227.0371 Ac Actinium	73 227.0371 Th Thorium	74 232.03772 Pa Protactinium	75 238.02891 U Uranium	76 238.02891 Np Neptunium	77 237.04817 Pu Plutonium	78 238.02891 Am Americium	79 237.04817 Cm Curium	80 238.02891 Bk Berkelium	81 238.02891 Cf Californium	82 238.02891 Es Einsteinium	83 238.02891 Fm Fermium	84 238.02891 Md Mendelevium	85 238.02891 No Nobelium	86 238.02891 Lr Lawrencium

Selected Radioactive Isotopes  
Naturally occurring radioactive isotopes are designated by a mass number in blue (although some are also manufactured). Letter in circles indicates an isomer of another isotope of the same mass number. Half-lives follow in parentheses, where a, min., h, d, and y stand respectively for seconds, minutes, hours, days, and years. The table includes many of the longer-lived radioactive isotopes; many others have been prepared, isotopes known to be radioactive but with half-lives exceeding 10<sup>17</sup> y have not been included. Symbols denoting the principal mode of decay of these are as follows:  $\alpha$ , alpha particle emission;  $\beta^-$ , beta particle (electron) emission;  $\beta^+$ , positron emission; EC, orbital electron capture; IT, isomeric transition from upper to lower isomeric state; SF, spontaneous fission.

The A & B subgroup designations, applicable to elements in rows 4, 5, 6, and 7, are those recommended by the International Union of Pure and Applied Chemistry. It should be noted that some authors and organizations use the opposite convention in distinguishing these subgroups.

ATOMIC NUMBER	ATOMIC WEIGHT (2)	BOILING POINT, K	OXIDATION STATES
58 140.12 Ce	140.12	3702	3, 4
59 140.9077 Pr	140.9077	3273	3, 4
60 144.24 Nd	144.24	3273	3, 4
61 144.24 Pm	144.24	3273	3, 4
62 150.4 Sm	150.4	3273	3, 4
63 151.96 Eu	151.96	3273	3, 4
64 157.25 Gd	157.25	3273	3, 4
65 158.9254 Tb	158.9254	3273	3, 4
66 162.50 Dy	162.50	3273	3, 4
67 164.9304 Ho	164.9304	3273	3, 4
68 167.26 Er	167.26	3273	3, 4
69 168.9342 Tm	168.9342	3273	3, 4
70 173.04 Yb	173.04	3273	3, 4
71 174.967 Lu	174.967	3273	3, 4

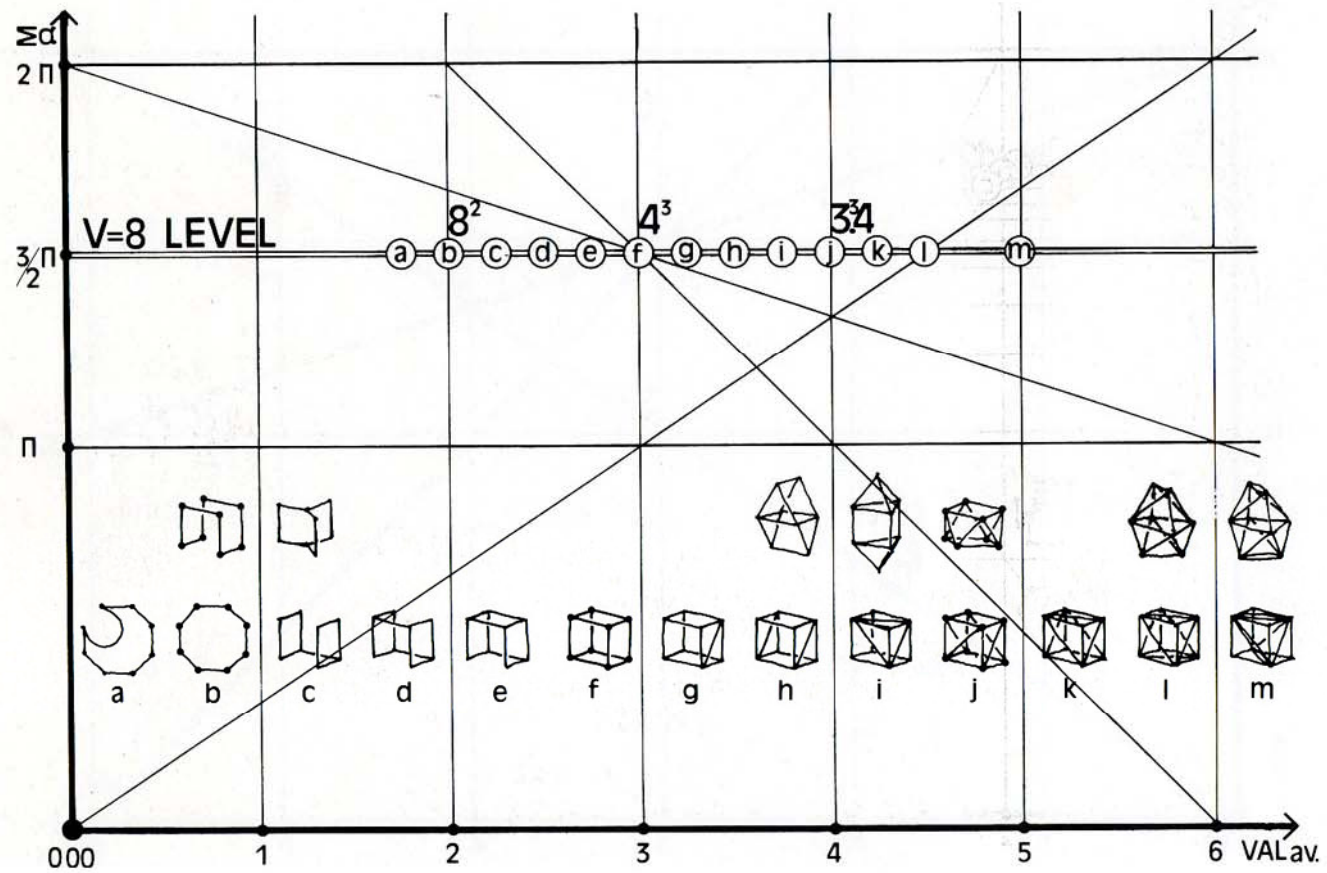
2-D manifolds  
surfaces, subdividing  
space into two  
complementary sub-  
spaces; polyhedral  
maps and their  
primary parameters.



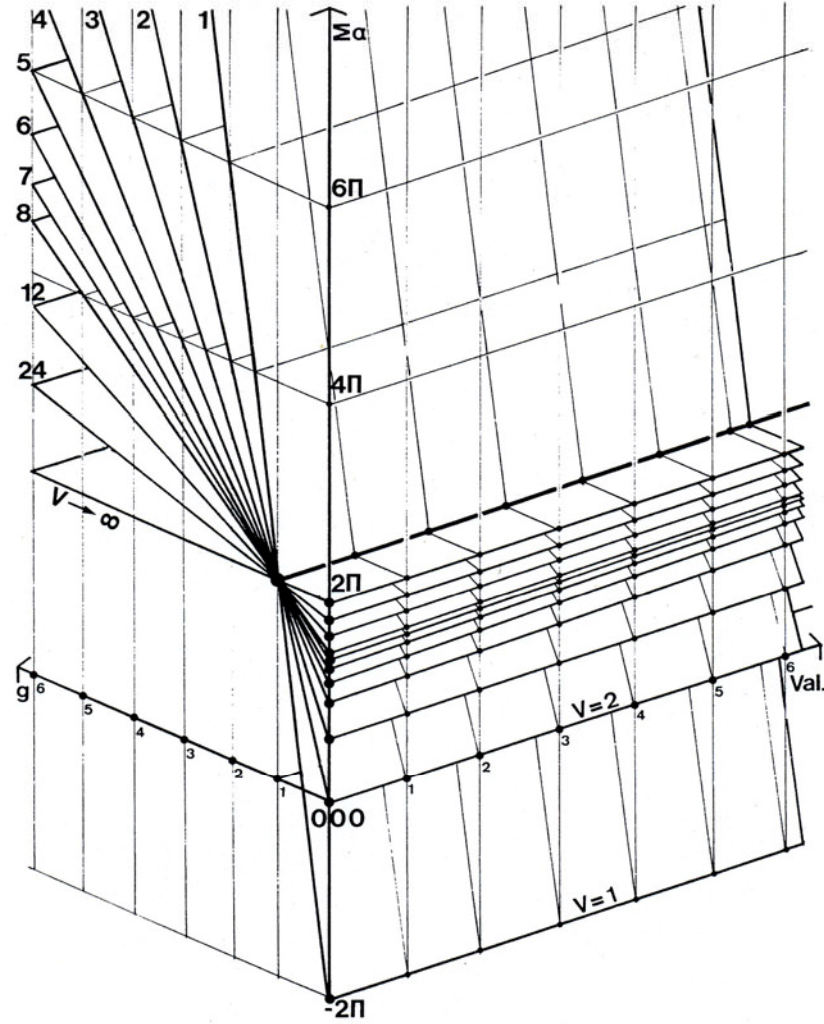
	$4_0^3$	$3_0^5$	$4_1^4$	$3_1^6$	$4_3^6$
$\Sigma\alpha$	270	300	360	360	540
Val.	3	5	4	6	6
g	0	0	1	1	3



Polyhedra of V=8 level, within the g=0 domain.







$$V = \frac{4\pi(1-g)}{2\pi - \sum \alpha_{av}}$$



Polyhedra with E=12 within the g=0 domain.

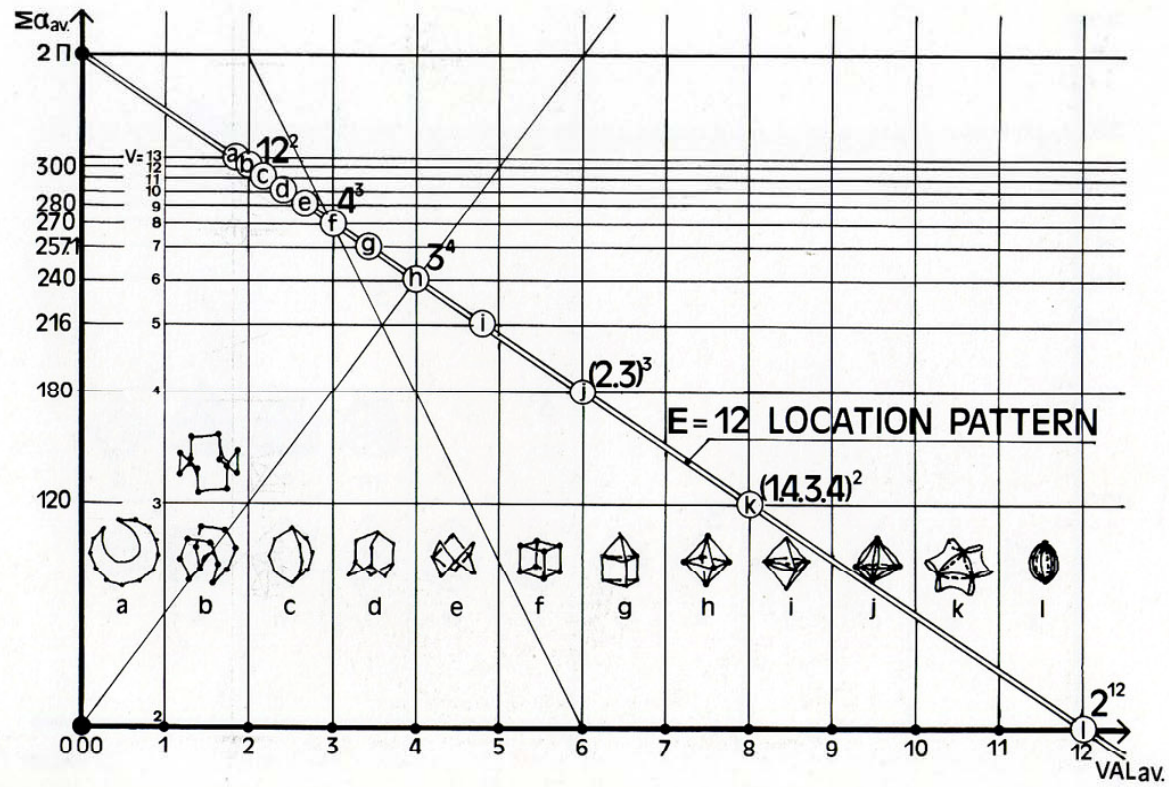
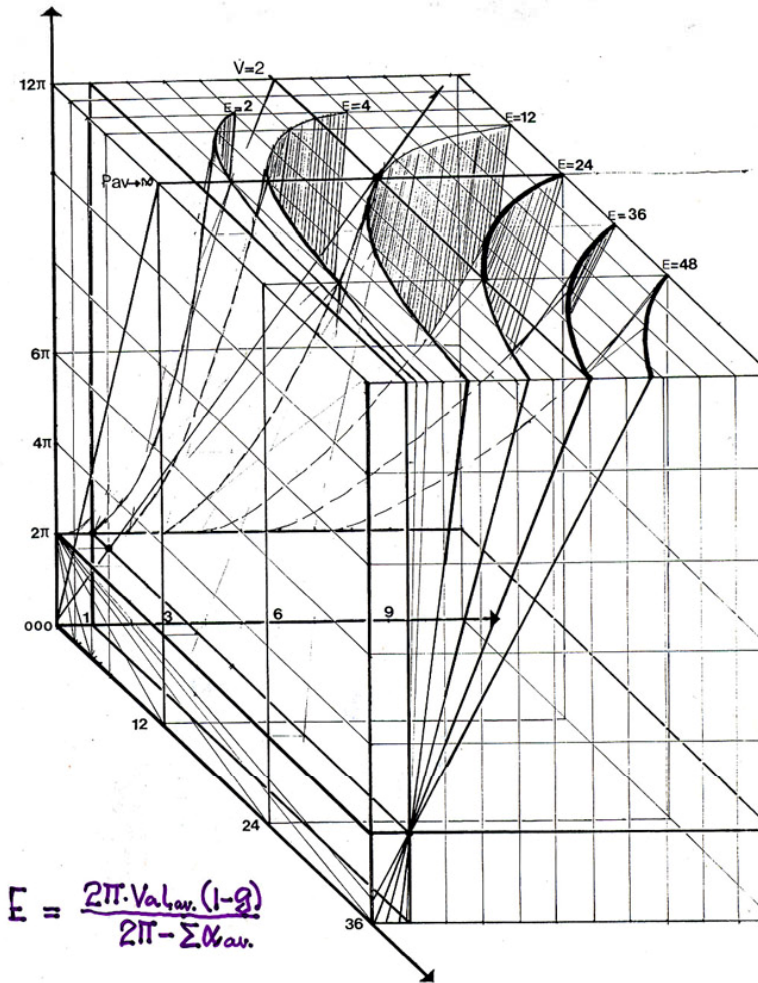
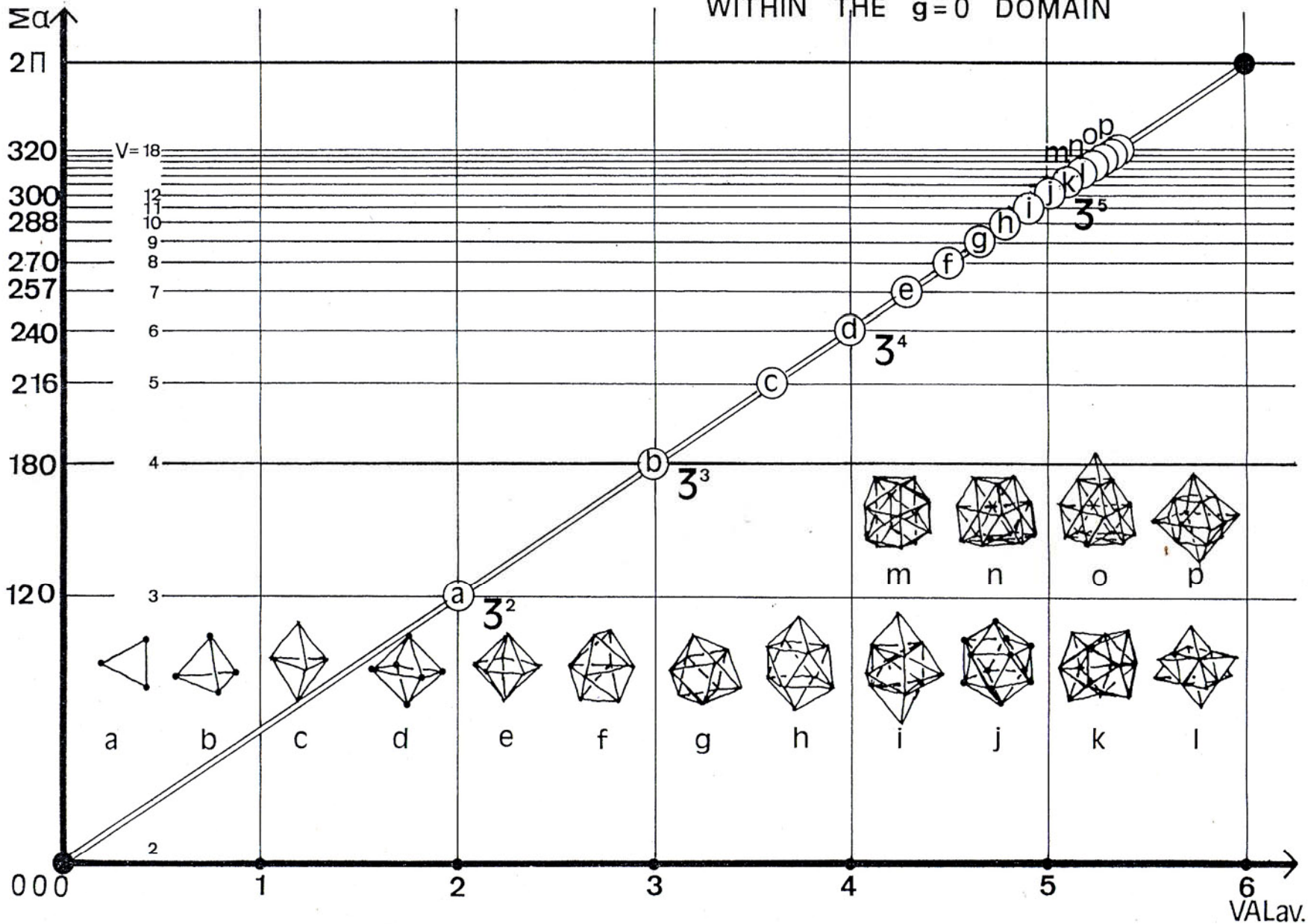


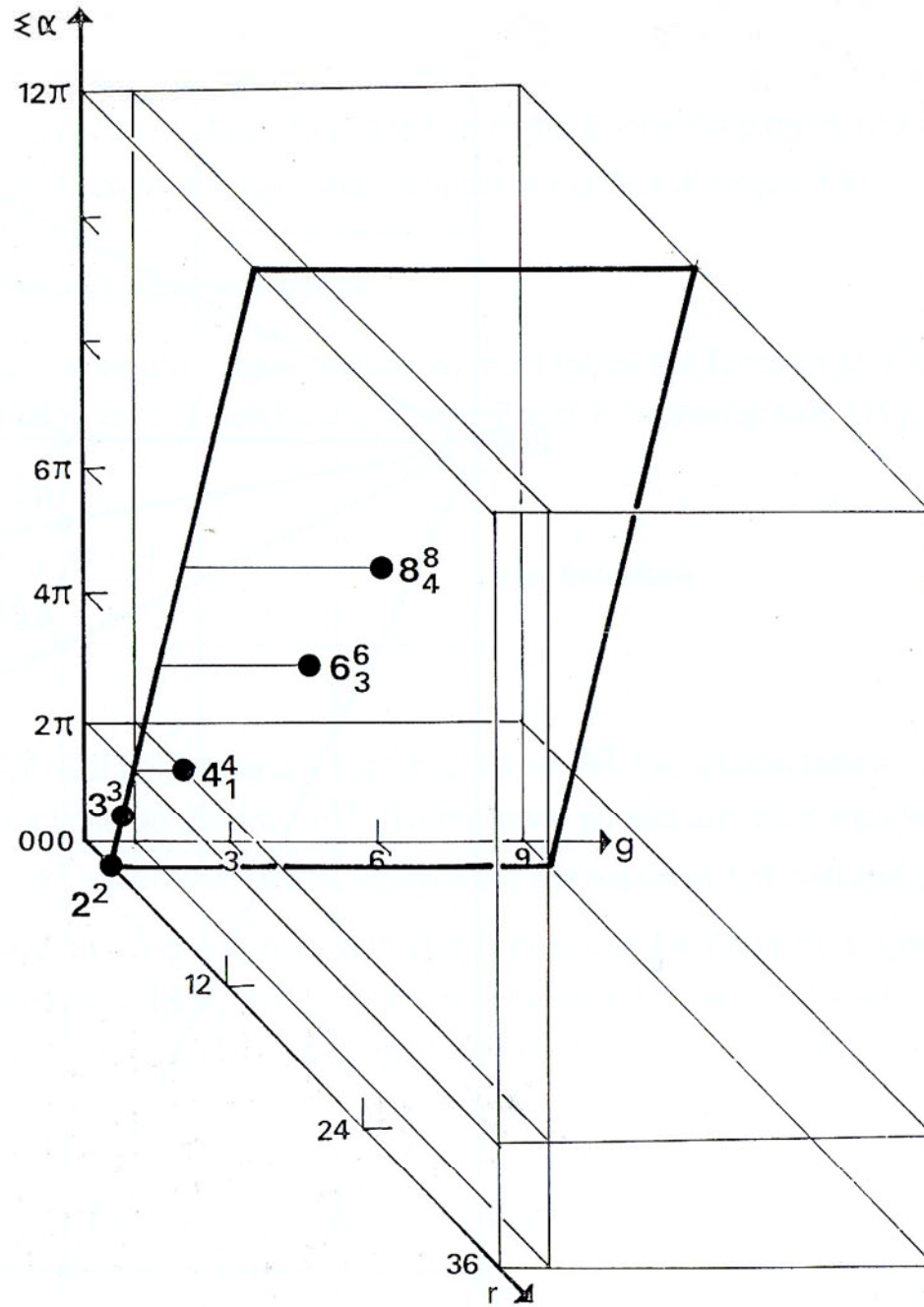
Fig. 34  
 Quadratic doubly  
 curved surfaces as  
 location patterns of  
 polyhedra sharing the  
 same number of  
 edges.



# LOCATION PATTERN OF POLYHEDRA WITH $P_{av} = 3$ WITHIN THE $g=0$ DOMAIN

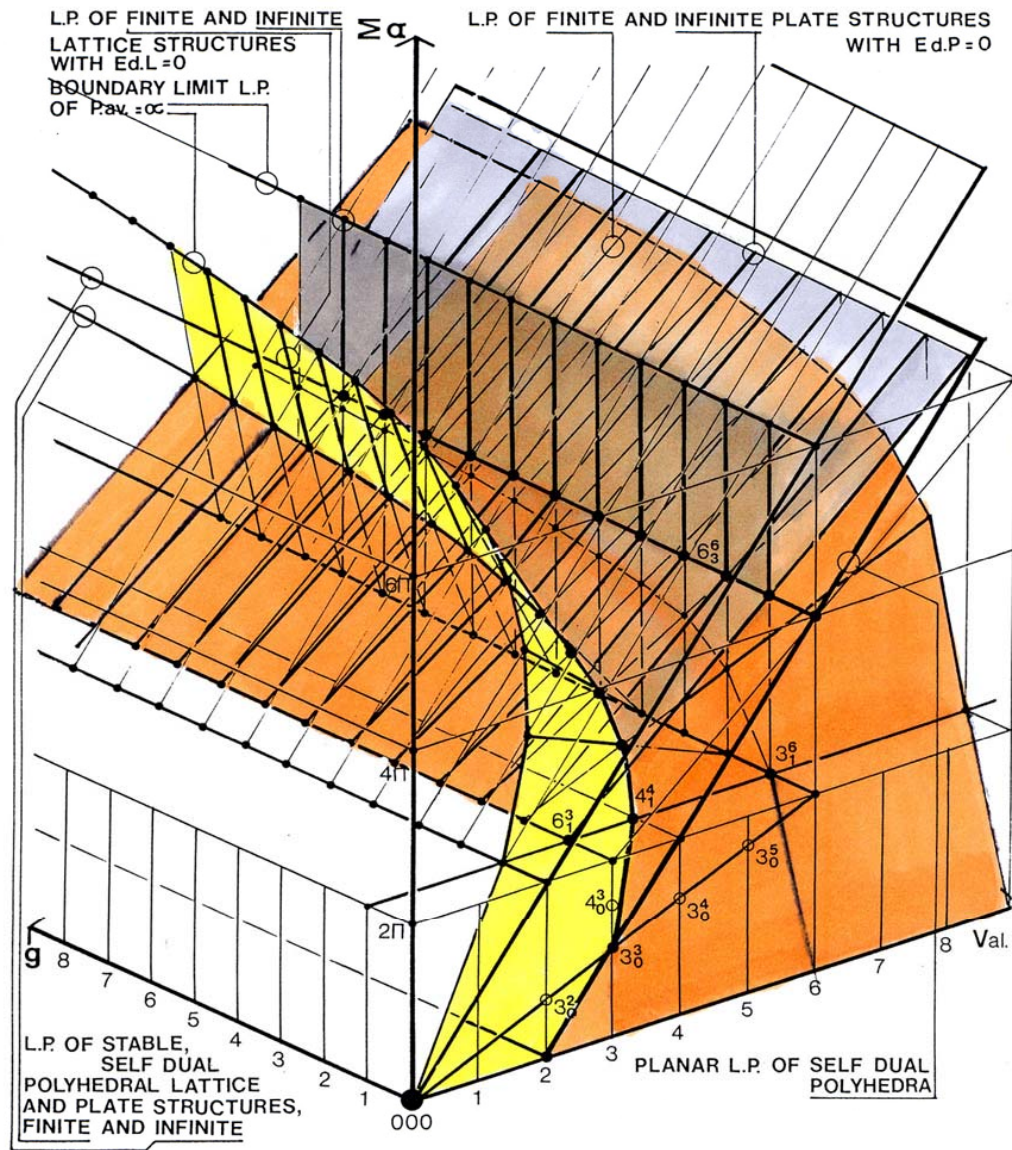


Plane location pattern  
of self-dual polyhedra.



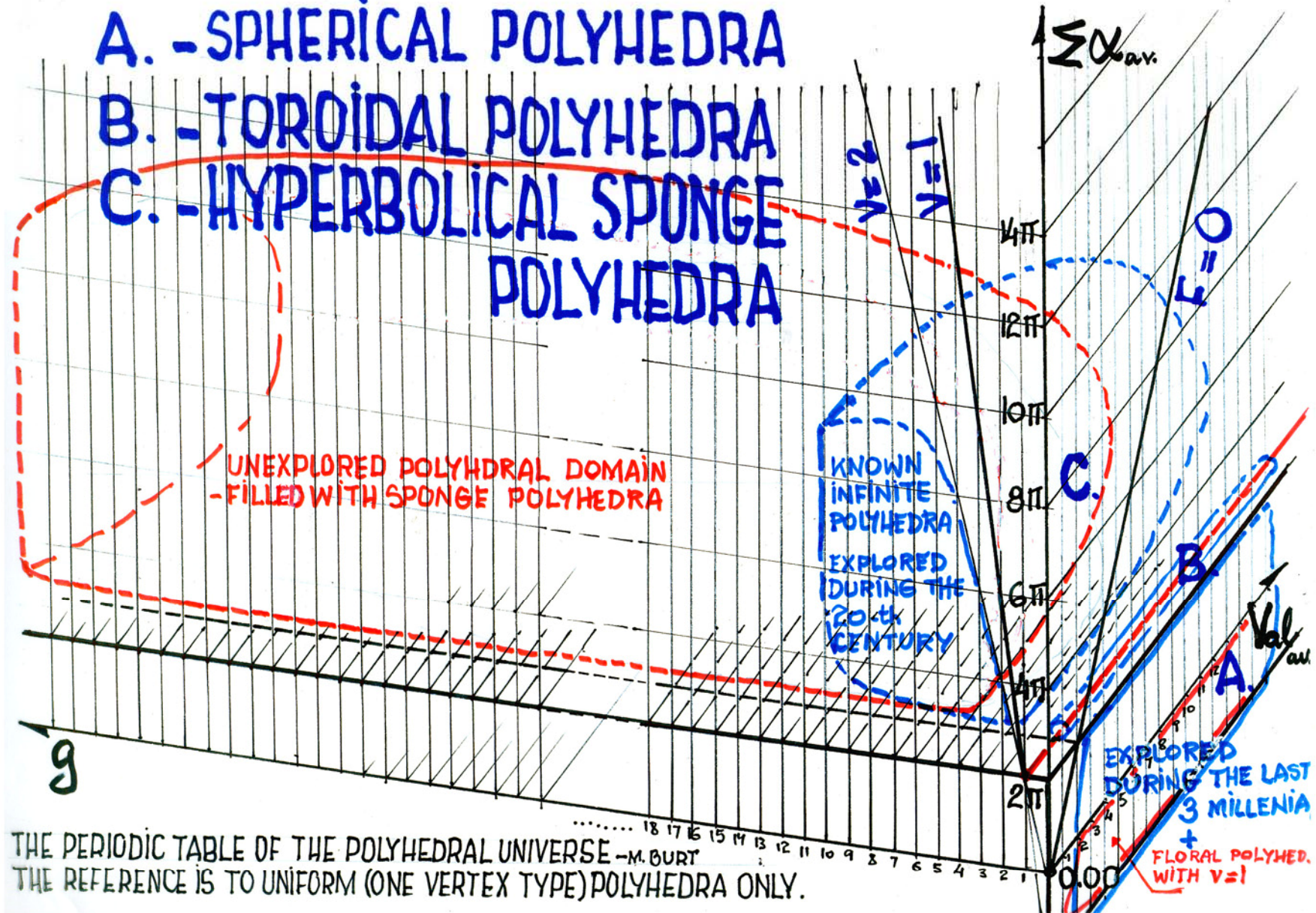


**THE GRAND DIVIDES OF THE POLYHEDRAL UNIVERSE** M. BURT  
 LOCATION PATTERN OF ALL POTENTIALLY STABLE LATTICE AND PLATE STRUCTURES





- A. - SPHERICAL POLYHEDRA
- B. - TOROIDAL POLYHEDRA
- C. - HYPERBOLICAL SPONGE POLYHEDRA

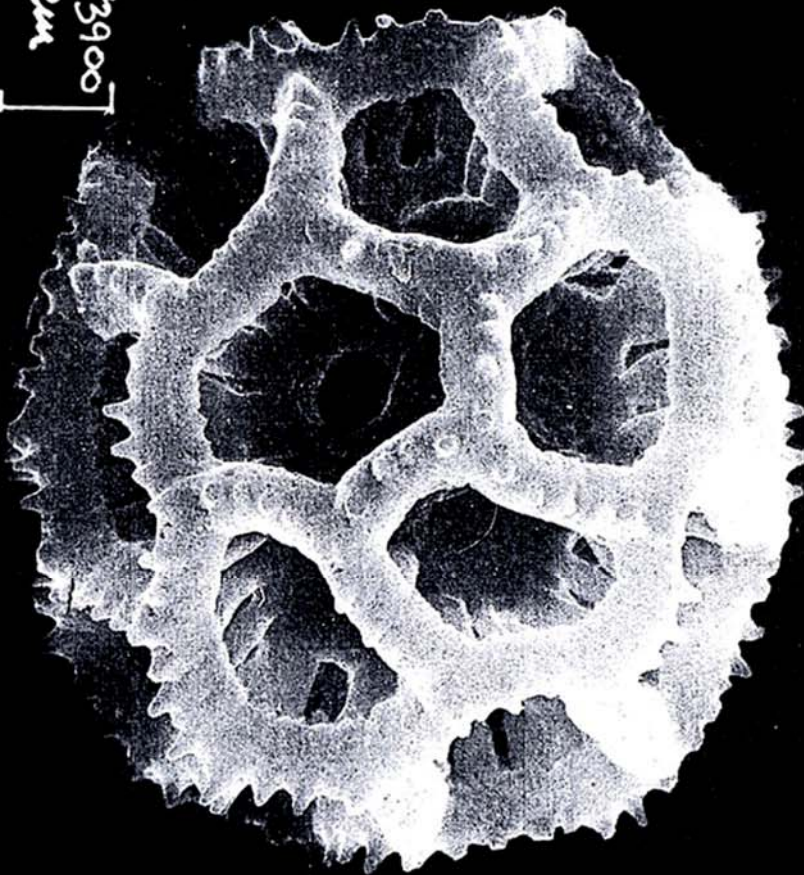


THE PERIODIC TABLE OF THE POLYHEDRAL UNIVERSE -M. BURT  
 THE REFERENCE IS TO UNIFORM (ONE VERTEX TYPE) POLYHEDRA ONLY.



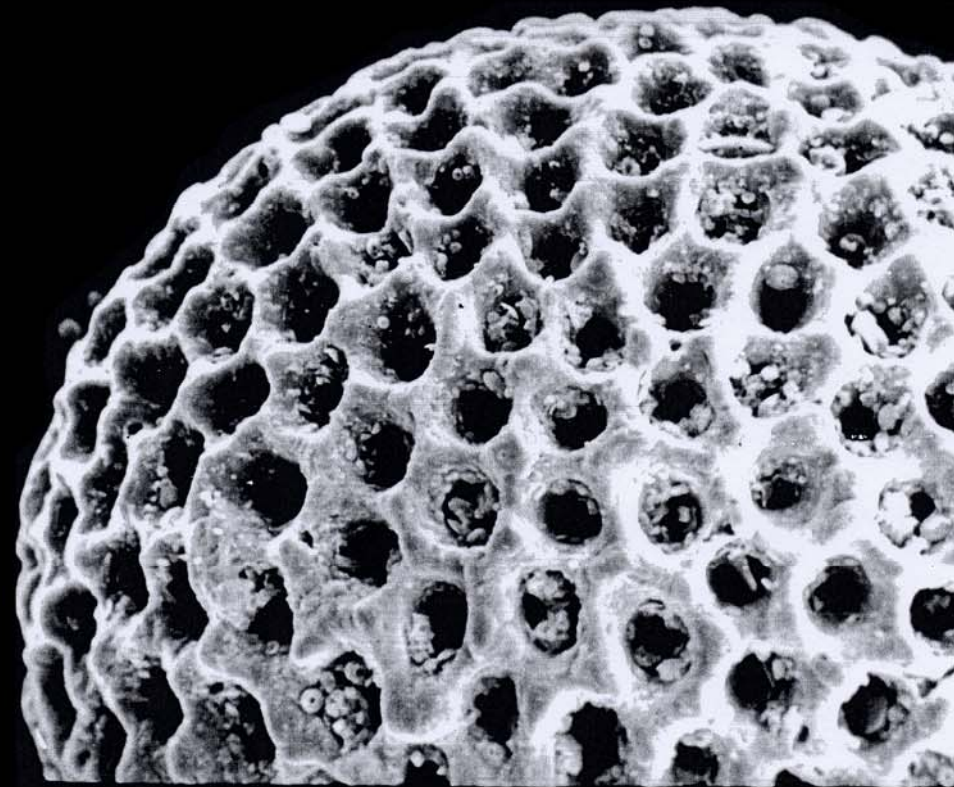
VERNONIA AEMULANS

1/3900  
cm



GRAINS DE POLLEN

1/800 cm



RADICLARIA

BY TURE WESTER

T-1

**Nature is saturated with sponge structures on every possible scale of physical-biological reality.** The term was first adopted in biology: "Sponge: any member of the phylum Porifera, sessile aquatic animals, with single cavity in the body, with numerous pores. The fibrous skeleton of such an animal, remarkable for its power of sucking up water".

(Wordsworth dictionary).

Of course the term applied to '**spherical sponges**'. **It turns out that the key characteristic of porosity is attributable to a much wider morphological phenomenon.**



$$\underline{3 \cdot 11 \cdot 4^2 \cdot 1^2 \cdot 3^2 \cdot 1^2 \cdot 4^2 \cdot 11 \cdot 4^2 \cdot 1^2 \cdot 3^2 \cdot 1^2 \cdot 4^2 \cdot 11 \cdot 3 \cdot 6 \cdot 4^2 \cdot 6^2 \cdot 3^3 \cdot 6^2 \cdot 4^2 \cdot 6}_{601}$$

$$g_{(2,3,5)} = 601$$

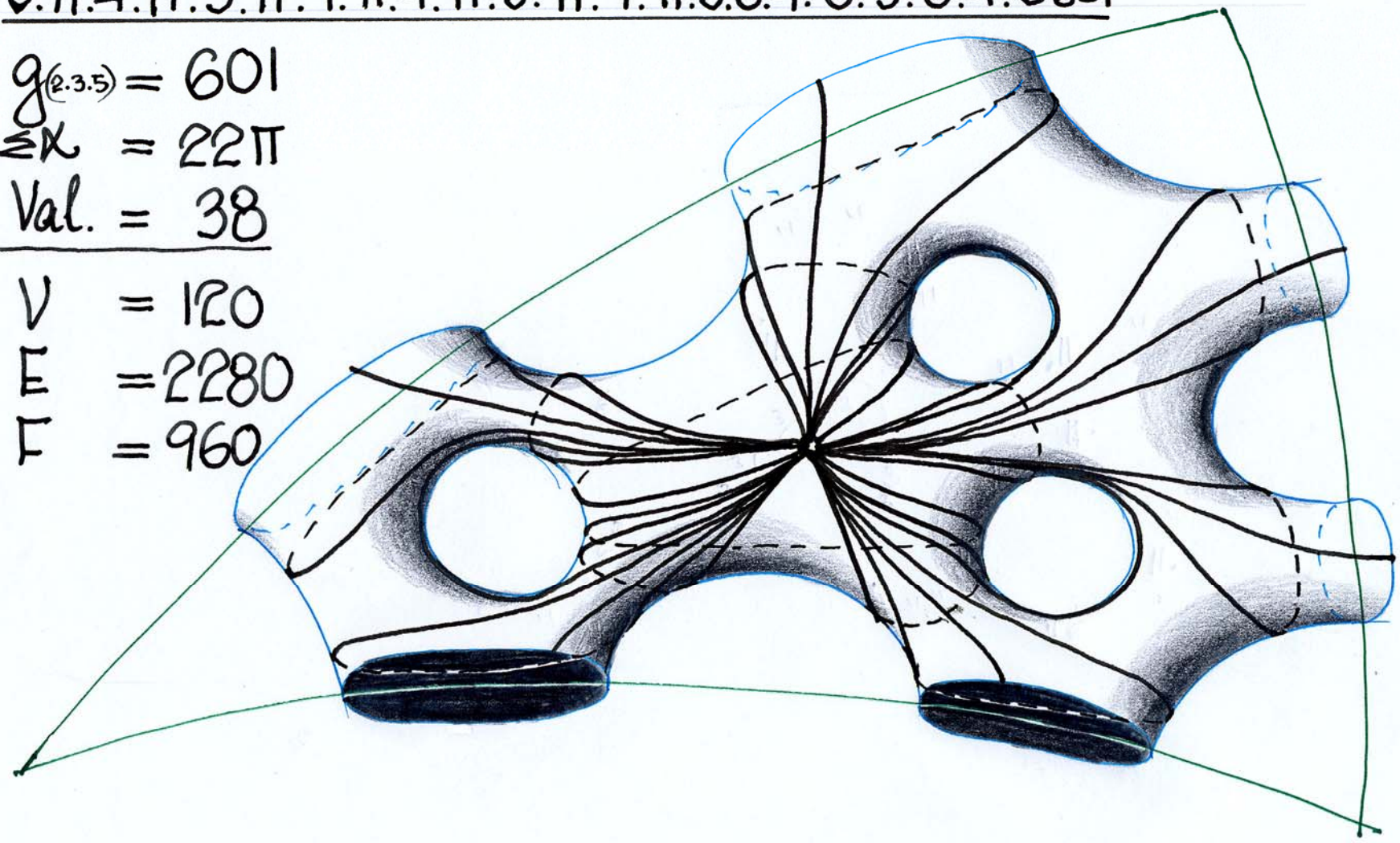
$$\chi = 22\pi$$

$$\underline{\text{Vol.} = 38}$$

$$V = 120$$

$$E = 2280$$

$$F = 960$$

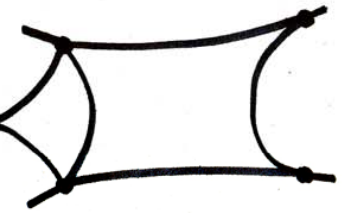
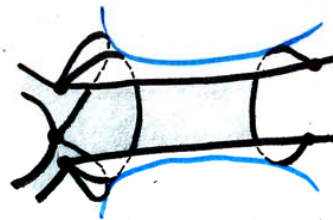
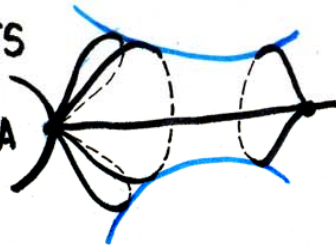


QUADRANGLES



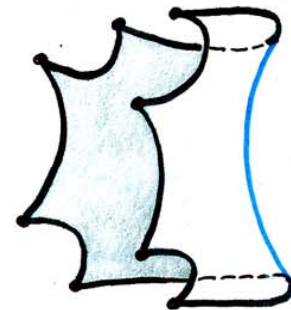
DODECAGON

POLIGONAL FACETS ASSOCIATED WITH SPONGE POLYHEDRA



TRIANGLE AND QUADRANGLE

OCTAGON





$3^4 \cdot 3^4 \cdot 3^8 \cdot 6^4 \cdot 6^3 \cdot 3^4 \cdot 3^4 \cdot 3^6 \cdot 8 \cdot 13 \cdot 8 \cdot 6 \cdot 3^4 \cdot 3^4 \cdot 3^6 \cdot 4^2 \cdot 6 \cdot 8 \cdot 3^4 \cdot 3^4 \cdot 3^8 \cdot 4^2 \cdot 8 \cdot 13^2 \cdot 11 \cdot 13^2 \cdot 3^4 \cdot 3^4 \cdot 3^3 \cdot 13 \cdot 4^4 \cdot 13 \cdot 11 \cdot 4^4 \cdot 11 \cdot 4^4 \cdot 11 \cdot 19 \cdot 4^4 \cdot 19 \cdot 3^4 \cdot 3^4 \cdot 3^3 \cdot 19^2 \cdot 11 \cdot 19^2 \cdot 4^2 \cdot 19 \cdot 3^4 \cdot 3^4 \cdot 3^3$   
 $19^2 \cdot 11 \cdot 19^2 \cdot 3^4 \cdot 3^4 \cdot 3^3 \cdot 19 \cdot 3^4 \cdot 3^4 \cdot 3^3 \cdot 19 \cdot 3^4 \cdot 3^4 \cdot 3^3 \cdot 19^2 \cdot 11 \cdot 19^2 \cdot 3^4 \cdot 3^4 \cdot 3^3 \cdot 19 \cdot 4^2 \cdot 19 \cdot 11 \cdot 3^4 \cdot 3^4 \cdot 3^3 \cdot 11 \cdot 4^4 \cdot 11 \cdot 13 \cdot 4^4 \cdot 13 \cdot 4^4 \cdot 13^2 \cdot 11 \cdot 13^2 \cdot 8 \cdot 4^4 \cdot 8 \quad 3481$

$g_{(2,3,5)} = 3481$

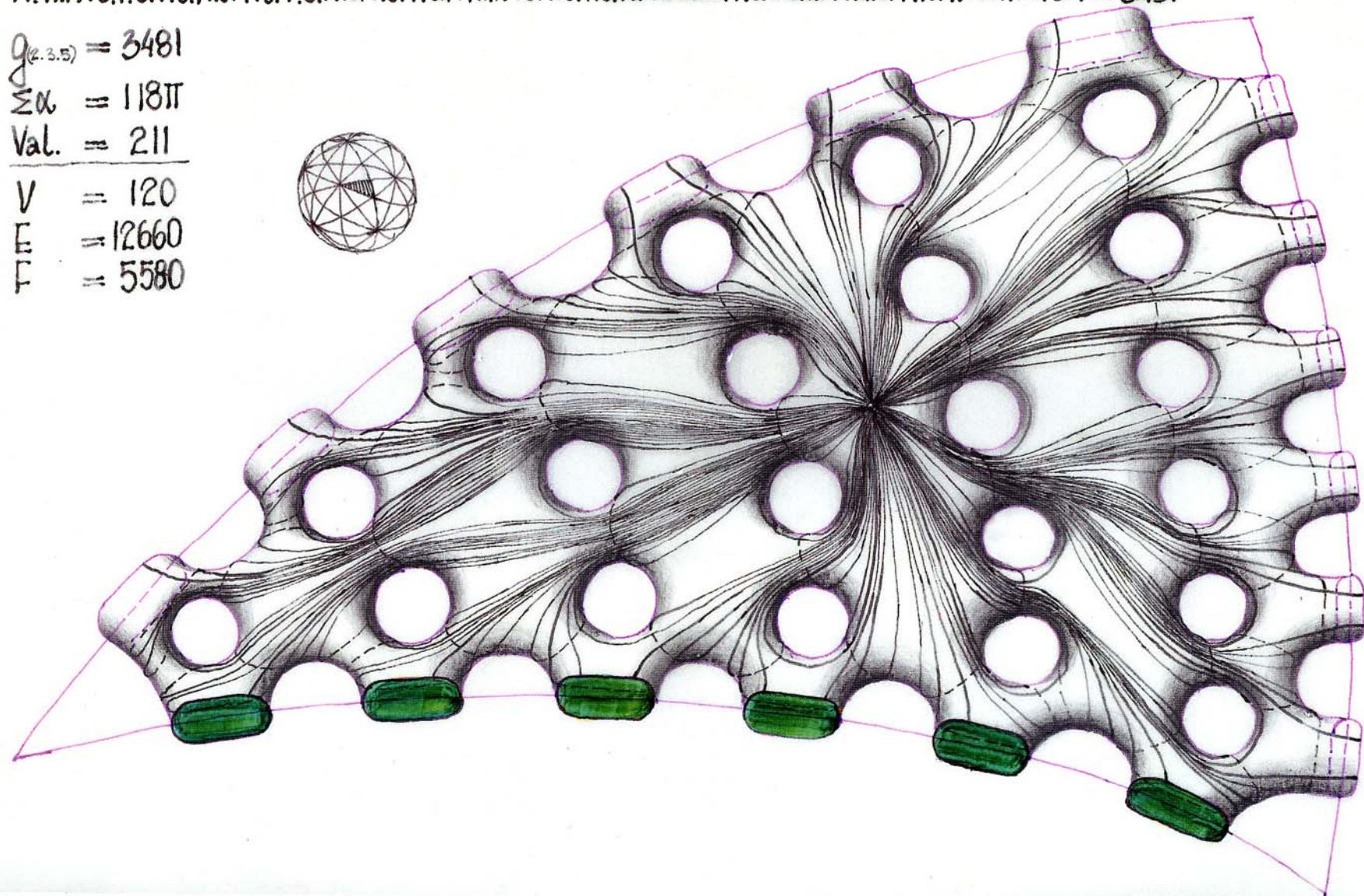
$\sum \alpha = 118\pi$

$Val. = 211$

$V = 120$

$E = 12660$

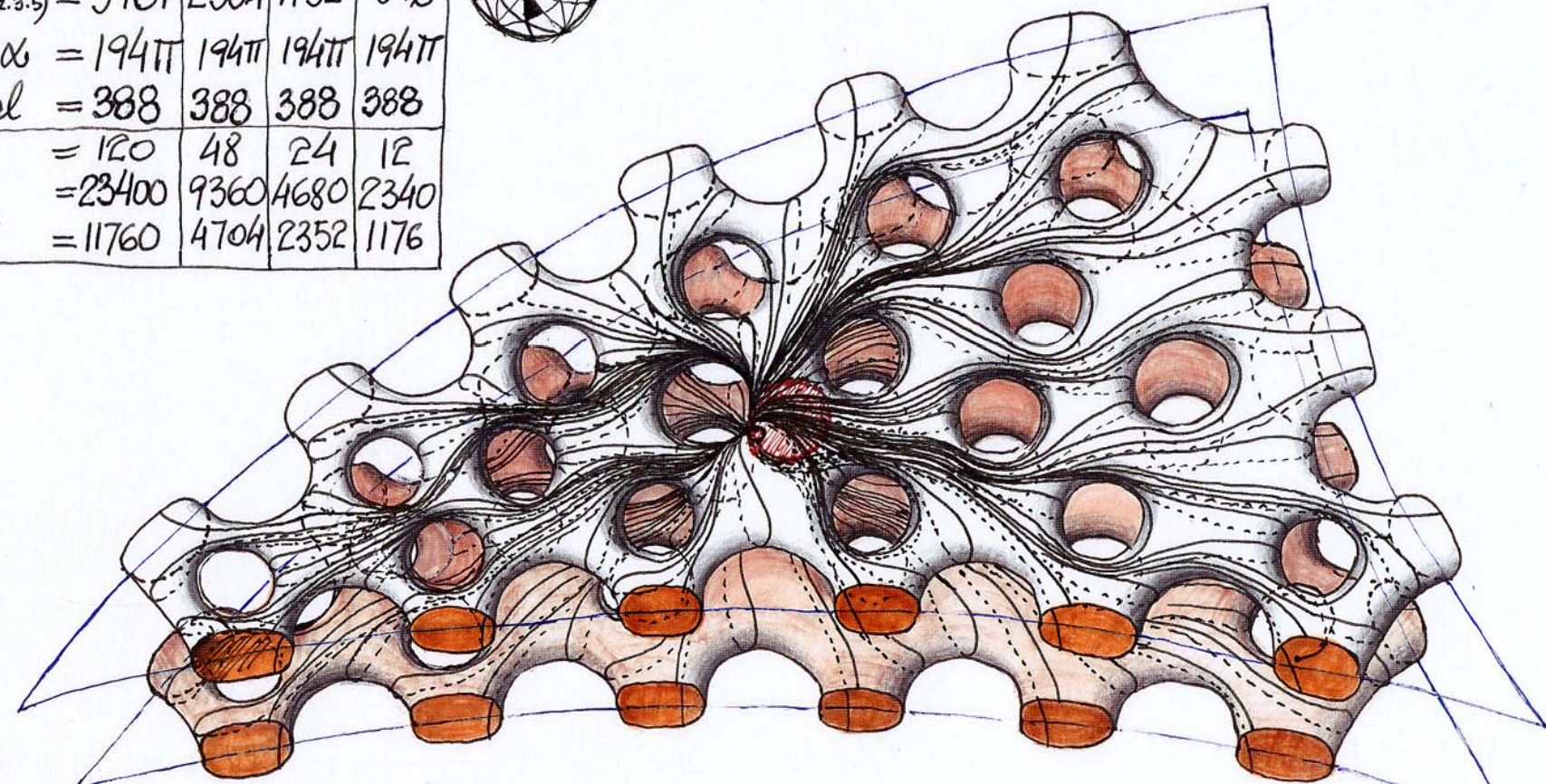
$F = 5580$





$(194)^2$   
 $1 \ 5761_{(2.3.5)}$

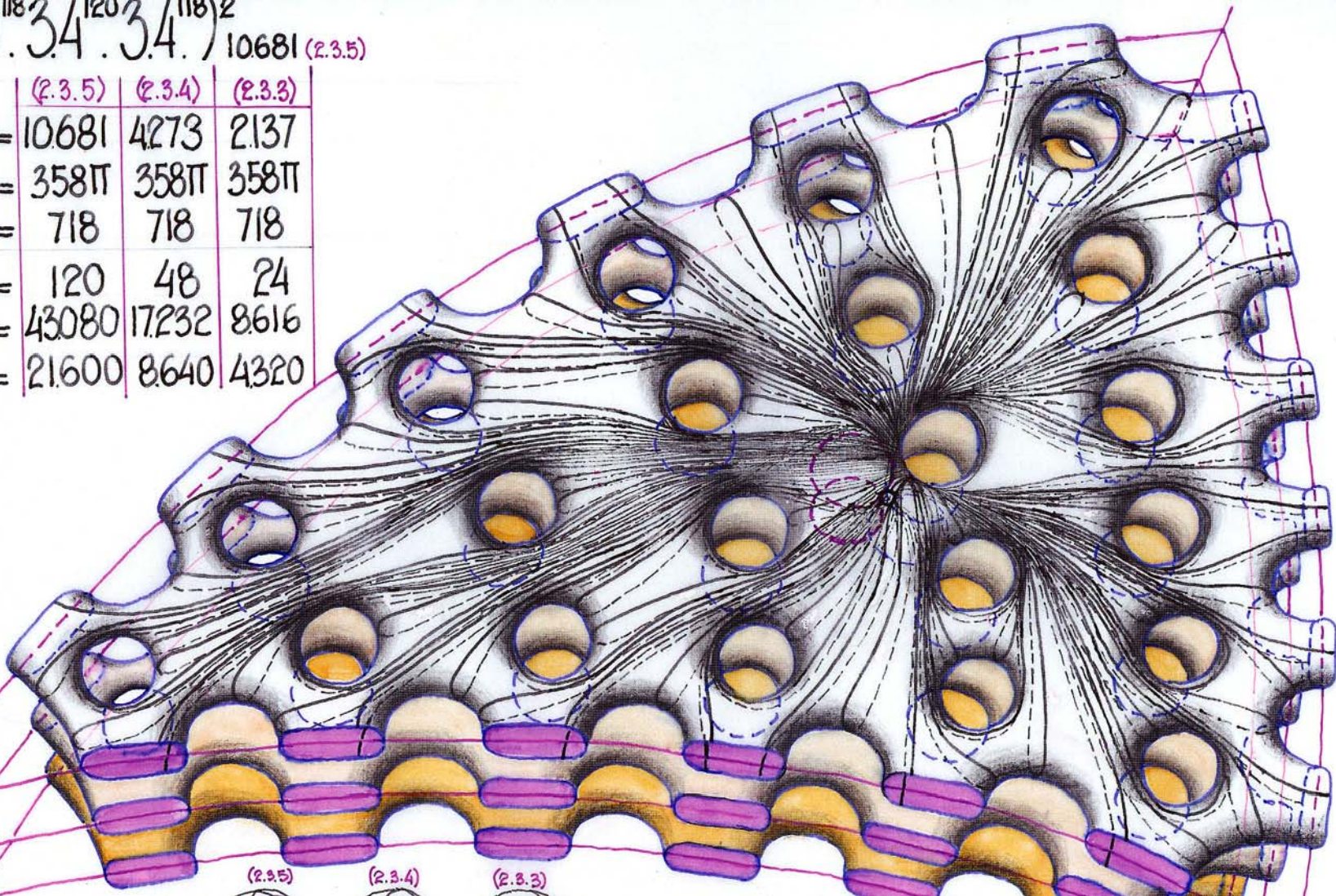
	(2.3.5)	(2.3.4)	(2.3.3)	(2.3.2)
$(2.3.5) =$	5761	2304	1152	576
$\omega =$	$194\pi$	$194\pi$	$194\pi$	$194\pi$
$l =$	388	388	388	388
$=$	120	48	24	12
$=$	23400	9360	4680	2340
$=$	11760	4704	2352	1176





118 2 / 120 3 / 118 2  
 . 3.4 . 3.4 . / 10681 (2.3.5)

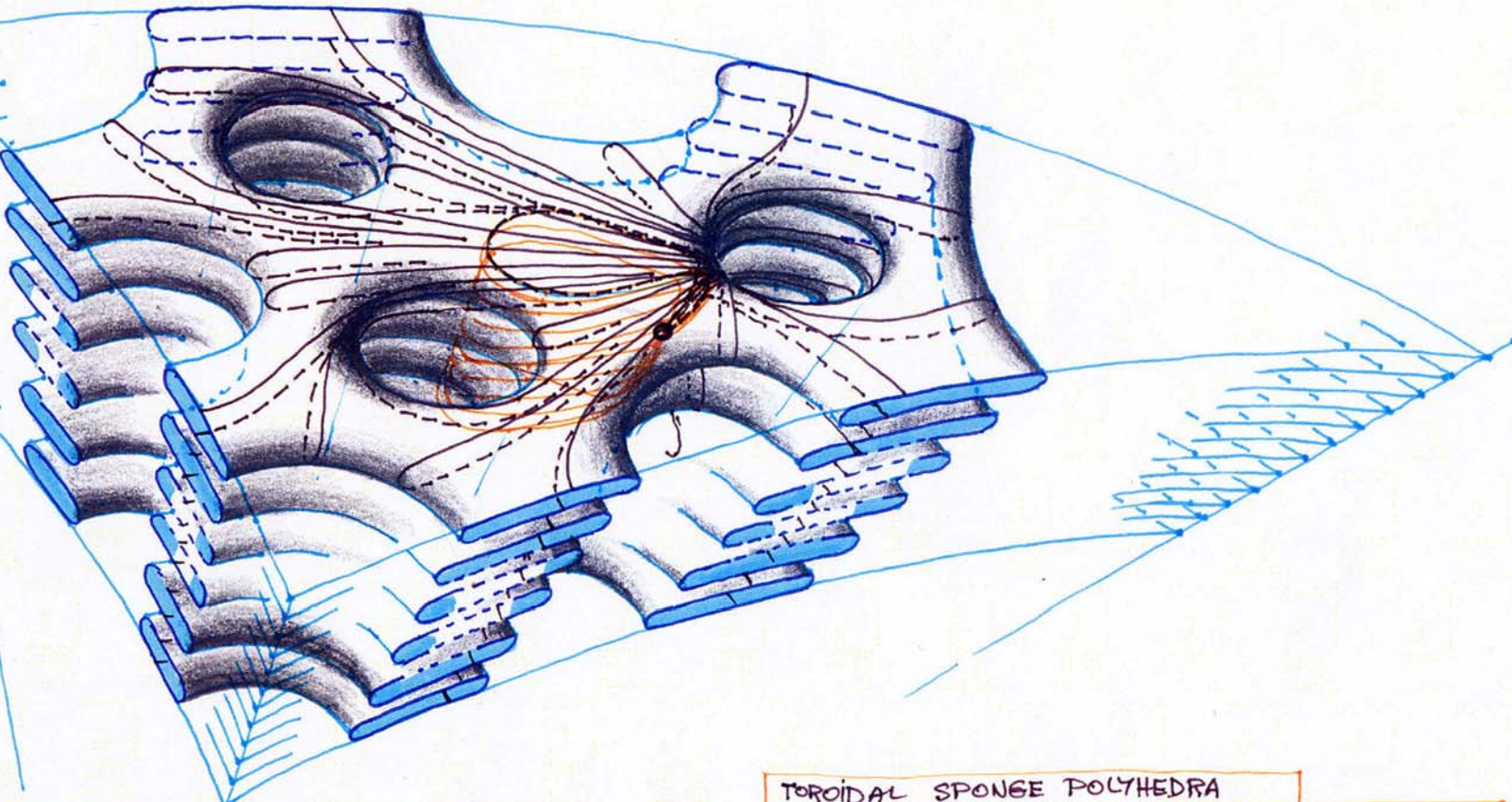
(2.3.5)	(2.3.4)	(2.3.3)
= 10681	4273	2137
= 358π	358π	358π
= 718	718	718
= 120	48	24
= 43080	17232	8616
= 21600	8640	4320



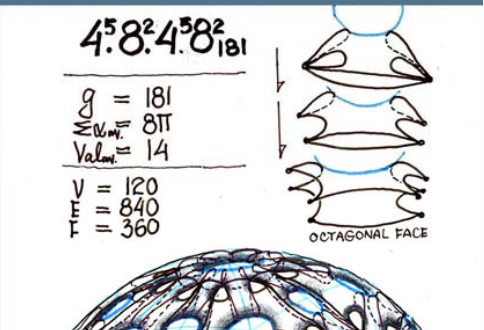
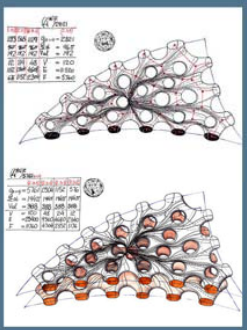
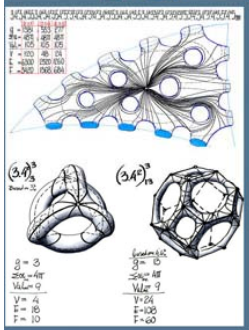
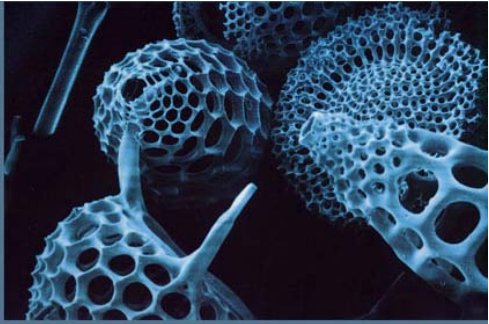
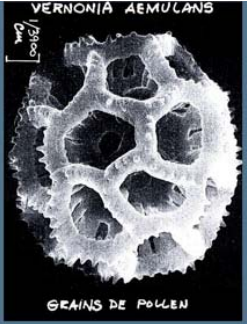


$$4^{11}3(2.4^2.4^{12})^{n-1}.(2.3.4^{11}.4^{11})^2 \quad 1321+720(n-1) ; (2.3.5)$$

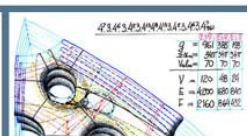
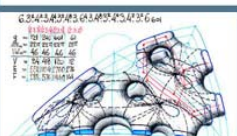
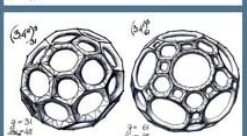
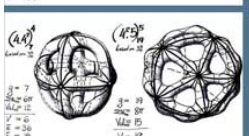
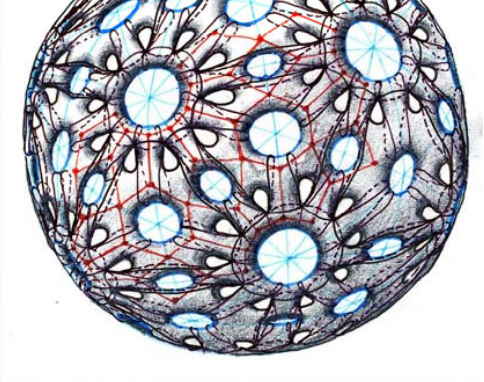
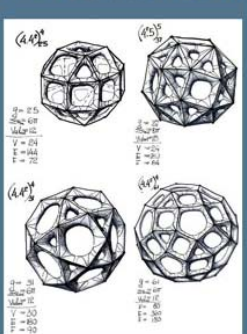
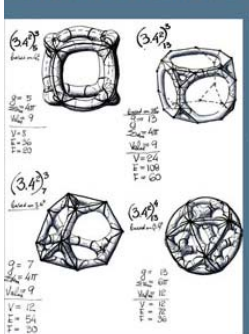
$$n = 1, \dots, \infty$$



TOROIDAL SPONGE POLYHEDRA								
GR.	(2.3.5)	(2.3.4)	(2.3.3)	(2.3.2)	(2.3.6) <sub>TU.</sub>	(2.4.4) <sub>TU.</sub>	(3.3.3) <sub>TU.</sub>	2.2.m
	$1321+720(n-1)$	$529+288(n-1)$	$265+144(n-1)$	$133+72(n-1)$	$133+72(n-1)$	$89+48(n-1)$	$67+36(n-1)$	$(22+12(n-1))m+1$
	$46\pi+24\pi(n-1)$							



UNIFORM SPHERICAL SPONGE POLYHEDRA





$$4^8_{9rv} ; 4^8_{2n+1}$$

$$g_{rv} = 9 ; i = n+1$$

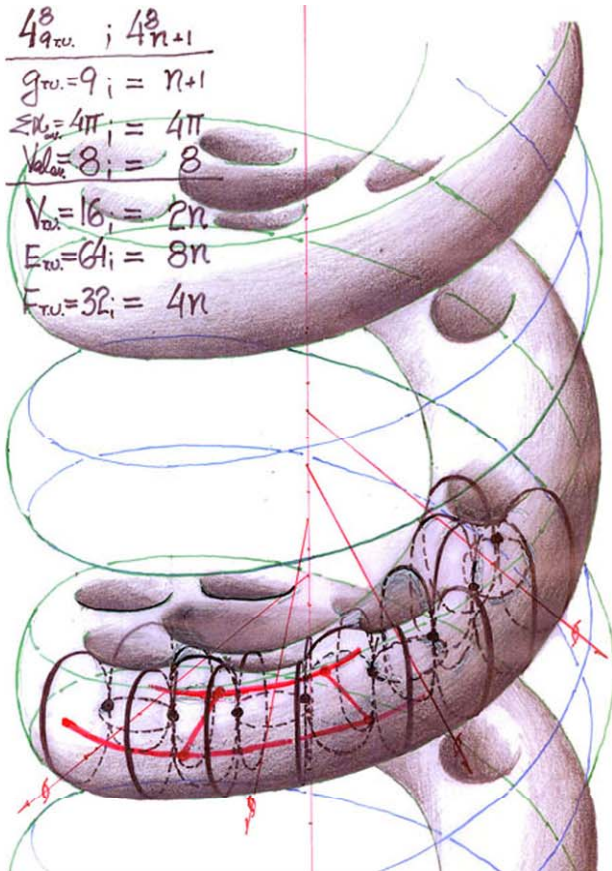
$$\sum \kappa_{rv} = 4\pi ; i = 4\pi$$

$$Vol_{rv} = 8 ; i = 8$$

$$V_{rv} = 16 ; i = 2n$$

$$E_{rv} = 64 ; i = 8n$$

$$F_{rv} = 32 ; i = 4n$$



$$4^{12}_{17rv} ; 4^{12}_{2n+1}$$

$$g_{rv} = 17 ; i = 2n+1$$

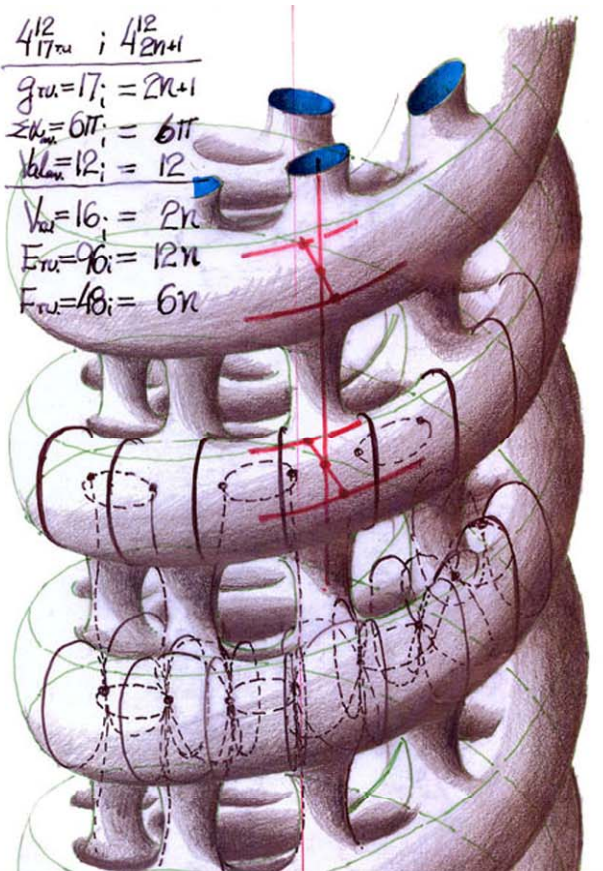
$$\sum \kappa_{rv} = 6\pi ; i = 6\pi$$

$$Vol_{rv} = 12 ; i = 12$$

$$V_{rv} = 16 ; i = 2n$$

$$E_{rv} = 96 ; i = 12n$$

$$F_{rv} = 48 ; i = 6n$$



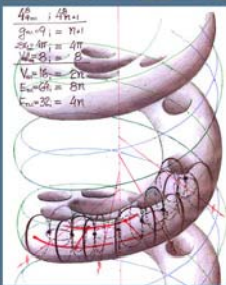




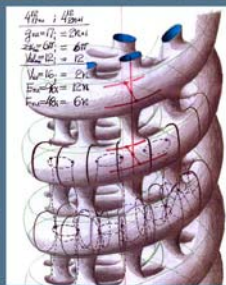
PONT DU GARD



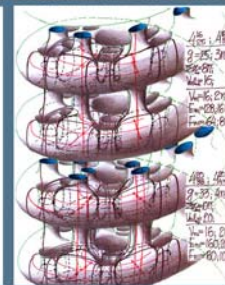
PARK GÜELL - GAUDI



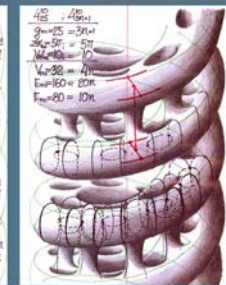
$$\begin{aligned} 4n &= 4 \cdot 2 = 8 \\ g_{\text{min}} &= 1 \\ \sum_{i=1}^n 4i &= 4 \cdot 2 = 8 \\ V_{\text{min}} &= 2 \\ E_{\text{min}} &= 8 \\ F_{\text{min}} &= 4 \end{aligned}$$



$$\begin{aligned} 4n &= 4 \cdot 3 = 12 \\ g_{\text{min}} &= 2 \\ \sum_{i=1}^n 4i &= 4 \cdot 3 = 12 \\ V_{\text{min}} &= 2 \\ E_{\text{min}} &= 12 \\ F_{\text{min}} &= 6 \end{aligned}$$

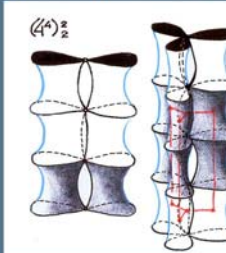


$$\begin{aligned} 4n &= 4 \cdot 4 = 16 \\ g_{\text{min}} &= 3 \\ \sum_{i=1}^n 4i &= 4 \cdot 4 = 16 \\ V_{\text{min}} &= 2 \\ E_{\text{min}} &= 16 \\ F_{\text{min}} &= 8 \end{aligned}$$

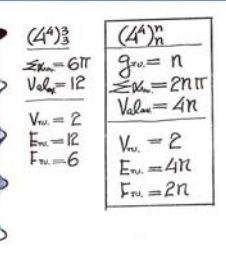


$$\begin{aligned} 4n &= 4 \cdot 5 = 20 \\ g_{\text{min}} &= 4 \\ \sum_{i=1}^n 4i &= 4 \cdot 5 = 20 \\ V_{\text{min}} &= 2 \\ E_{\text{min}} &= 20 \\ F_{\text{min}} &= 10 \end{aligned}$$

PRIMITIVE UNIFORM SPONGE POLYHEDRA M.BURT

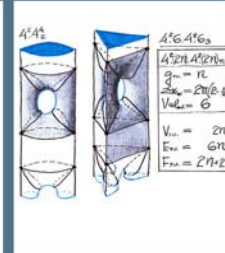


$$\begin{aligned} (4^4)_2 \\ \sum_{i=1}^n 4i &= 6 \cdot \pi \\ V_{\text{min}} &= 12 \\ V_{\text{in}} &= 2 \\ E_{\text{min}} &= 12 \\ F_{\text{min}} &= 6 \end{aligned}$$

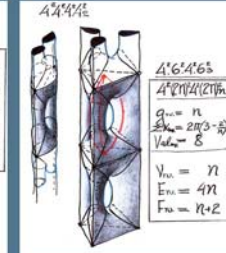


$$\begin{aligned} (4^4)_3 \\ \sum_{i=1}^n 4i &= 6 \cdot \pi \\ V_{\text{min}} &= 12 \\ V_{\text{in}} &= 2 \\ E_{\text{min}} &= 12 \\ F_{\text{min}} &= 6 \end{aligned}$$

$$\begin{aligned} (4^4)_n \\ g_{\text{min}} &= n \\ \sum_{i=1}^n 4i &= 2n \cdot \pi \\ V_{\text{min}} &= 4n \\ V_{\text{in}} &= 2 \\ E_{\text{min}} &= 4n \\ F_{\text{min}} &= 2n \end{aligned}$$



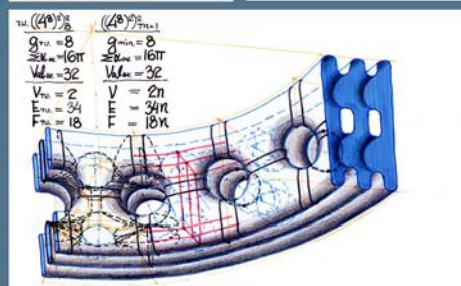
$$\begin{aligned} 4^4 4^4 6_3 \\ g_{\text{min}} &= n \\ \sum_{i=1}^n 4i &= 2n \cdot \pi \\ V_{\text{min}} &= 6 \\ V_{\text{in}} &= 2n \\ E_{\text{min}} &= 6n \\ F_{\text{min}} &= 2n + 2 \end{aligned}$$



$$\begin{aligned} 4^4 4^4 6_4 \\ g_{\text{min}} &= n \\ \sum_{i=1}^n 4i &= 2n \cdot \pi \\ V_{\text{min}} &= 8 \\ V_{\text{in}} &= n \\ E_{\text{min}} &= 4n \\ F_{\text{min}} &= n + 2 \end{aligned}$$



CASA MILLA - GAUDI



$$\begin{aligned} (4^4)_8 \\ g_{\text{min}} &= 8 \\ \sum_{i=1}^n 4i &= 16 \cdot \pi \\ V_{\text{min}} &= 32 \\ V_{\text{in}} &= 2 \\ E_{\text{min}} &= 34 \\ F_{\text{min}} &= 18 \end{aligned}$$

$$\begin{aligned} (4^4)_{2n-1} \\ g_{\text{min}} &= 8 \\ \sum_{i=1}^n 4i &= 16 \cdot \pi \\ V_{\text{min}} &= 32 \\ V_{\text{in}} &= 2n \\ E_{\text{min}} &= 34n \\ F_{\text{min}} &= 18n \end{aligned}$$

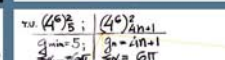


$$\begin{aligned} 3 \cdot 4^4 \\ g_{\text{min}} &= 6 \\ \sum_{i=1}^n 4i &= 5 \cdot \pi \\ V_{\text{min}} &= 5 \end{aligned}$$



$$\begin{aligned} 3 \cdot 4^4 \\ g_{\text{min}} &= 6 \\ \sum_{i=1}^n 4i &= 5 \cdot \pi \\ V_{\text{min}} &= 5 \end{aligned}$$

$$\begin{aligned} n \cdot 4^4 \\ g_{\text{min}} &= 2n \\ \sum_{i=1}^n 4i &= 2n \cdot \pi \end{aligned}$$



$$\begin{aligned} (4^4)_8 \\ g_{\text{min}} &= 5 \\ \sum_{i=1}^n 4i &= 5 \cdot \pi \\ V_{\text{min}} &= 5 \end{aligned}$$

$$\begin{aligned} (4^4)_{2n-1} \\ g_{\text{min}} &= 5 \\ \sum_{i=1}^n 4i &= 5 \cdot \pi \\ V_{\text{min}} &= 5 \end{aligned}$$

$(4.6.4)_5^6$   
 $g_{\text{tr.}} = 5$   
 $\sum_{a.v.} = 10\pi$   
 $V_{a.v.} = 18$

$g_{\text{tr.}} = 2n+1$   
 $\sum_{a.v.} = 10\pi$   
 $V_{a.v.} = 18$   
 $V_{\text{tr.}} = 2n$   
 $E_{\text{tr.}} = 9n$   
 $F_{\text{tr.}} = 4n$

$(4^2.6)_9^6$

PERIODIC (INFINITE) SPONGE POLYHEDRON- $(4^2.6)_9^6$   
 OF THE POLYHEDRAL FAMILY:  $(4^2.6)_9^6 = 2\pi-1$

$$n=2 \quad (4^2 5)_{19}^5$$

$$g = 19 = 9n + 1$$

$$\sum \alpha_{av.} = 8\pi$$

$$\underline{Val_{av.} = 15}$$

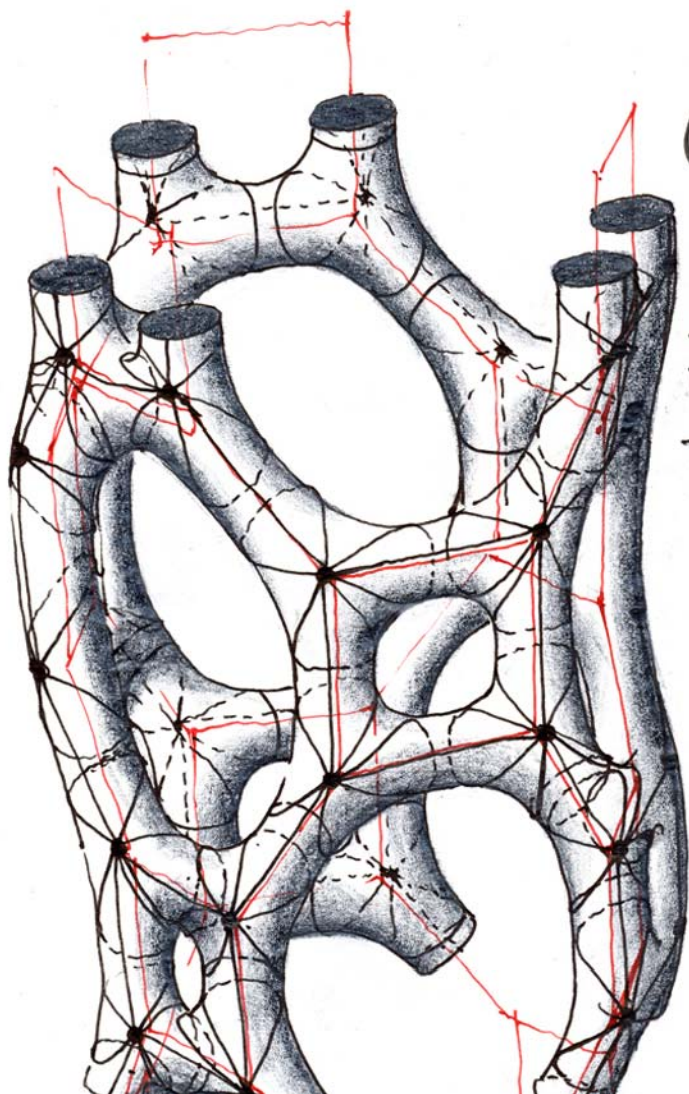
$$V_{T.U.} = 6 \times 2 = 6n$$

$$E_{T.U.} = 45 \times 2 = 45n$$

$$F_{T.U.} = 21 \times 2 = 21n$$







$$(3.4)_7^3$$

$$g = 7$$

$$\sum \chi_{av.} = 4\pi$$

$$Val_{av.} = 9$$

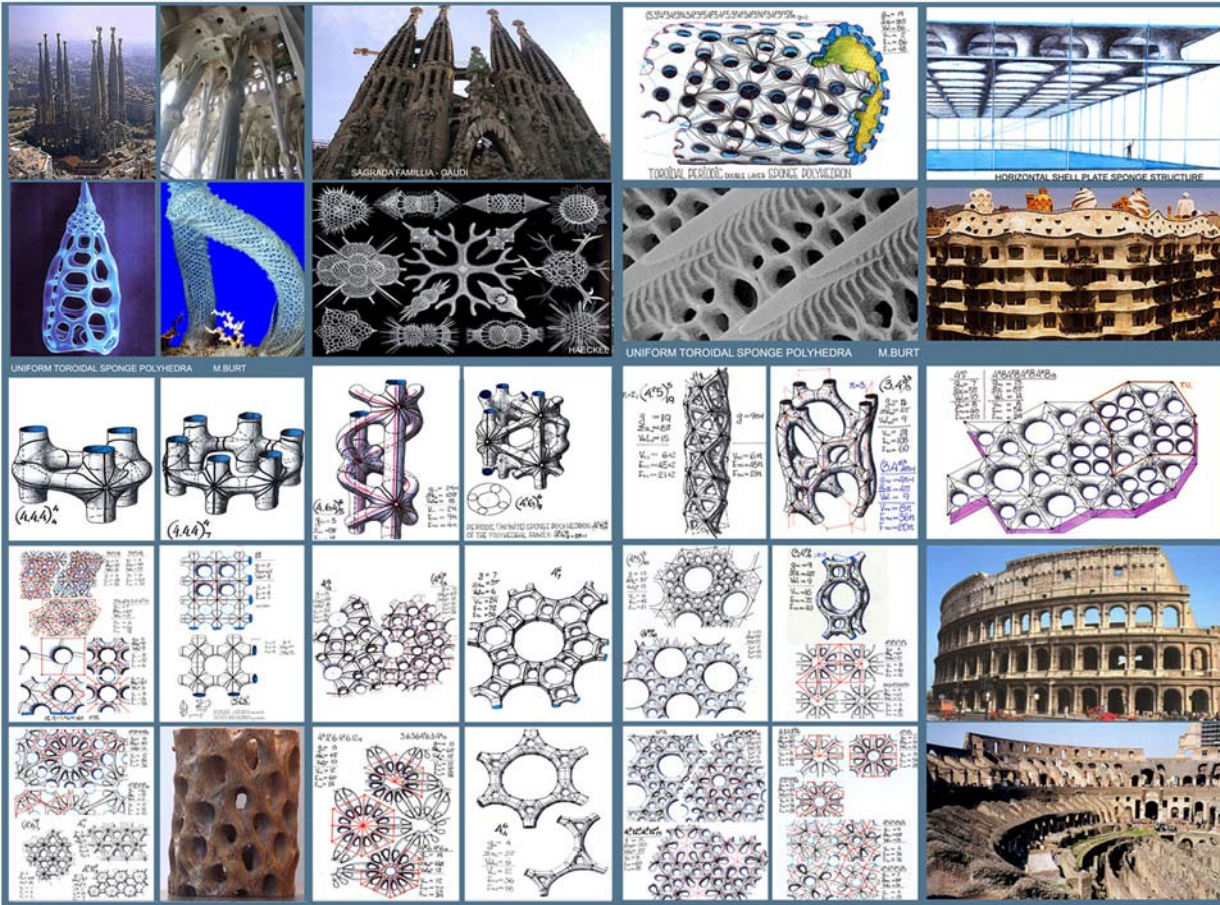
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$$V_{T.U.} = 12$$

$$E_{T.U.} = 54$$

$$F_{T.U.} = 30$$





$$(4^2 \cdot 7)_{61}^7$$

$$g = 61$$

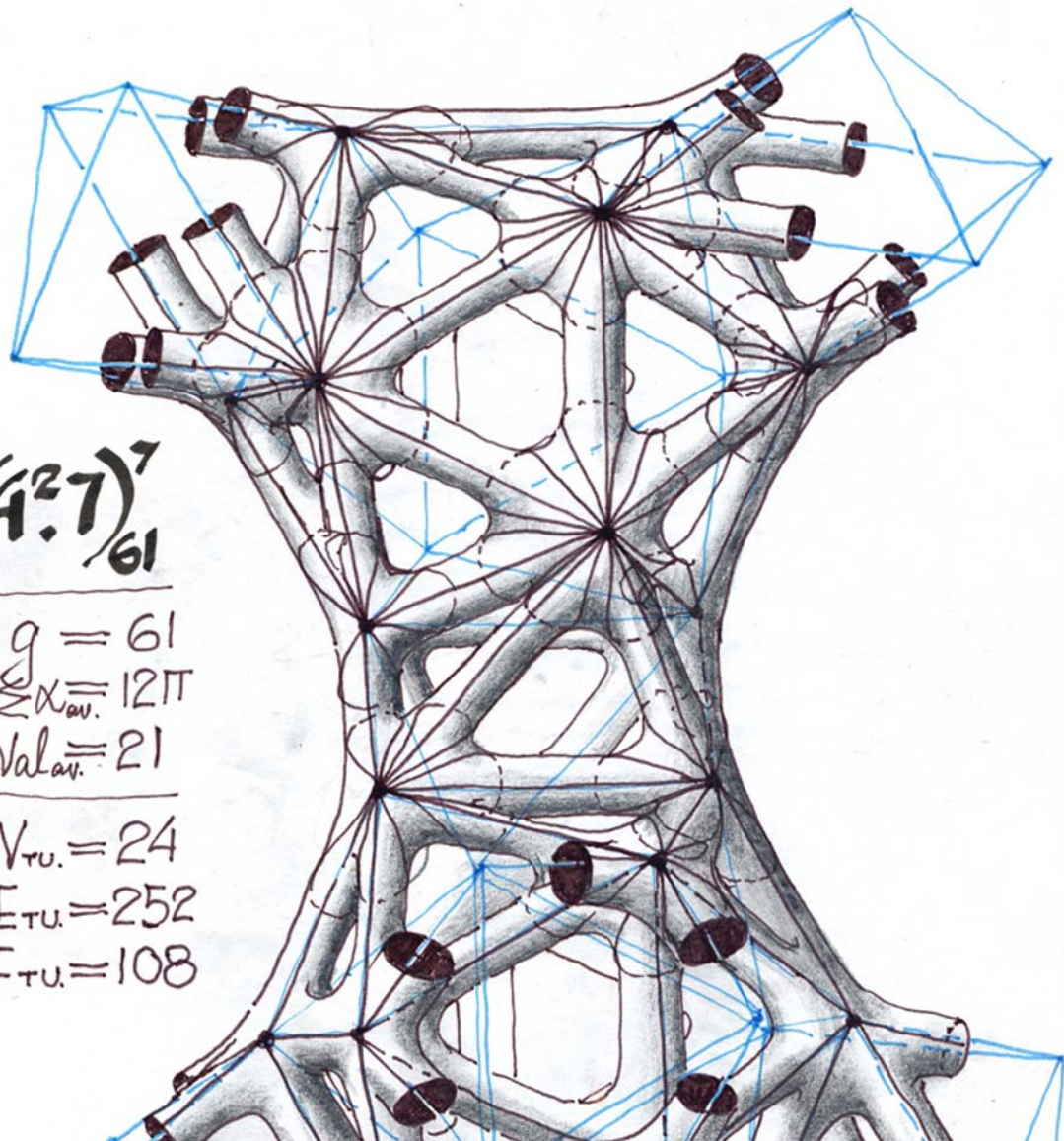
$$\sum \alpha_{av.} = 12\pi$$

$$Val_{av.} = 21$$

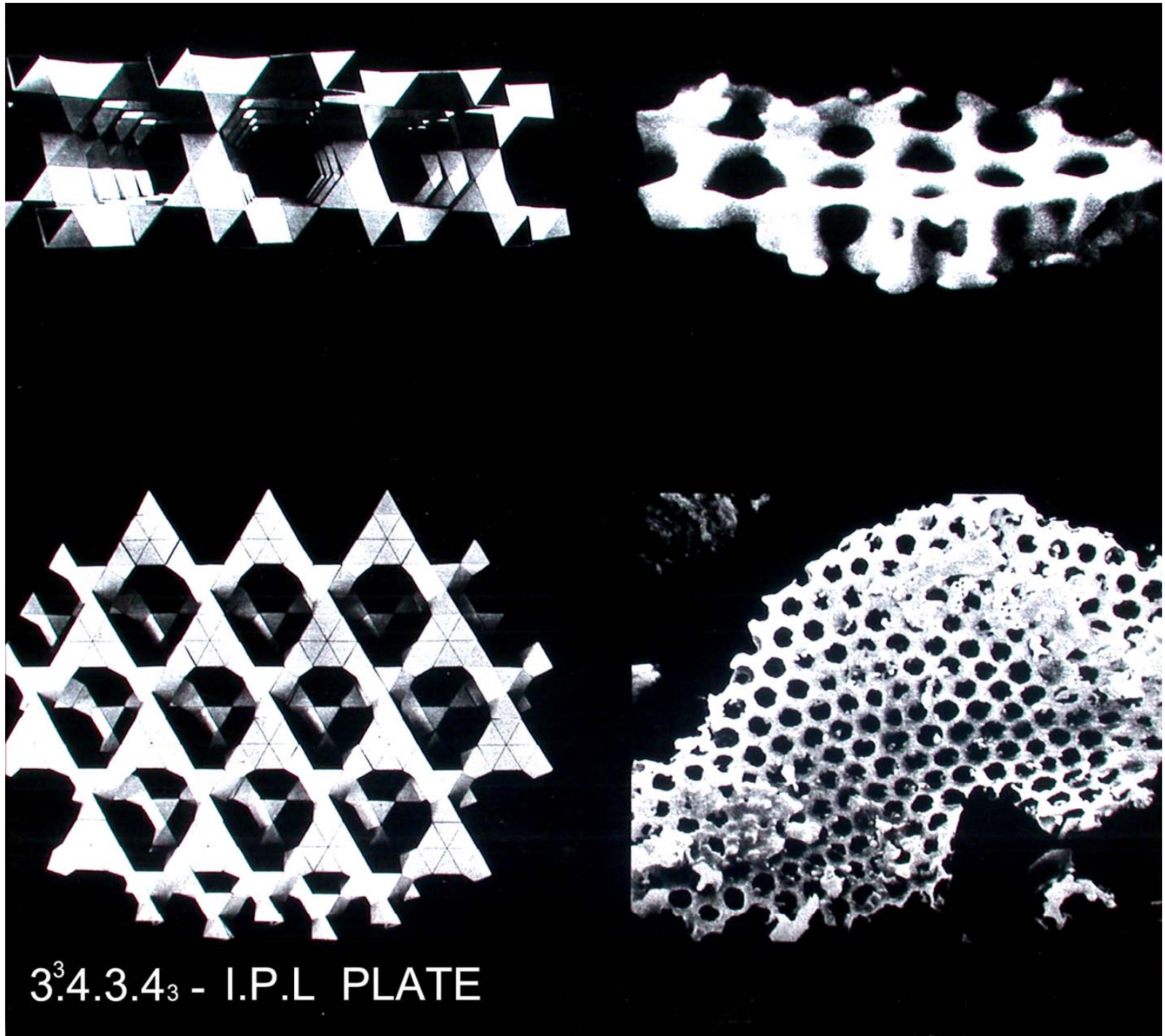
$$V_{TU.} = 24$$

$$E_{TU.} = 252$$

$$F_{TU.} = 108$$







$3^3.4.3.4_3$  - I.P.L PLATE



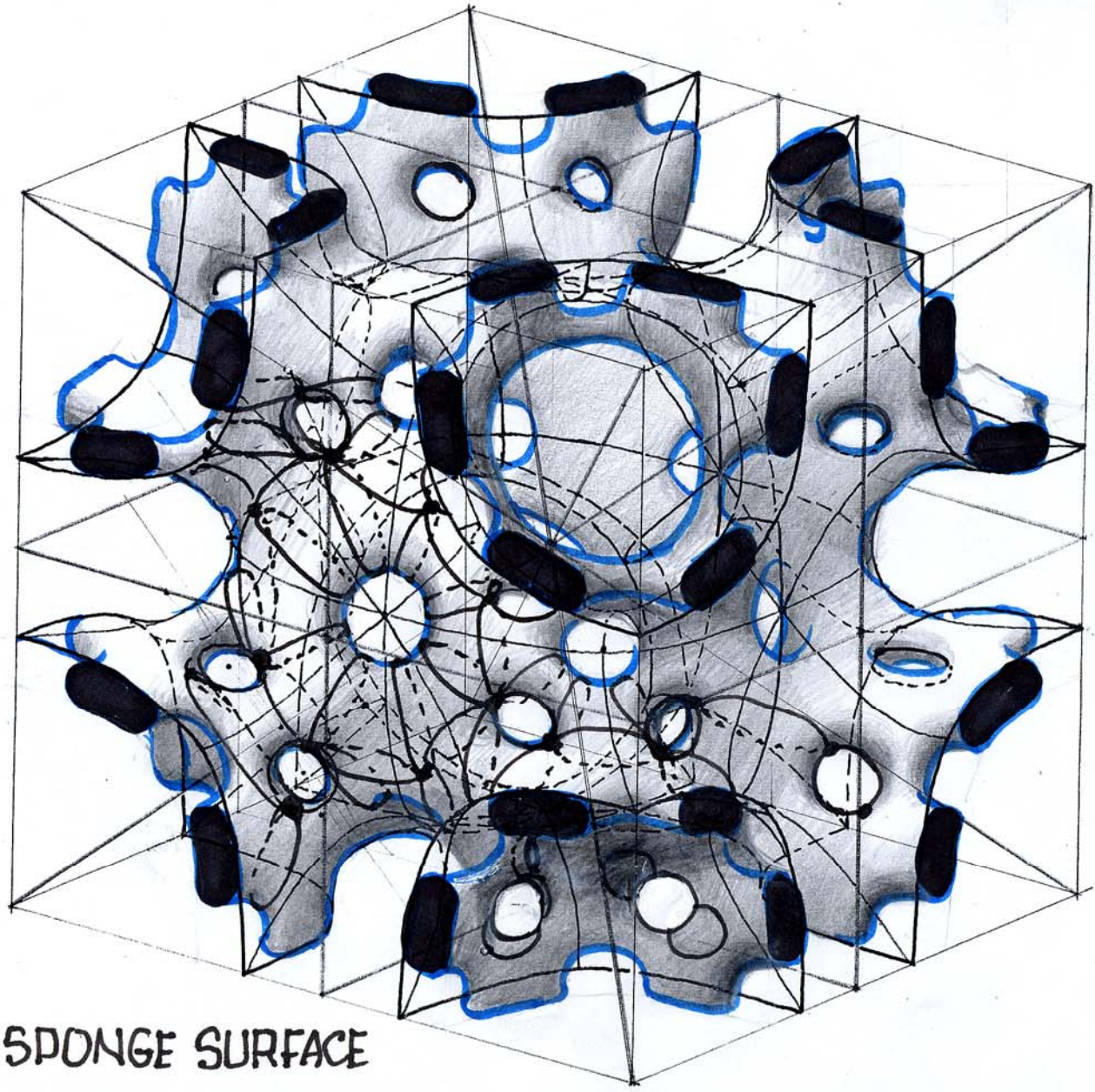
$$\frac{(4^6)_{97}}{g_{TV.} = 97}$$

$$\frac{\Sigma N_{av.} = 6\pi}{V_{av.} = 12}$$

$$V_{TV.} = 96$$

$$E_{TV.} = 576$$

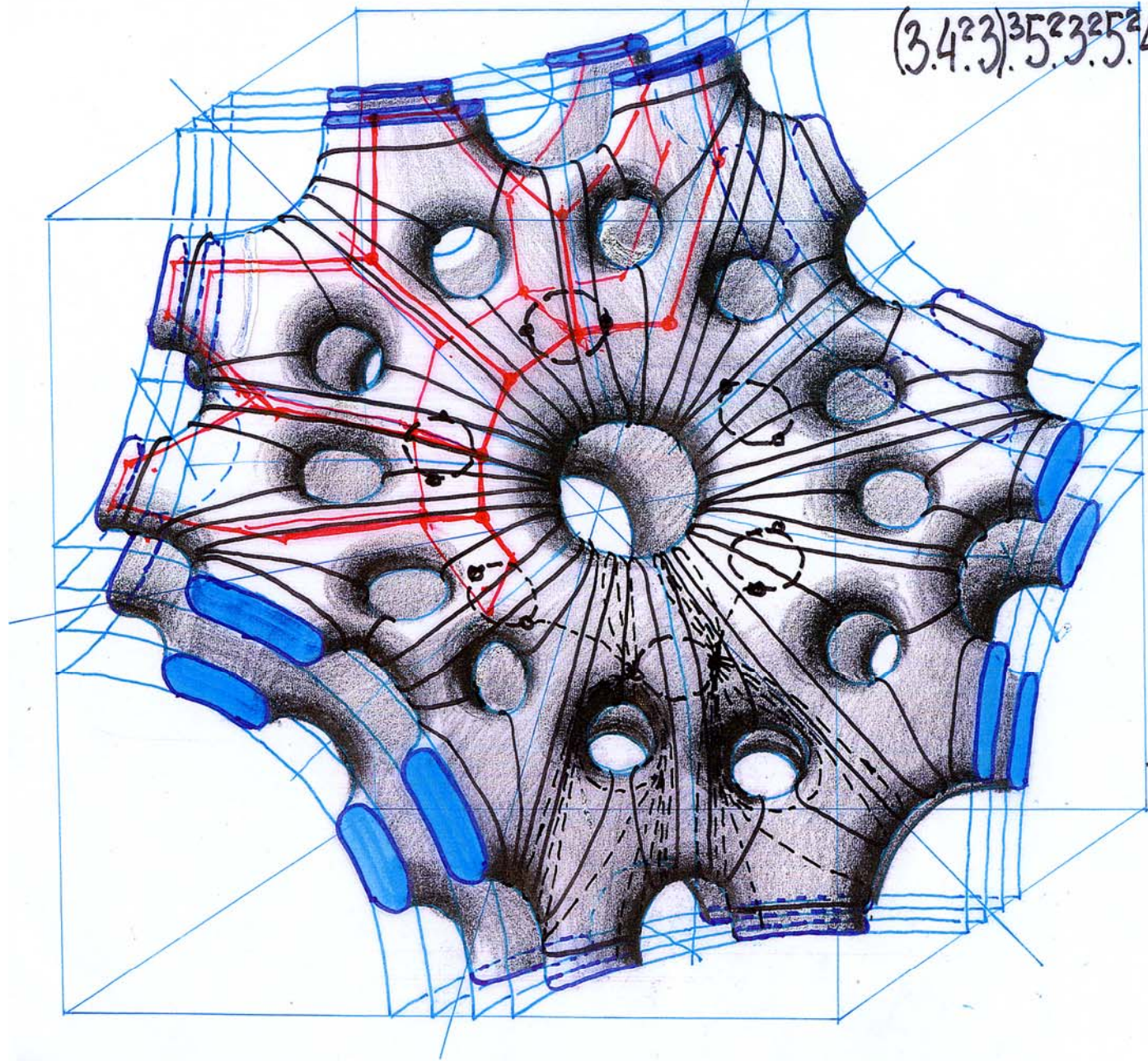
$$F_{TV.} = 288$$



HYPERBOLIC C.C SPONGE SURFACE



$$(3.4^2.3)^3.5^2.3^2.5^2.4^2.5.3.4^2.3.5.4^2.5^2.3^2.5^2_{337}$$



$$g_{TU} = 337$$

$$\sum \alpha_{uv} = 16\pi$$

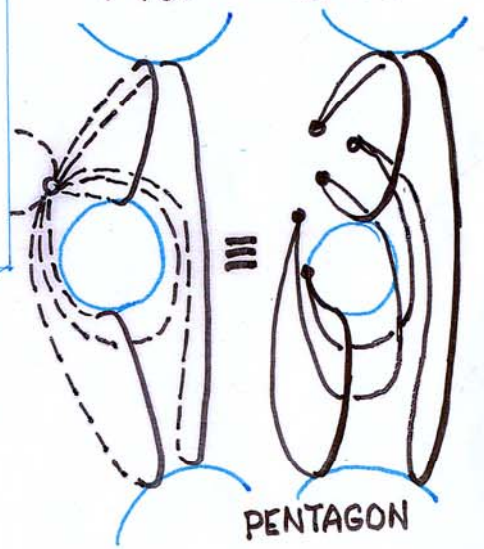
$$Val_{av} = 34$$


---

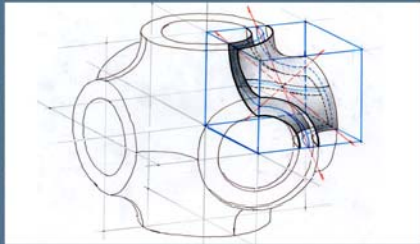
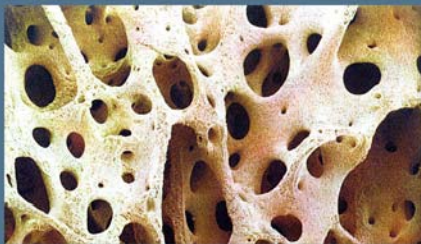
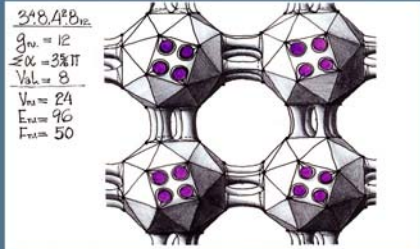
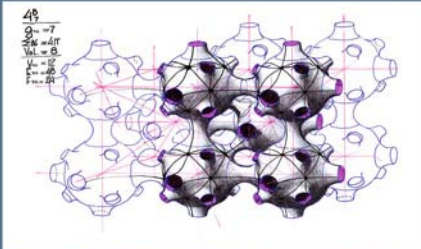
$$V_{TU} = 96$$

$$E_{TU} = 1632$$

$$F_{TU} = 864$$

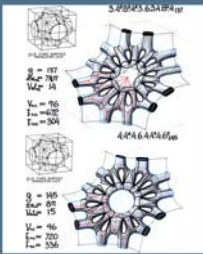
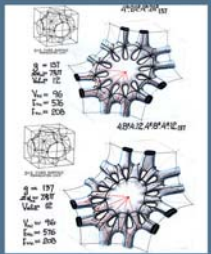
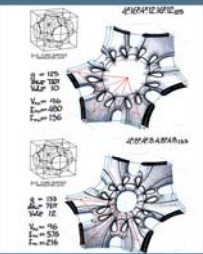
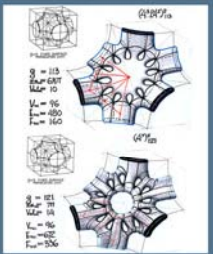
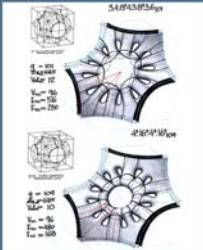
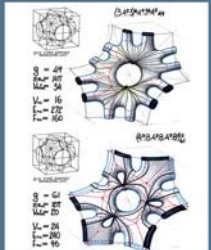
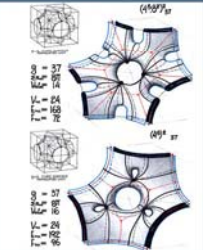
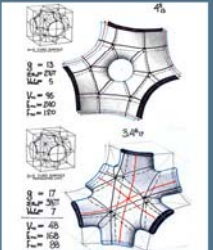
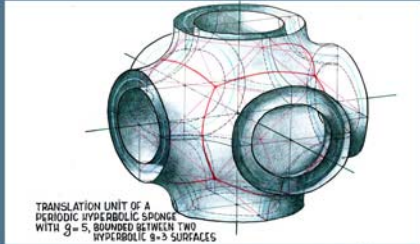
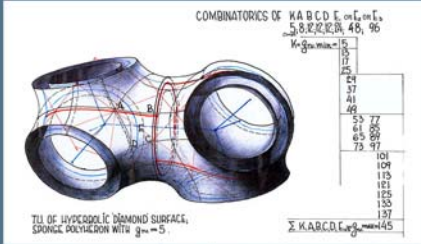






UNIFORM HYPERBOLICAL SPONGE POLYHEDRA

MICHAEL BURT 2008



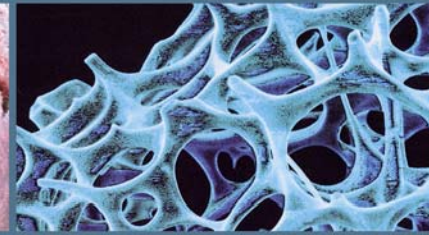
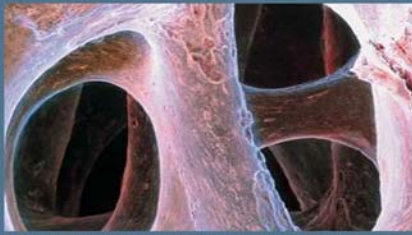


**449**  
 PERIODIC, UNIFORM SPONGE POLYHEDRON - CUBIC SYMMETRY  
 $g = 49$   
 $2g = 98$   
 $V_{in} = 96$   
 $E_{in} = 354$   
 $F_{in} = 192$

THE SPONGE NETWORK

**449**  
 $g = 61$   
 $2g = 122$   
 $V_{in} = 204$   
 $E_{in} = 756$   
 $F_{in} = 392$

**449**  
 $g = 61$   
 $2g = 122$   
 $V_{in} = 204$   
 $E_{in} = 756$   
 $F_{in} = 392$



UNIFORM HYPERBOLIC SPONGE POLYHEDRA

M. BURT

COMBINATORICS OF:  $g$  LEVELS  
 $g_{min} = 13$   

13	19	25
14	21	27
15	23	29
16	25	31
17	27	33
18	29	35
19	31	37
20	33	39
21	35	41
22	37	43
23	39	45
24	41	47
25	43	49
26	45	51
27	47	53
28	49	55
29	51	57
30	53	59
31	55	61
32	57	63
33	59	65
34	61	67
35	63	69
36	65	71
37	67	73
38	69	75
39	71	77
40	73	79
41	75	81
42	77	83
43	79	85
44	81	87
45	83	89
46	85	91
47	87	93
48	89	95
49	91	97
50	93	99
51	95	101
52	97	103
53	99	105
54	101	107
55	103	109
56	105	111
57	107	113
58	109	115
59	111	117
60	113	119
61	115	121
62	117	123
63	119	125
64	121	127
65	123	129
66	125	131
67	127	133
68	129	135
69	131	137
70	133	139
71	135	141
72	137	143
73	139	145

TU OF C.C. HYPERBOLIC SPONGE SURFACE

COMBINATORICS OF:  $g$  LEVELS  

13	25	77
14	27	79
15	29	81
16	31	83
17	33	85
18	35	87
19	37	89
20	39	91
21	41	93
22	43	95
23	45	97
24	47	99
25	49	101
26	51	103
27	53	105
28	55	107
29	57	109
30	59	111
31	61	113
32	63	115
33	65	117
34	67	119
35	69	121
36	71	123
37	73	125
38	75	127
39	77	129
40	79	131
41	81	133
42	83	135
43	85	137
44	87	139
45	89	141
46	91	143
47	93	145
48	95	147
49	97	149
50	99	151
51	101	153
52	103	155
53	105	157
54	107	159
55	109	161
56	111	163
57	113	165
58	115	167
59	117	169
60	119	171
61	121	173
62	123	175
63	125	177
64	127	179
65	129	181
66	131	183
67	133	185
68	135	187
69	137	189
70	139	191
71	141	193
72	143	195
73	145	197

TU OF E.C. HYPERBOLIC SPONGE SURFACE

**449**  
 $g = 97$   
 $2g = 194$   
 $V_{in} = 96$   
 $E_{in} = 576$   
 $F_{in} = 288$

HYPERBOLIC C.C. SPONGE SURFACE

**449**  
 $g = 49$   
 $2g = 98$   
 $V_{in} = 16$   
 $E_{in} = 24$   
 $F_{in} = 84$

HYPERBOLIC SPONGE POLYHEDRON

**449**  
 $g = 61$   
 $2g = 122$   
 $V_{in} = 24$   
 $E_{in} = 204$   
 $F_{in} = 120$

HYPERBOLIC SPONGE POLYHEDRON

**449**  
 $g = 50$   
 $2g = 100$   
 $V_{in} = 96$   
 $E_{in} = 360$   
 $F_{in} = 180$

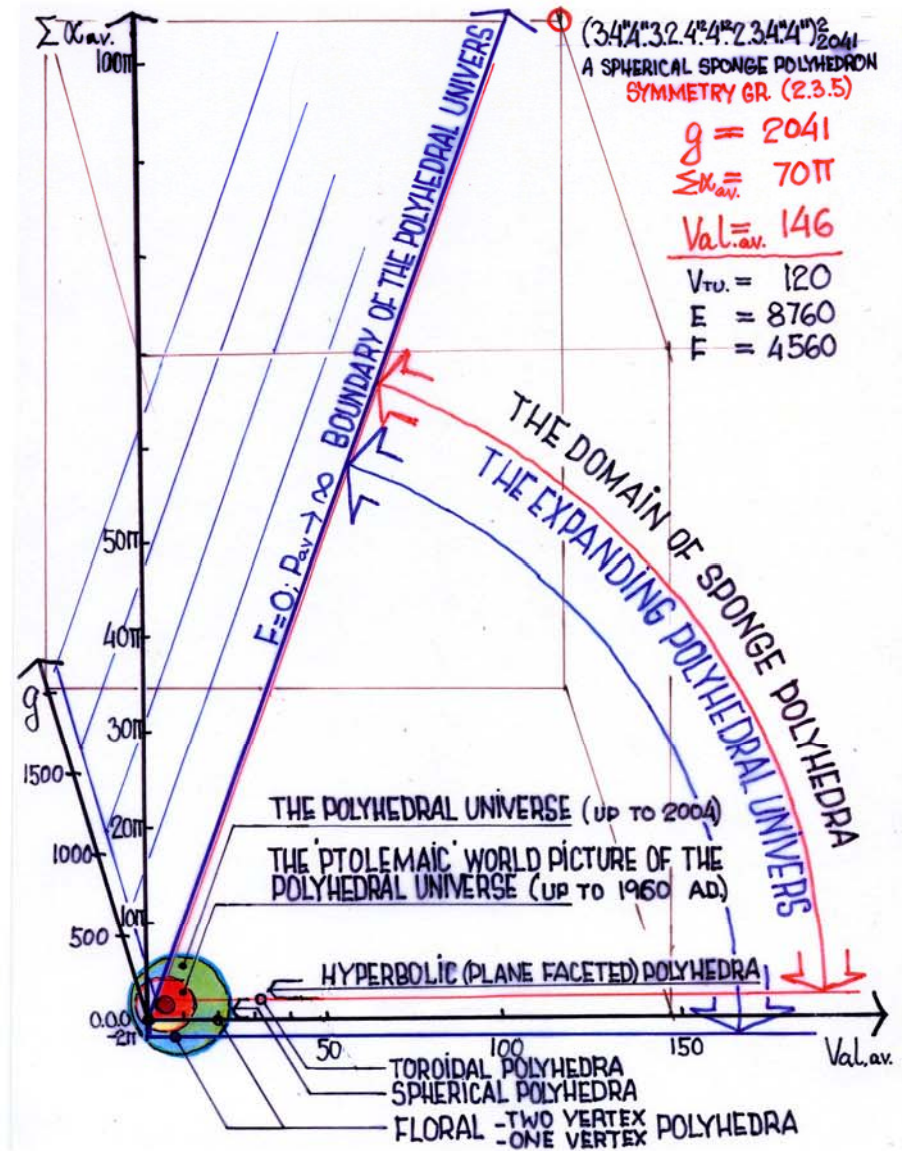
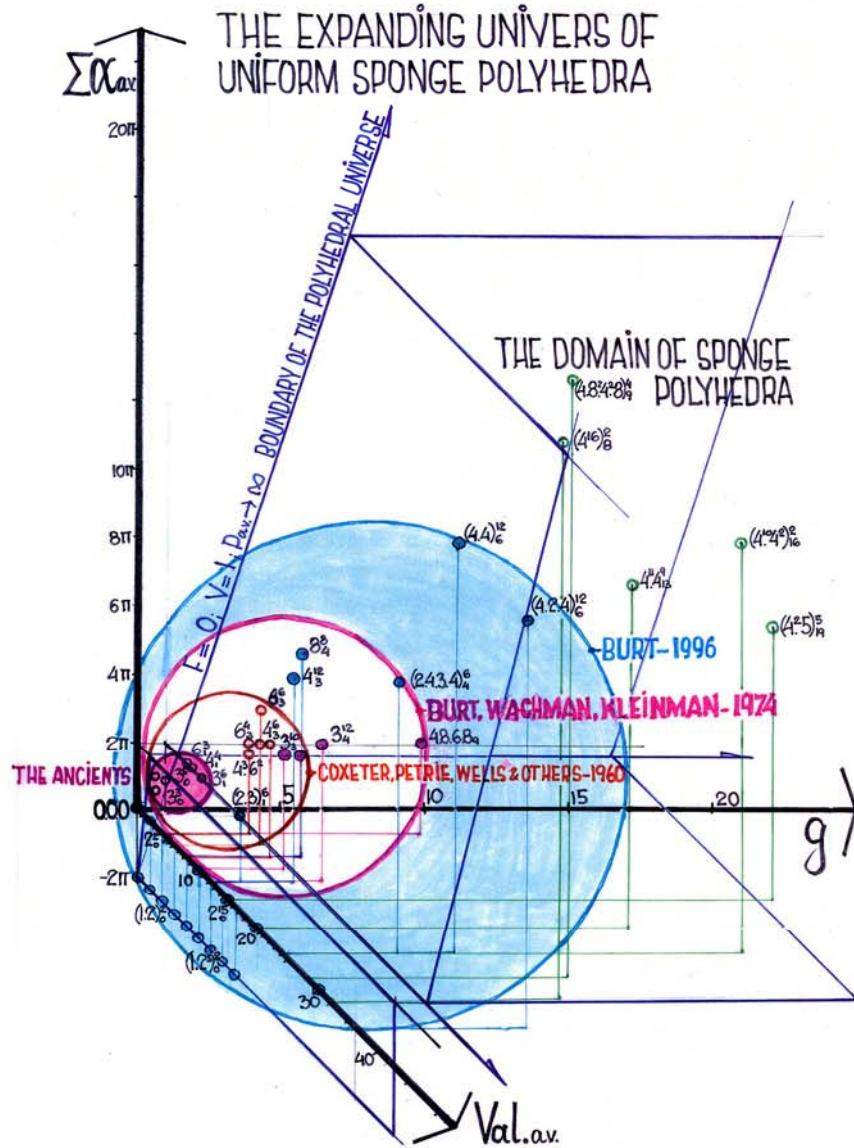
**449**  
 $g = 57$   
 $2g = 114$   
 $V_{in} = 96$   
 $E_{in} = 420$   
 $F_{in} = 210$

**449**  
 $g = 64$   
 $2g = 128$   
 $V_{in} = 96$   
 $E_{in} = 480$   
 $F_{in} = 240$

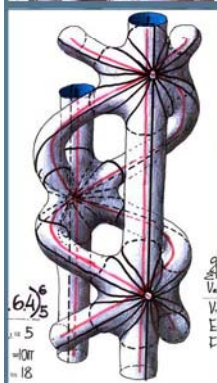
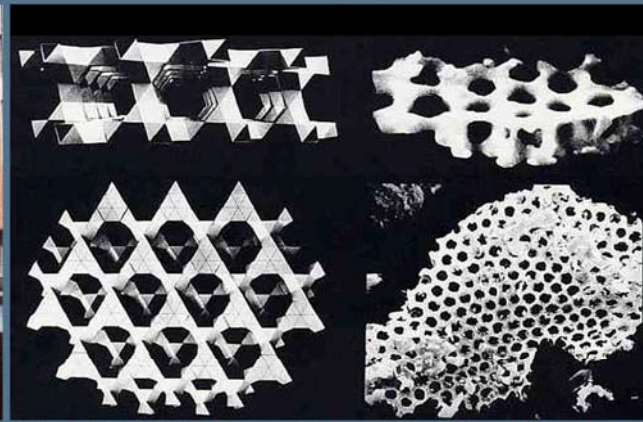
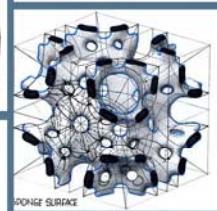
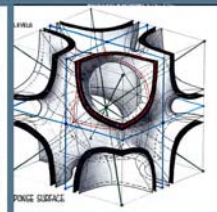
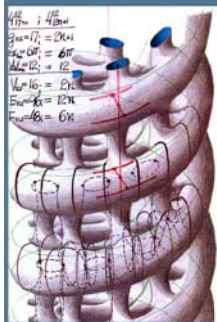
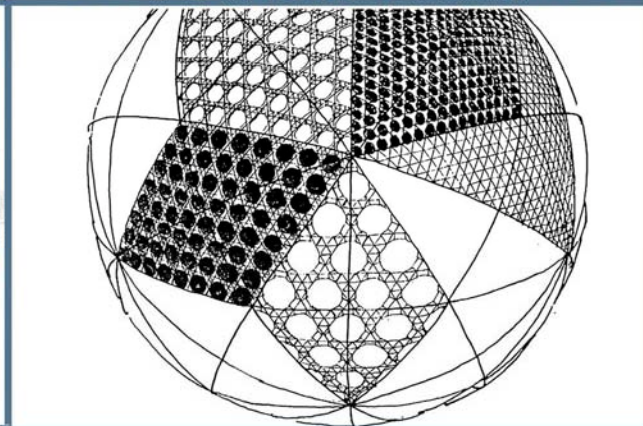
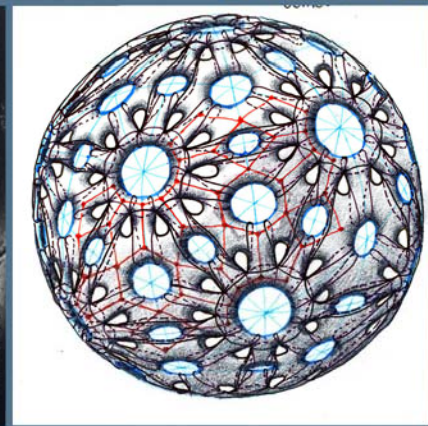
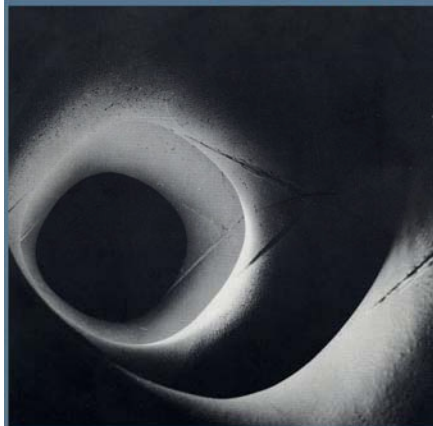
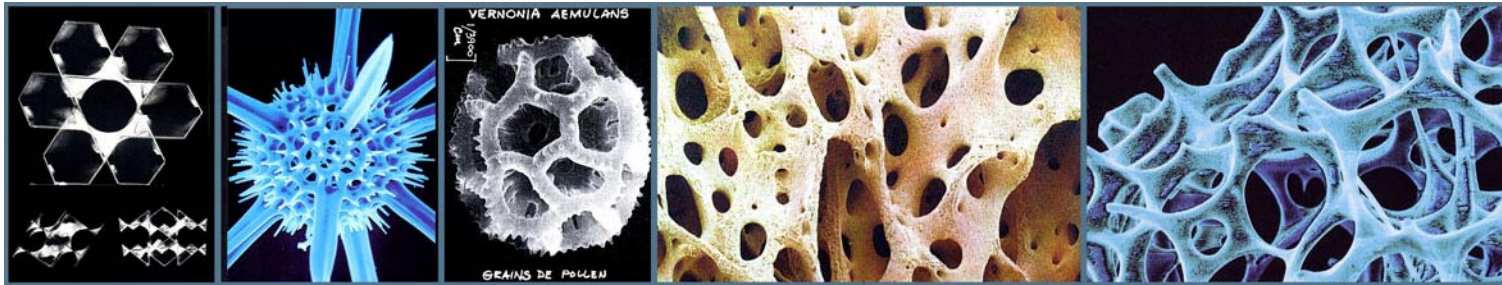
LATTICE-A      LATTICE-B

$g = T - N + 1 = H + P_{g,n} - 1$   
 $g_1 = 8(3 + 6n - 1 - 6n) - 1 = 29$   
 $g_2 = 8(3 + 3n - 2n) - 1 = 29$   
 $g_3 = 11 - 2(2n - 1) = 38 - 4n - 29$   
 (WITH  $g, T, H, N, P_{g,n}$  WHICH STAND FOR GENUS, LINKS, NODES, HOLES & GENUS OF THE GENETIC SURFACE, RESPECTIVELY.)

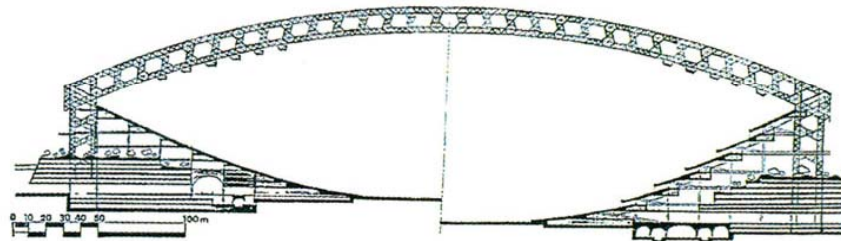
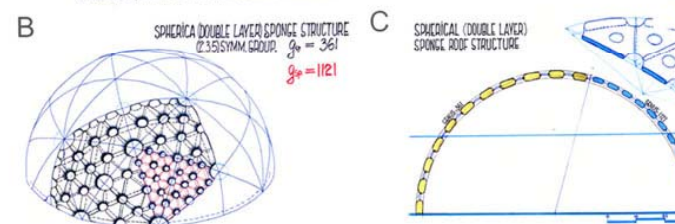
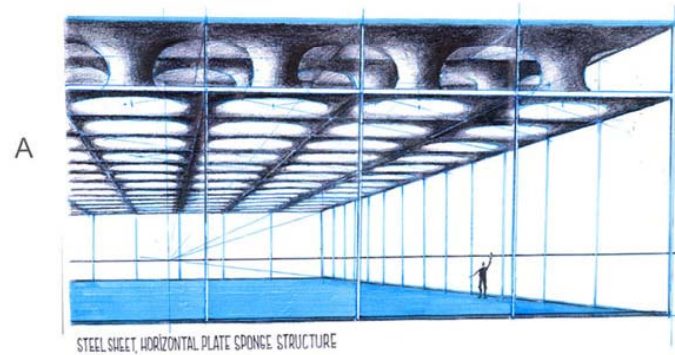
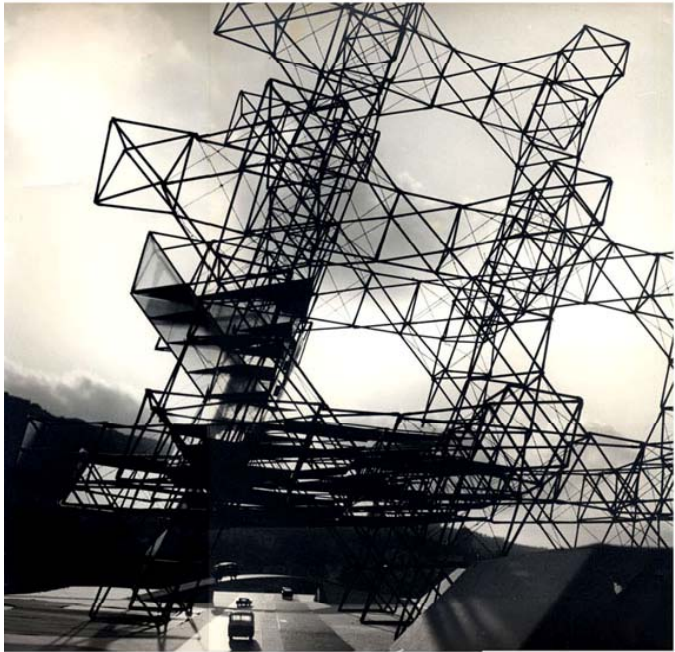
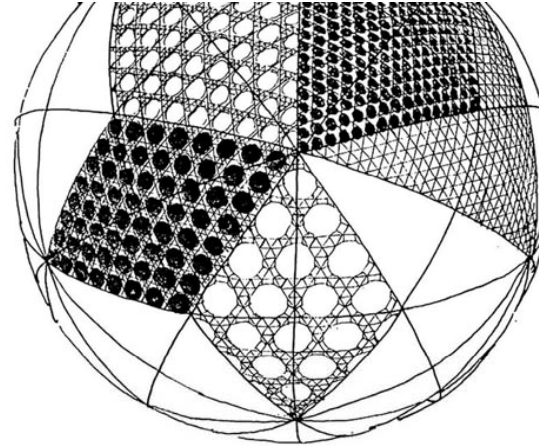
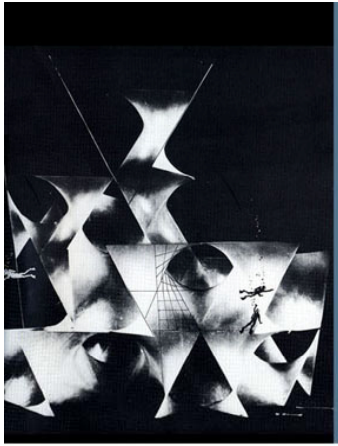
PERIODIC SPONGE POLYHEDRON SUBDIVIDING SPACE BETWEEN TWO DUAL LATTICES.











J

**Any significant venture into the field of periodic sponge surfaces and polyhedra dictates a systematic exploration of the uniform space lattice domain.**

It came as a shocking surprise to realize that in spite of the great efforts of the last three centuries or so, in the exploration of the structure of matter and space (crystallography included), **no systematic effort was committed to exhaustively explore the network domain in the "abstract realm of the theoretically imaginable".**

E

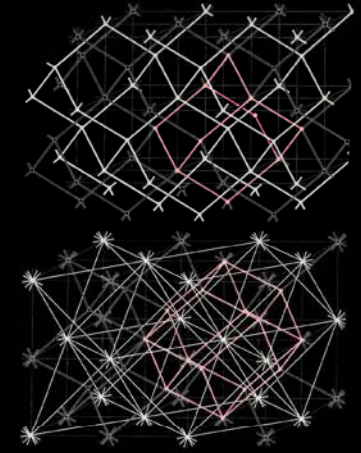
**All networks come in dual pairs.** Each network is uniquely determined by, and is a reciprocal of its dual (complementary) companion.

**-Every dual pair of networks is associated with a continuous hyperbolical sponge surface** which subdivides the space between the two, into two complementary sub-spaces.

This **trinity of the dual pair and the associated-reciprocal sponge surface** is the most conspicuous, all pervading geometric-topological phenomenon of our 3-D space, associated with its order and organization and more than anything else determines the way we perceive and comprehend its structure

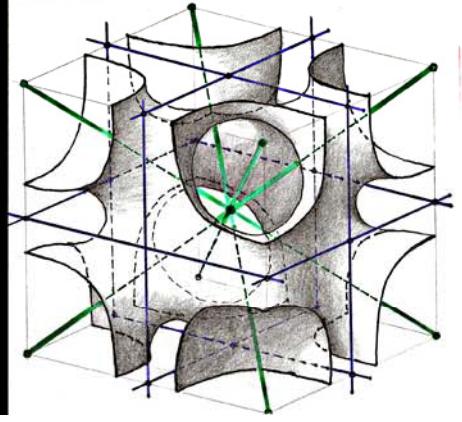


TRINITY OF THE DUAL NETWORKS  
PAIR AND THE PARTITION SURFACE

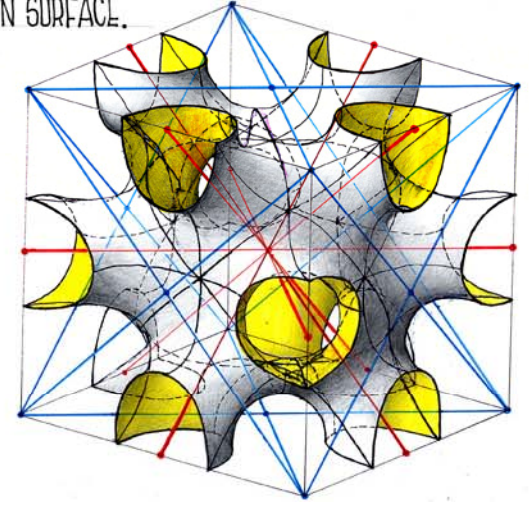


UNIFORM TETRAVALENT DIAMOND LATTICE AND  
UNIFORM DODECAVALENT OCTET LATTICE AND DUALS.

THE TRINITY: TWO DUAL-COMPLEMENTARY  
NETWORKS AND THE RECIPROCAL SURFACE-  
PARTITION, SUBDIVIDING THE SPACE BETWEEN  
THE TWO.



THE TRINITY OF THE DUAL PAIR OF NETWORKS AND THE ASSOCIATED  
PARTITION SURFACE.

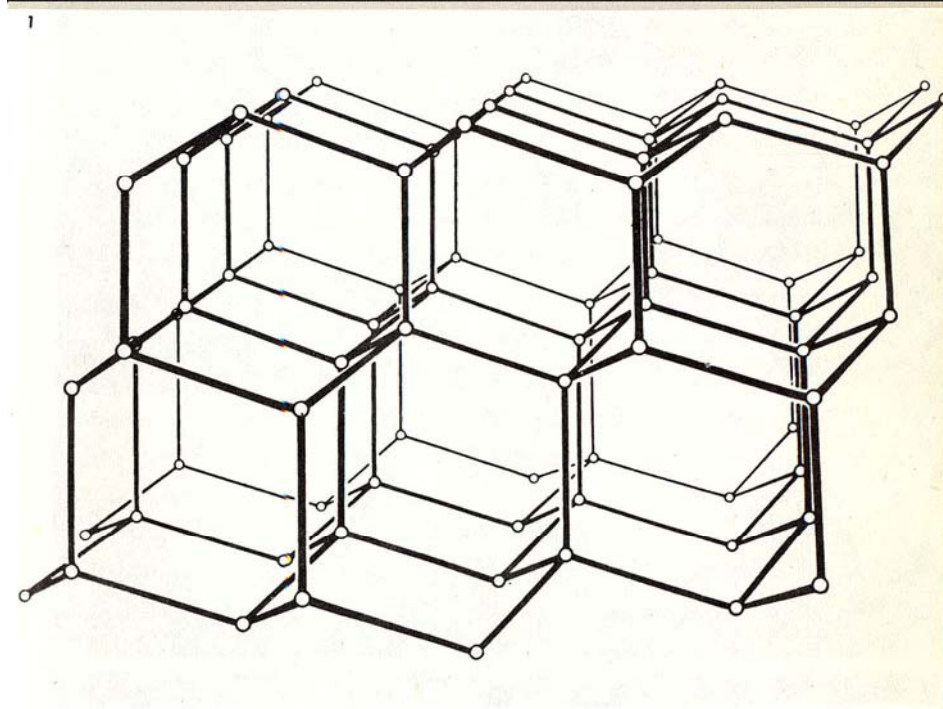
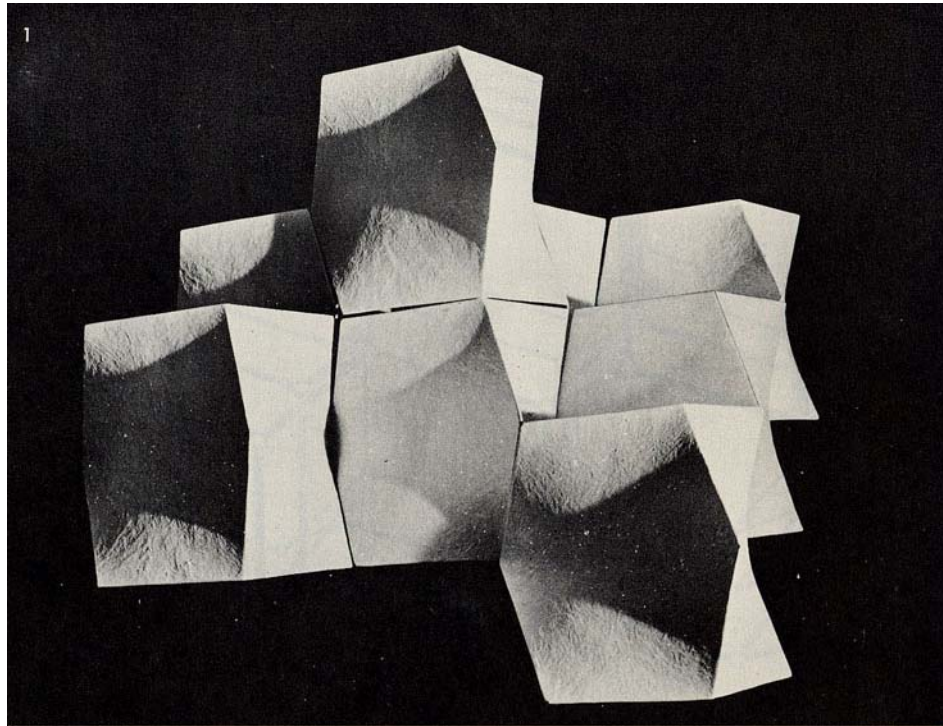


A periodic ordered space network may be generated through one of the following processes

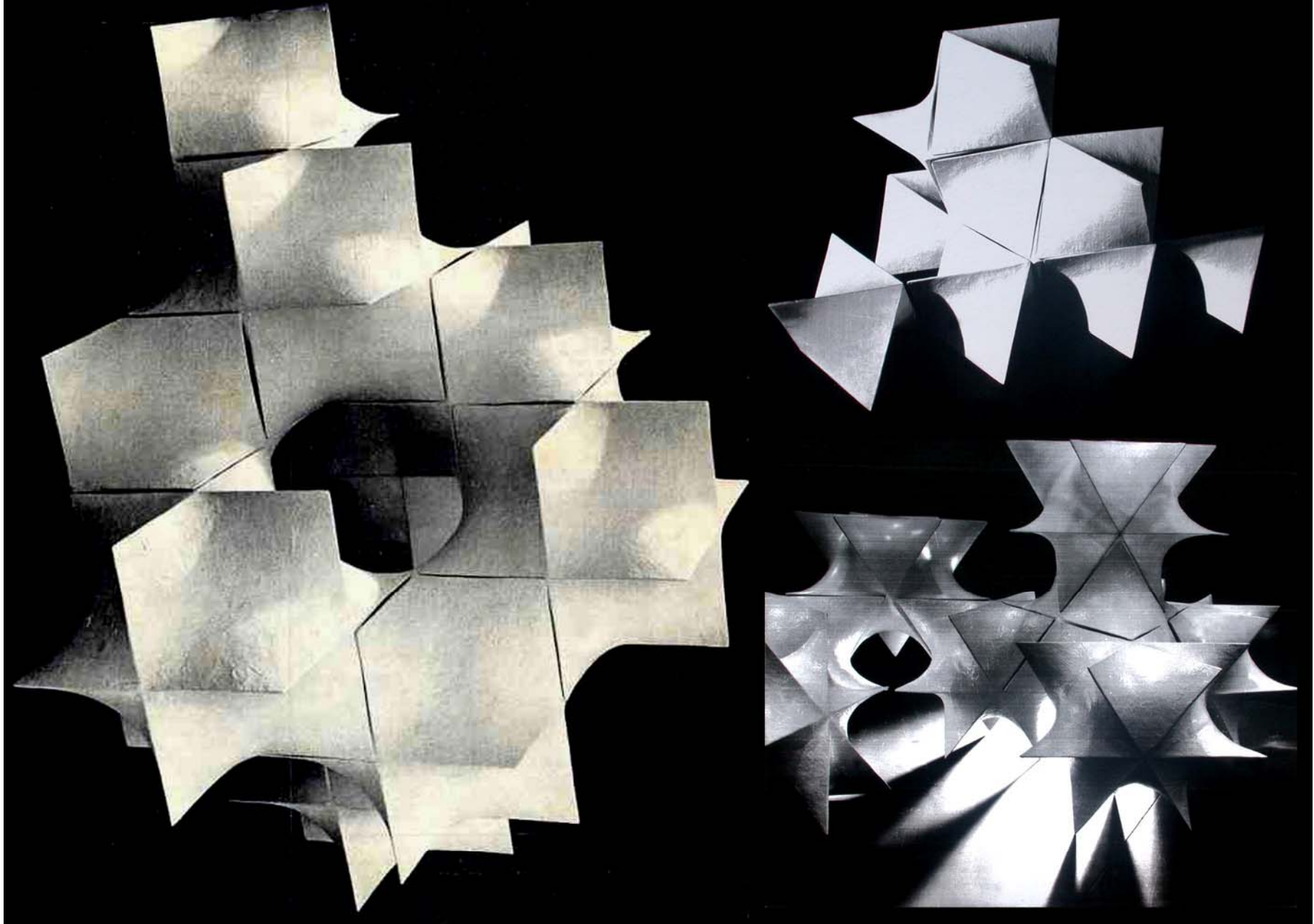
-By an extended repetition of a locally and globally symmetrical association of vertex figures.

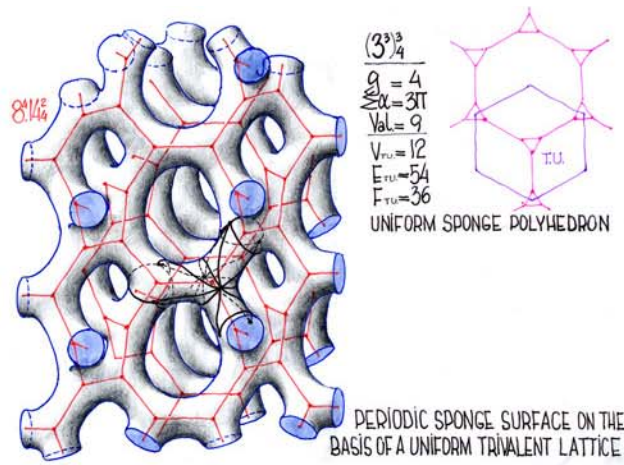
-As a result of a close (compact) packing of polyhedral cells, the vertex-edge array of which combine to form the network.

-As a result of a tessellation process of an unbounded periodic (2d-manifold) surface, spherical, toroidal or hyperbolic, leading eventually to a connected 3-D network.

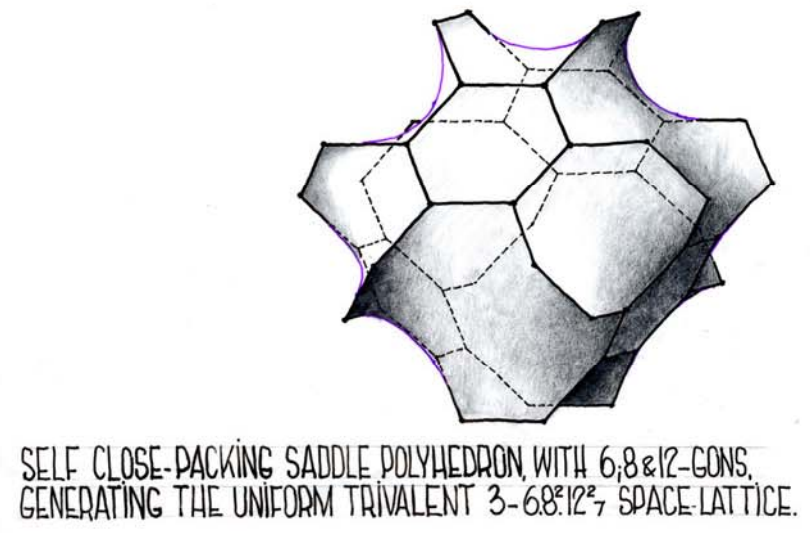
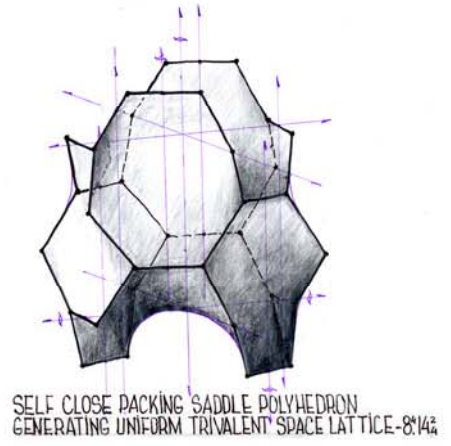
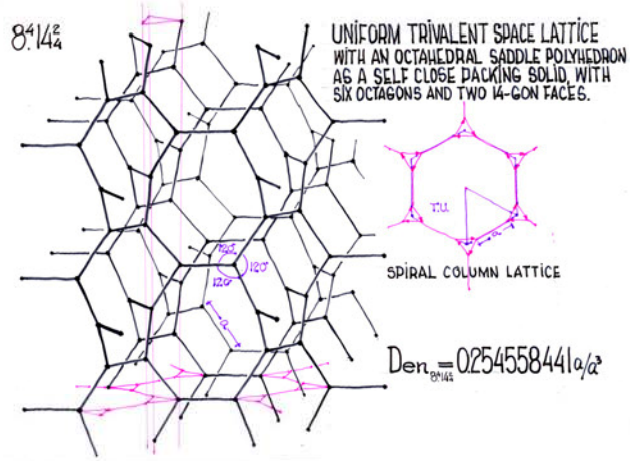
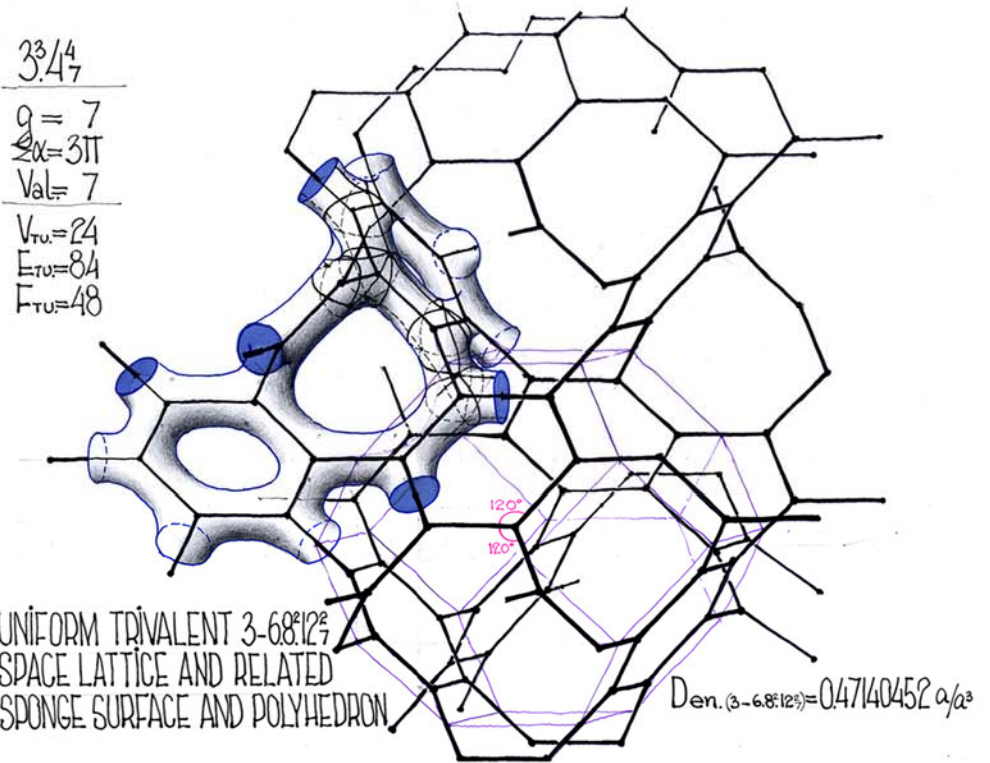




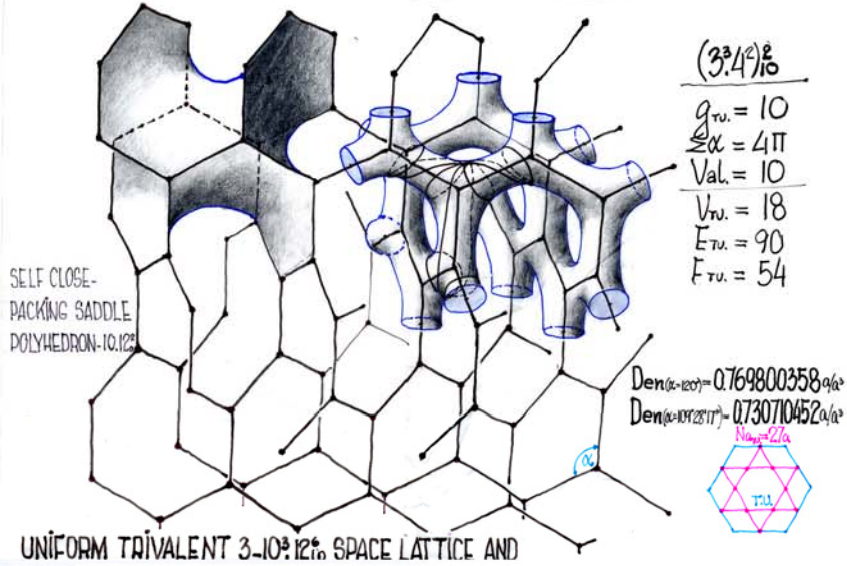




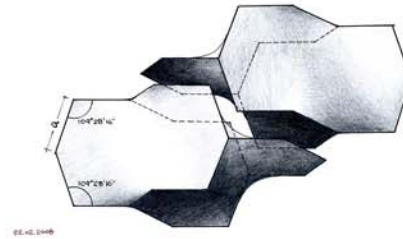
$3^3/4^7$   
 $q = 7$   
 $\Sigma\alpha = 3T$   
 $Val = 7$   
 $V_{TU} = 24$   
 $E_{TU} = 84$   
 $F_{TU} = 48$



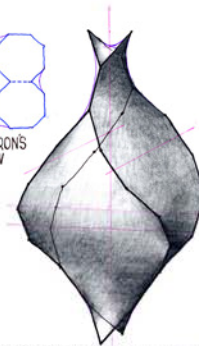
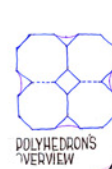
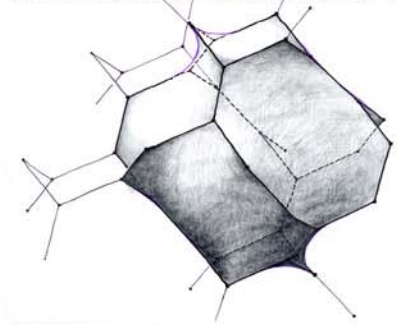




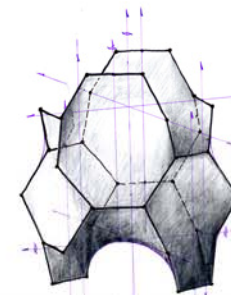
DECA-TETRAHEDRON, A SELF CLOSE-PACKING SADDLE-POLYHEDRON GENERATING THE UNIFORM TRIVALENT SPACE LATTICE-10%.



SELF CLOSE-PACKING SADDLE-POLYHEDRON GENERATING UNIFORM TRIVALENT LATTICE- 6.10%

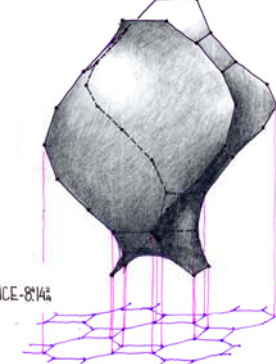


SELF CLOSE-PACKING SADDLE-POLYHEDRON GENERATING UNIFORM TRIVALENT LATTICE-4%.

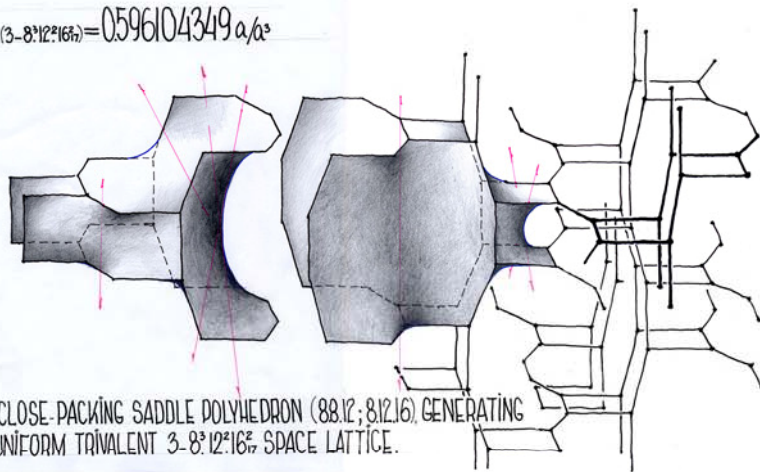


SELF CLOSE-PACKING SADDLE-POLYHEDRON GENERATING UNIFORM TRIVALENT SPACE LATTICE-8%.

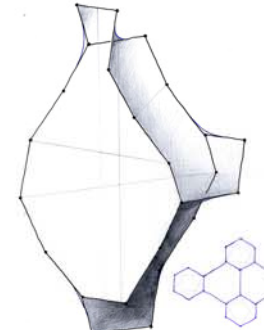
SELF CLOSE-PACKING SADDLE-POLYHEDRON GENERATING UNIFORM TRIVALENT LATTICE-48.6%



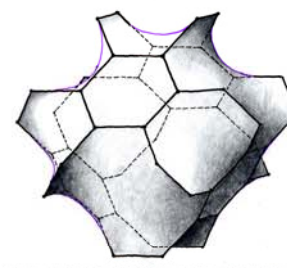
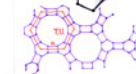
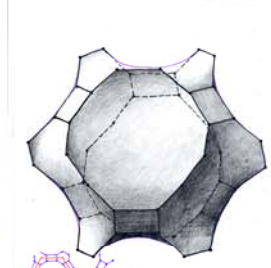
Den<sub>(3-8°12'16")</sub> = 0.596104349 a/a<sup>3</sup>



SELF CLOSE-PACKING SADDLE-POLYHEDRON GENERATING UNIFORM TRIVALENT LATTICE - THE 40%

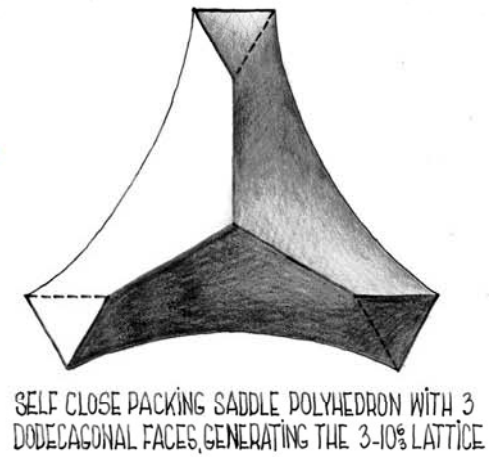
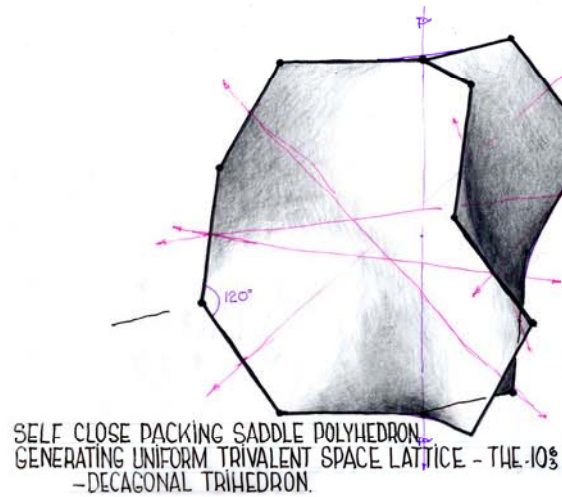
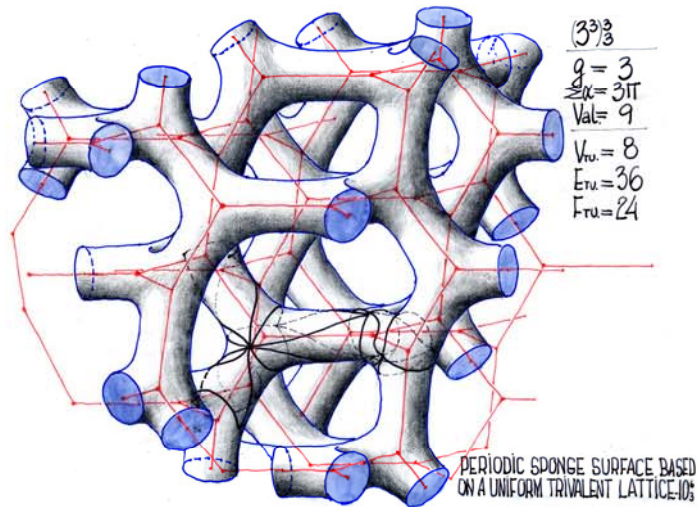
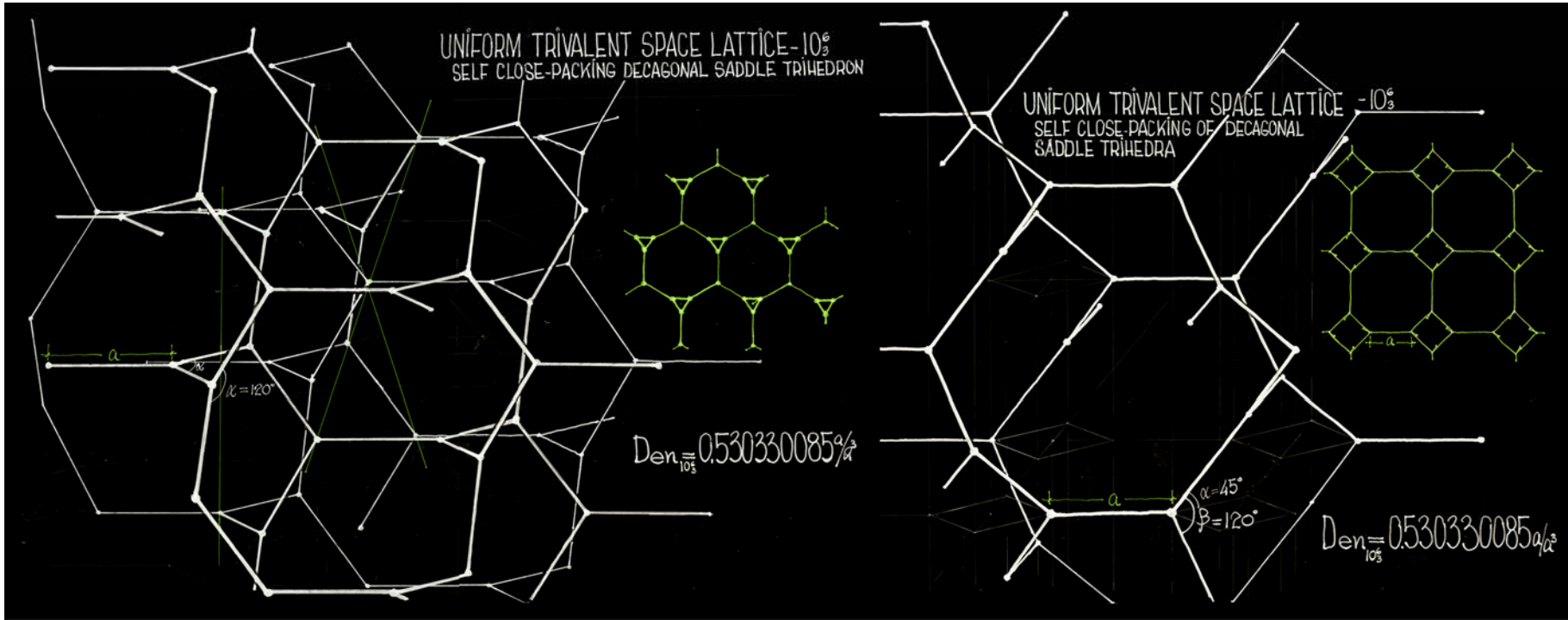


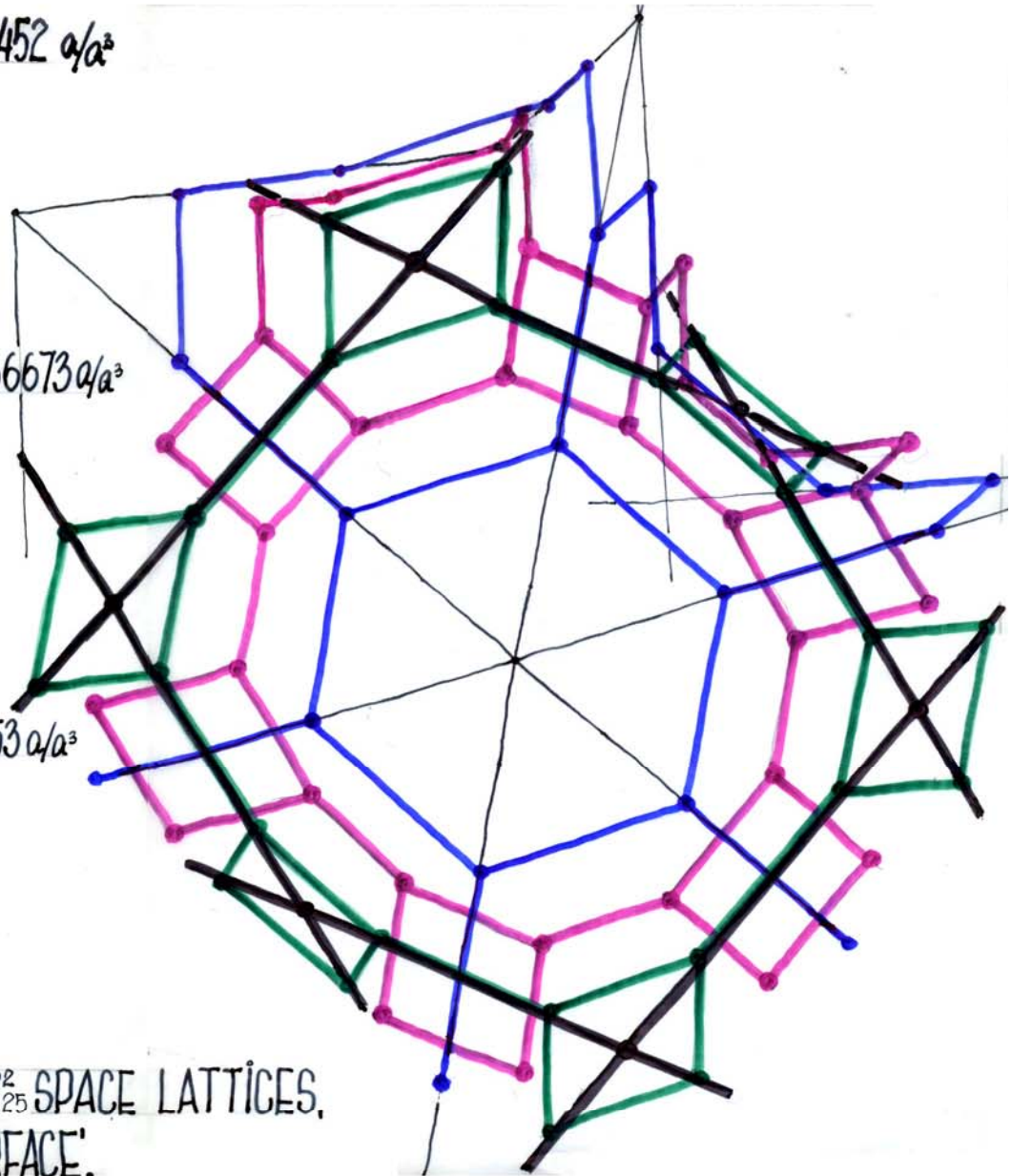
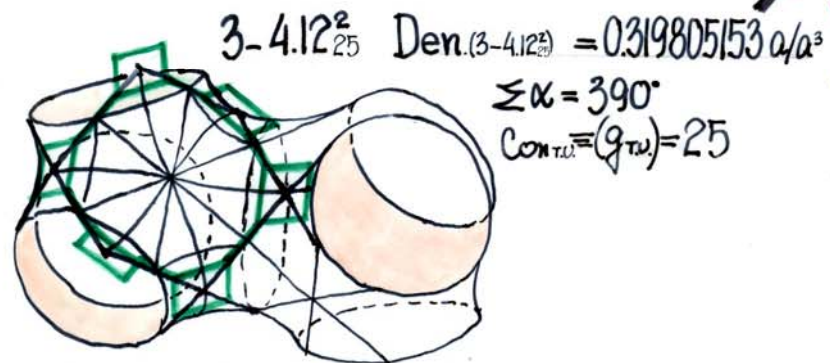
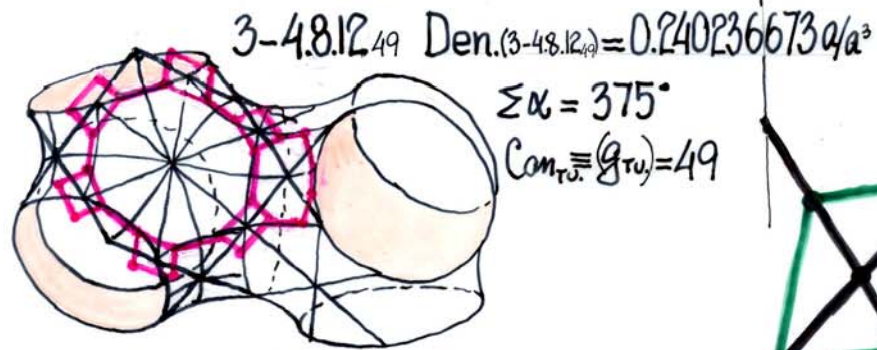
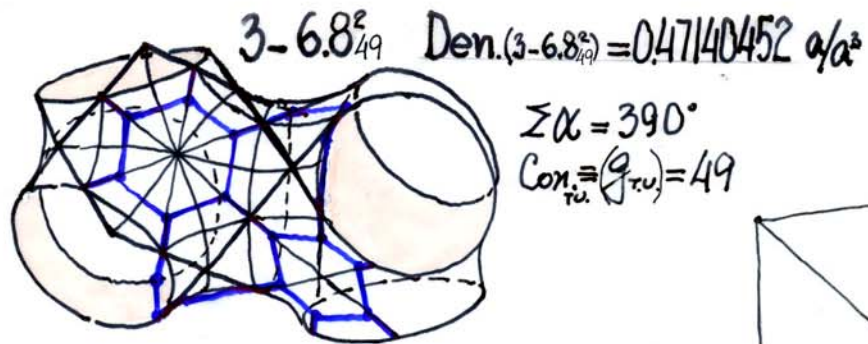
SELF CLOSE-PACKING SADDLE POLYHEDRON GENERATING THE UNIFORM TRIVALENT 3-12% SPACE LATTICE.



SELF CLOSE-PACKING SADDLE POLYHEDRON WITH 6,8 & 12-GONS, UNIFORM TRIVALENT 3-68°12% SPACE LATTICE.







UNIFORM TRIVALENT  $3-6.8_{49}^2$ ;  $3-4.8.12_{49}$ ;  $3-4.12_{25}^2$  SPACE LATTICES,  
 ALL TESSELLATIONS OF THE 'DIAMOND SURFACE'.

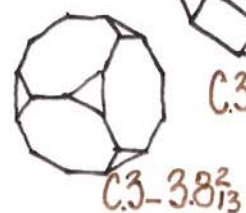
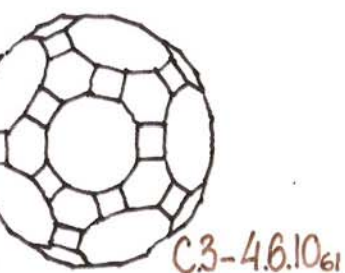
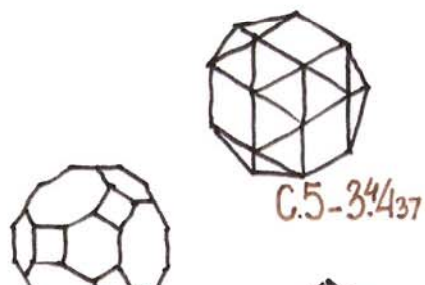
G

The vertex figure characteristics (geometric-symmetrical and topological) of a given network, tightly correspond to the topological-symmetrical characteristics of the close-pack cells of it's dual. By proxy it may be stated that all constituents of a given 'trinity' (the dual networks pair and the associated sponge surface) act under the same topological – Symmetrical regime.

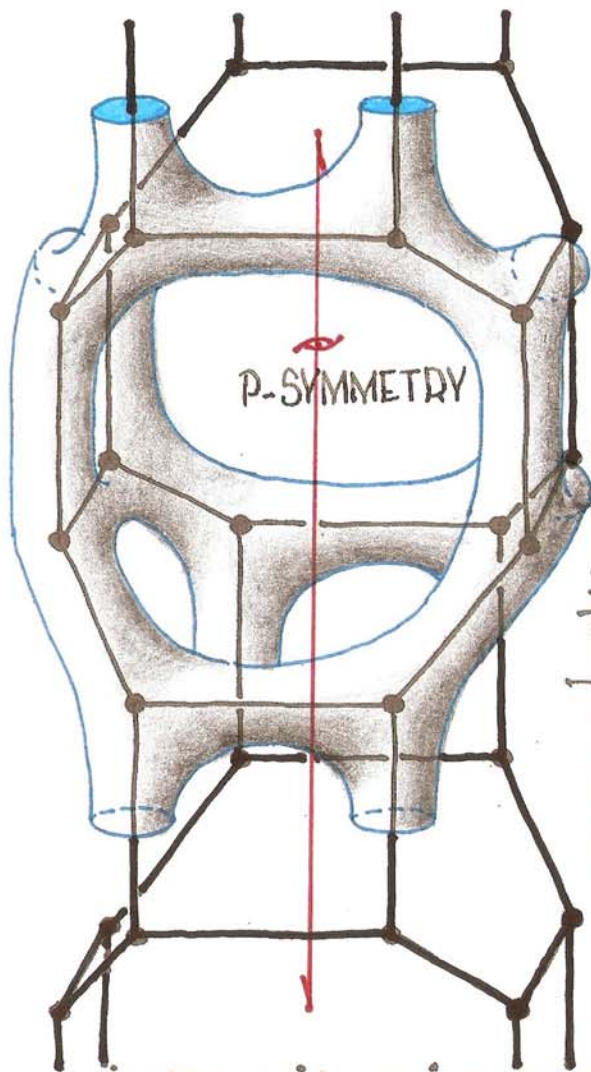
**-Connectivity value (C) of the two continuous dual network graphs is one and the same for both, and is the same as genus-(g) value of the associated sponge surface:**

**$C=L-N+1=g$**  (with L&N as the number of Line-edges and vertex-Nodes respectively)





UNIFORM CENTRAL NETWORKS THE VERTICES OF WHICH ARE EQUIDISTANT FROM A



$$\frac{(3 \cdot 4^2)^3}{2(n+1)}$$

$$g_{T.V.} = 4n+1$$

$$\sum x = 4n$$

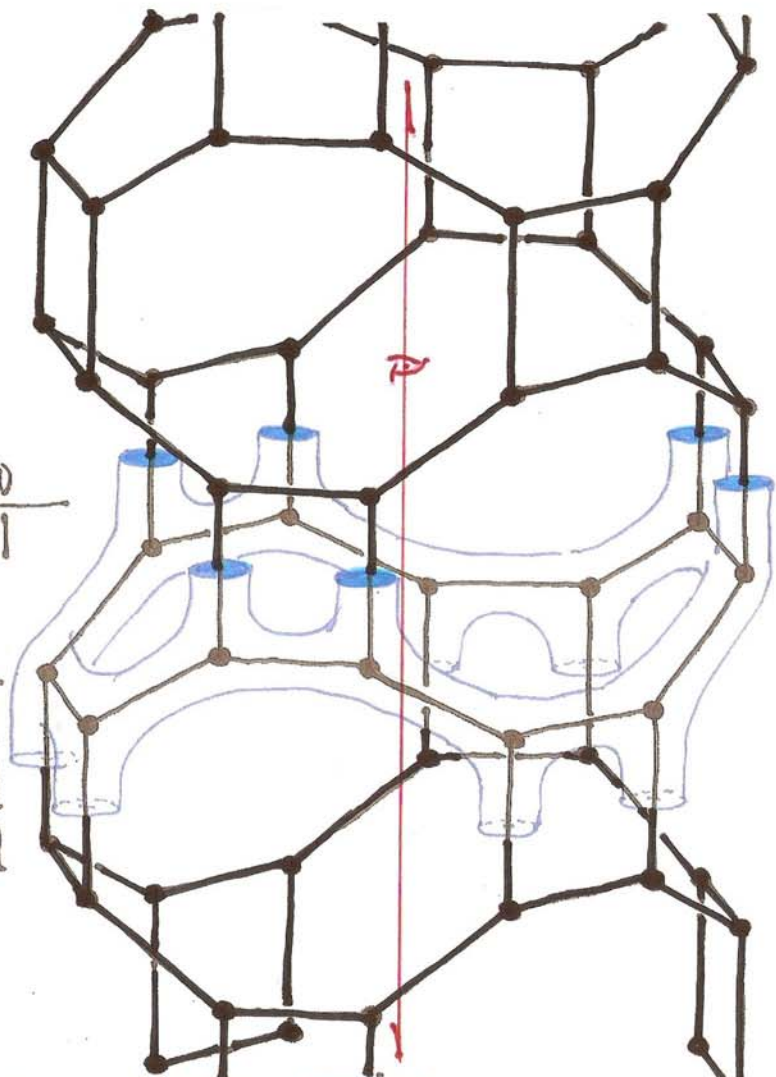
$$\text{Val.} = 9$$


---


$$V_{T.V.} = 8n$$

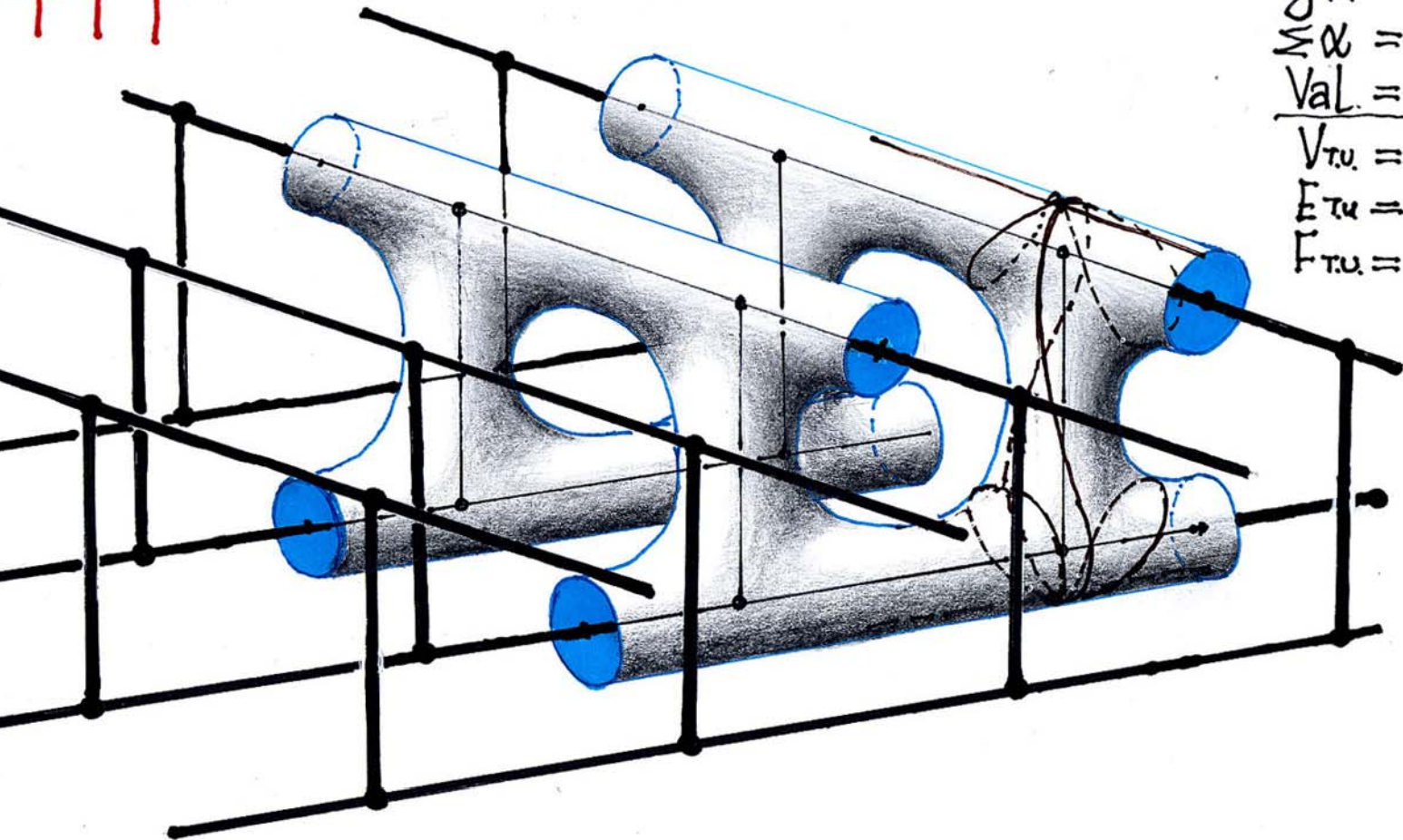
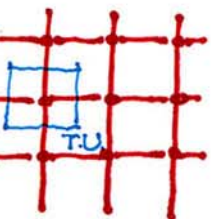
$$E_{T.V.} = 36n$$

$$F_{T.V.} = 20n$$



UNIFORM AXIAL TRIVALENT 10-10012

CRISTAL LATTICE



$$\frac{(4^2)_2^4}{g_{TU} = 2}$$

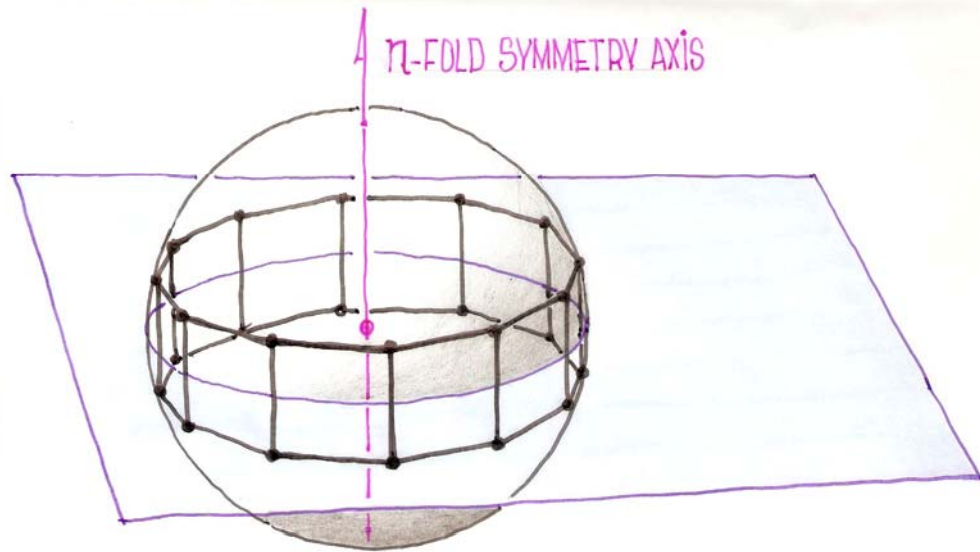
$$\frac{\sum \alpha = 4\pi}{Val. = 8}$$

$$\frac{V_{TU} = 2}{E_{TU} = 8}$$

$$F_{TU} = 4$$

FORM DOUBLE LAYERED TRIVALENT B<sub>2</sub> O<sub>2</sub> SPACE LATTICE AND THE





CAD $n-2^{n-1}$

1.



POLYDIGONS

CAD $3-4^2n+1$

2.



ALL VERTICES OF THE BAND NETWORKS ARE EQUIDISTANT FROM A FIXED CENTRE-POINT, AXIS AND A PLANE SURFACE.

CAD $4-3^3n+1$

3.



CAD $2-4n$

4.



CAD $2-2n$

5.



THE CAD CATEGORY GROUP INCLUDES INFINITE NUMBER OF MEMBERS.

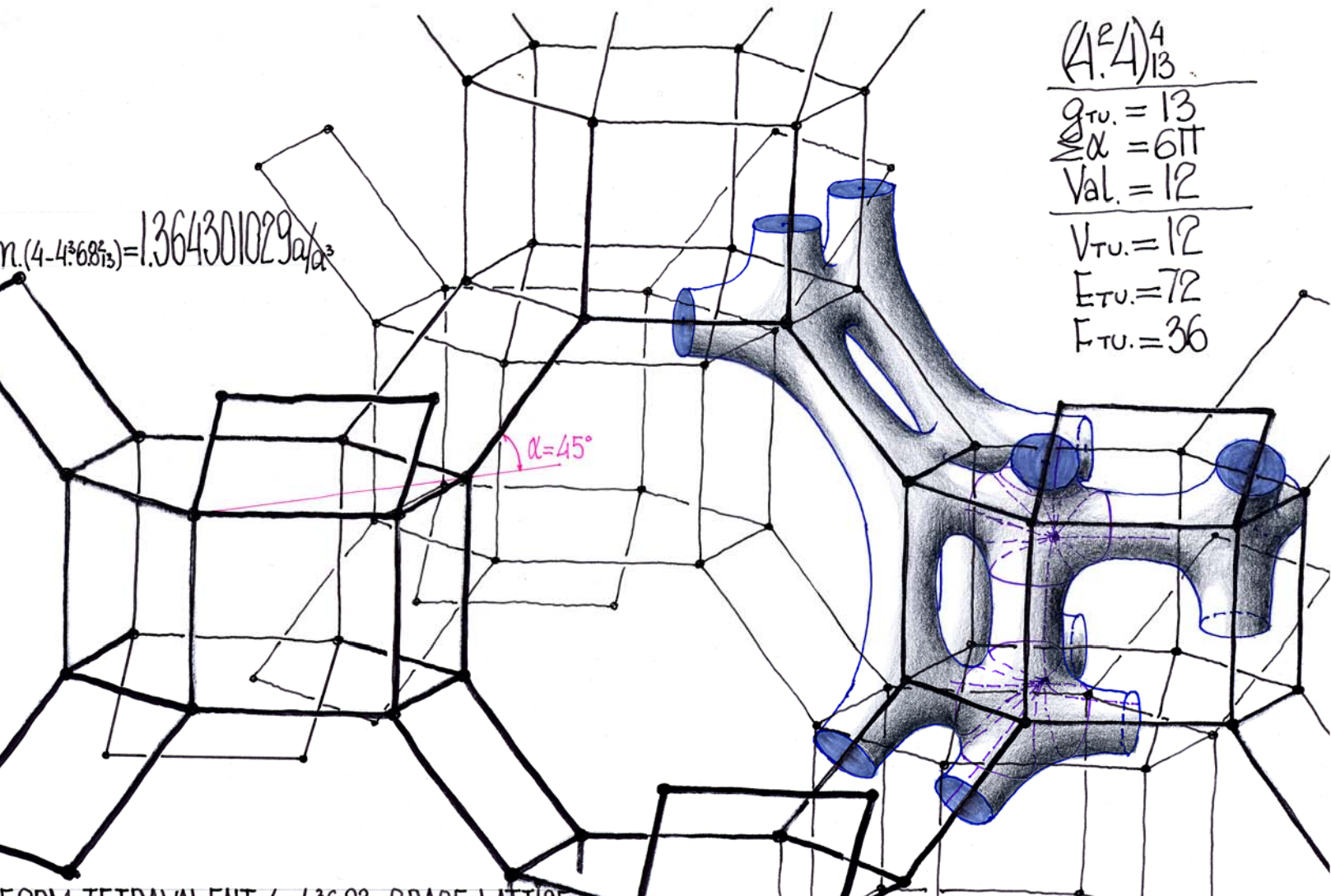
CAD $2-n$

6.



DISTINCTIVE GROUP OF PRIMITIVE UNIFORM BAND-

$$n \cdot (4 - 4 \cdot 6.85_{13}) = 1.364301029 a^3$$



$$(A^2 4)_{13}^4$$

$$g_{TU} = 13$$

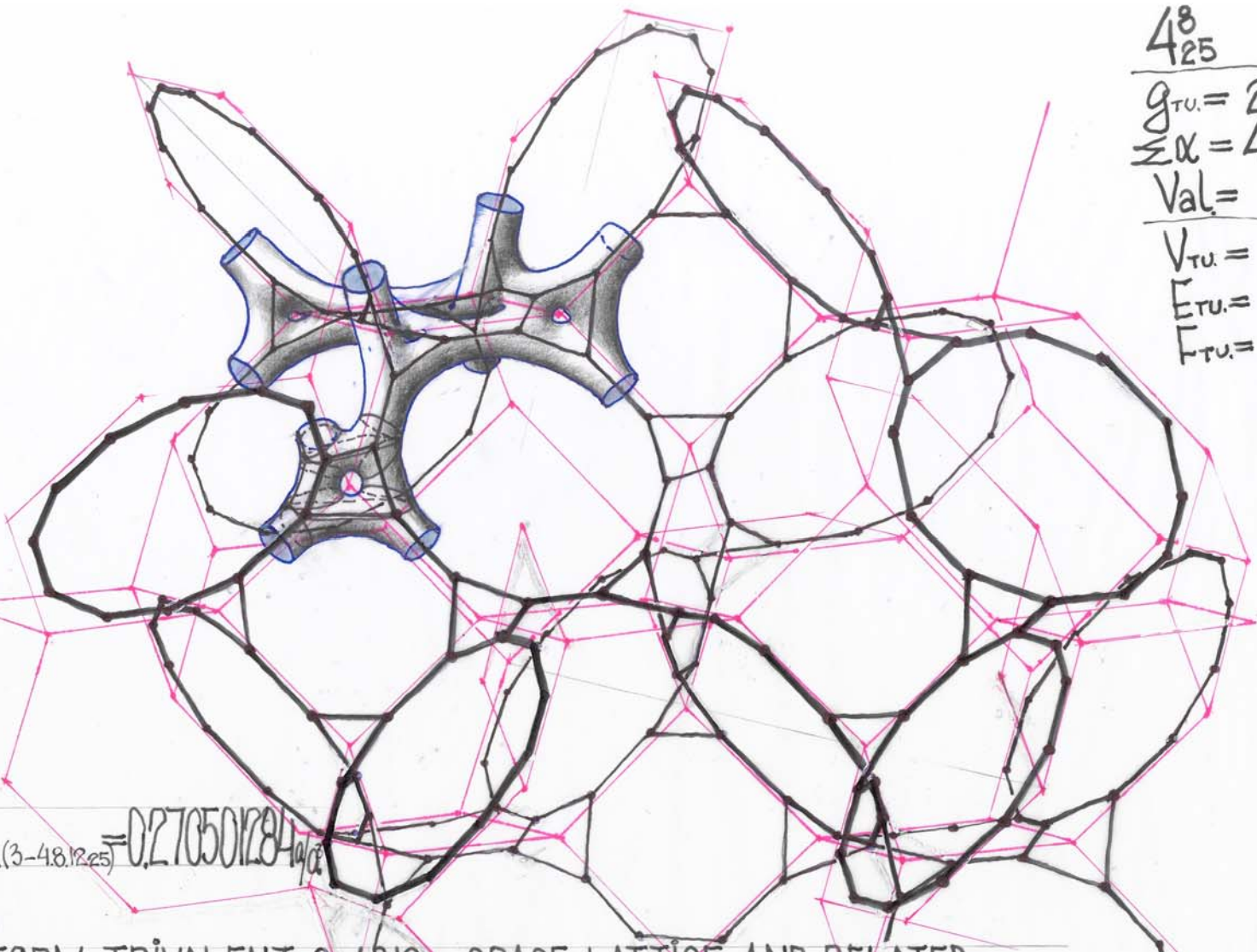
$$\sum \alpha = 6\pi$$

$$Val. = 12$$

$$V_{TU} = 12$$

$$E_{TU} = 72$$

$$F_{TU} = 36$$



$$\frac{48}{25}$$

$$g_{TU} = 25$$

$$\sum \alpha = 4\pi$$

$$\text{Val} = 8$$

$$V_{TU} = 48$$

$$E_{TU} = 192$$

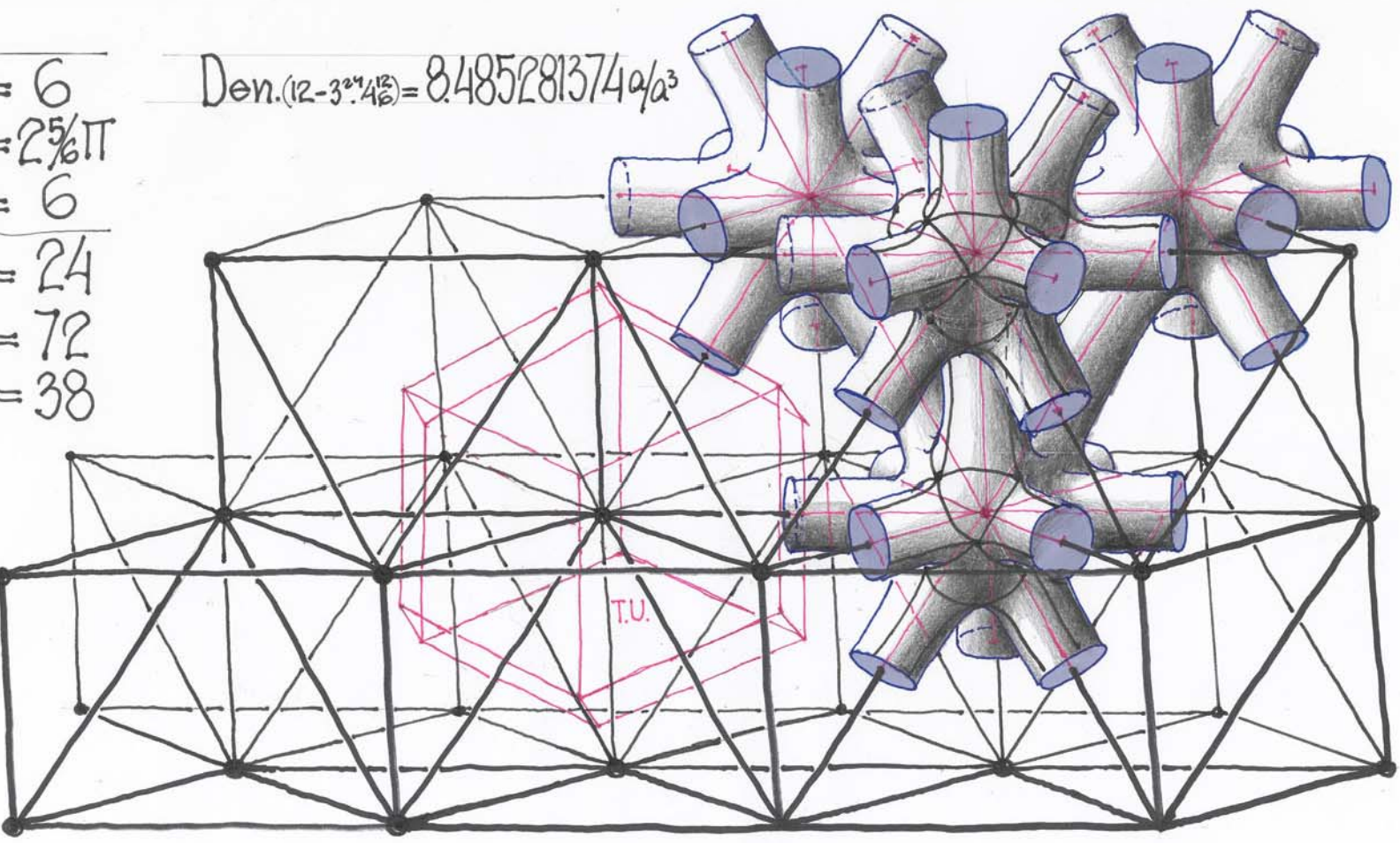
$$F_{TU} = 96$$

$$(3-4.8.12.25) = 0.270501284 \dots$$



= 6  
 =  $2\frac{5}{6}\pi$   
 = 6  
 = 24  
 = 72  
 = 38

Den.  $(12 - 3 \cdot 4 \frac{1}{2}) = 8.485281374 a/a^3$

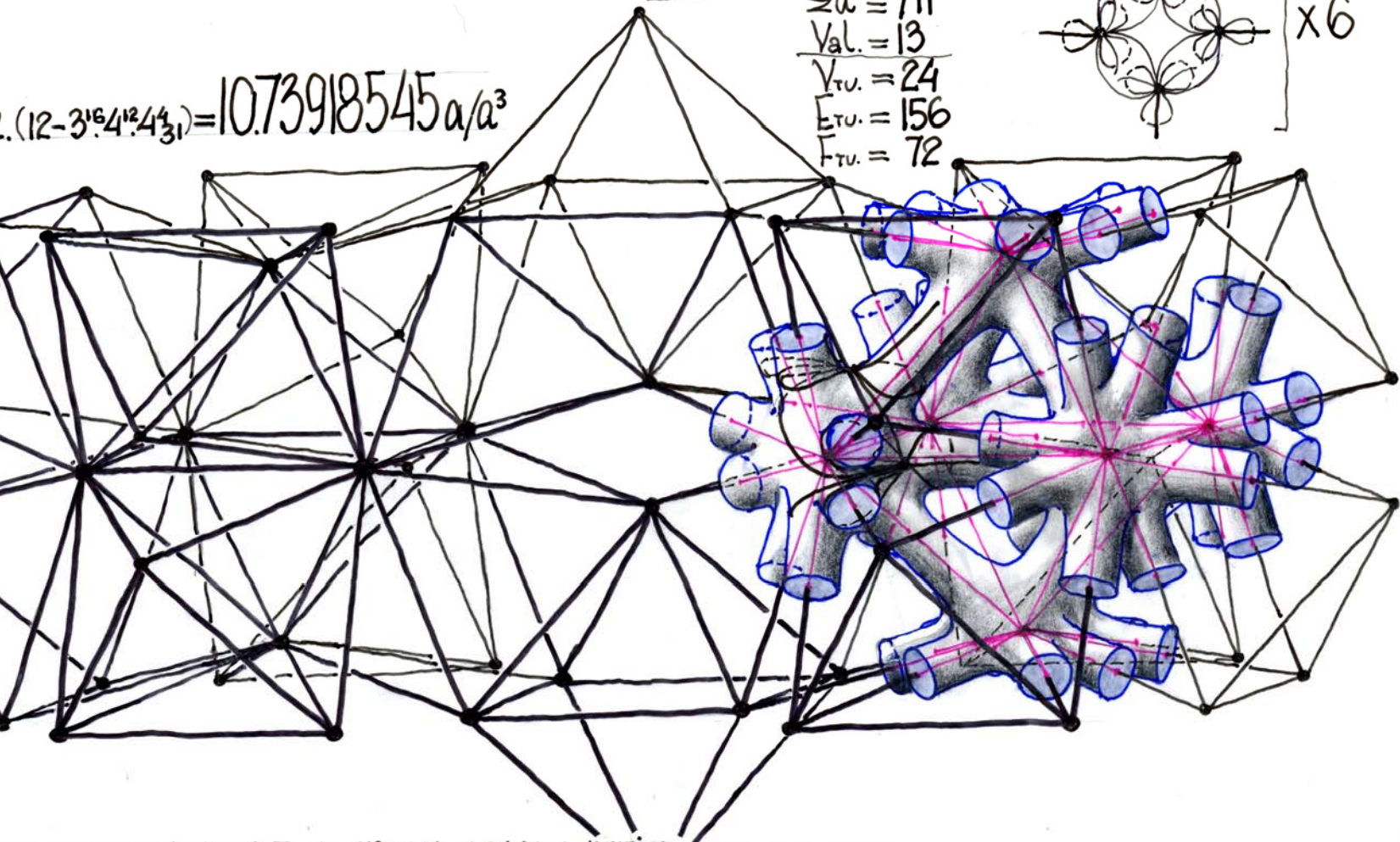
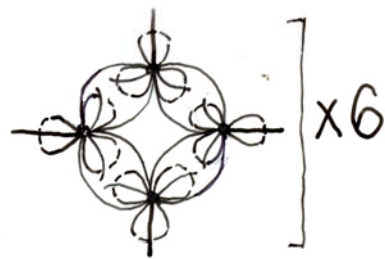


FORM REPRESENTATIVE IS 2% 1/2 SPACE LATTICE (NOTET LATTICE)

$$\dots(12 \cdot 3^6 \cdot 4^2 \cdot 4^2 \cdot 3_1) = 10.73918545 a/a^3$$

4<sup>20</sup>.4<sup>98</sup>  
4.8.4.831

$g_{TU} = 31$   
 $\Sigma \alpha = 7\pi$   
 $Val. = 13$   
 $V_{TU} = 24$   
 $E_{TU} = 156$   
 $F_{TU} = 72$



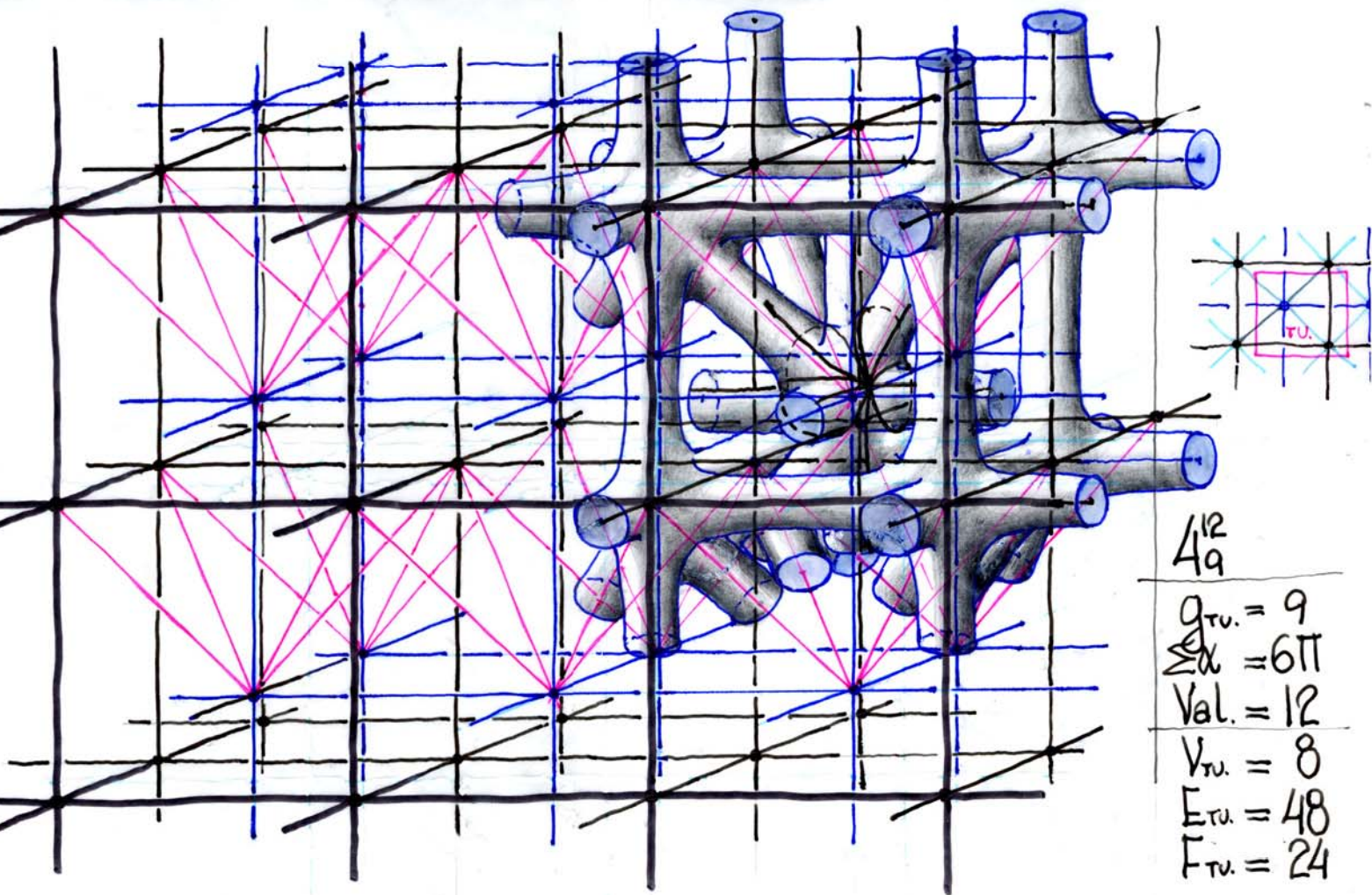
P

**Uniform Dodecavalent and higher valency Space Lattices or: how far valency and spatial density values can go.**

Uniform dodecavalent 'octet' based space lattices exist in more than one topological version, but all come to same spatial density of **8,485281374**  $/a^3$ .

The infinite sponge polyhedron  $3^{12}_4$  gives rise to a uniform dodecavalent **(12-3<sup>12</sup>.4<sup>20</sup><sub>31</sub>)** space lattice, the density of which is **10,73918545a/a<sup>3</sup> (!)**





$$\frac{4^{12}}{4^9}$$

$$q_{TU} = 9$$

$$\sum \alpha = 6\pi$$

$$Val. = 12$$

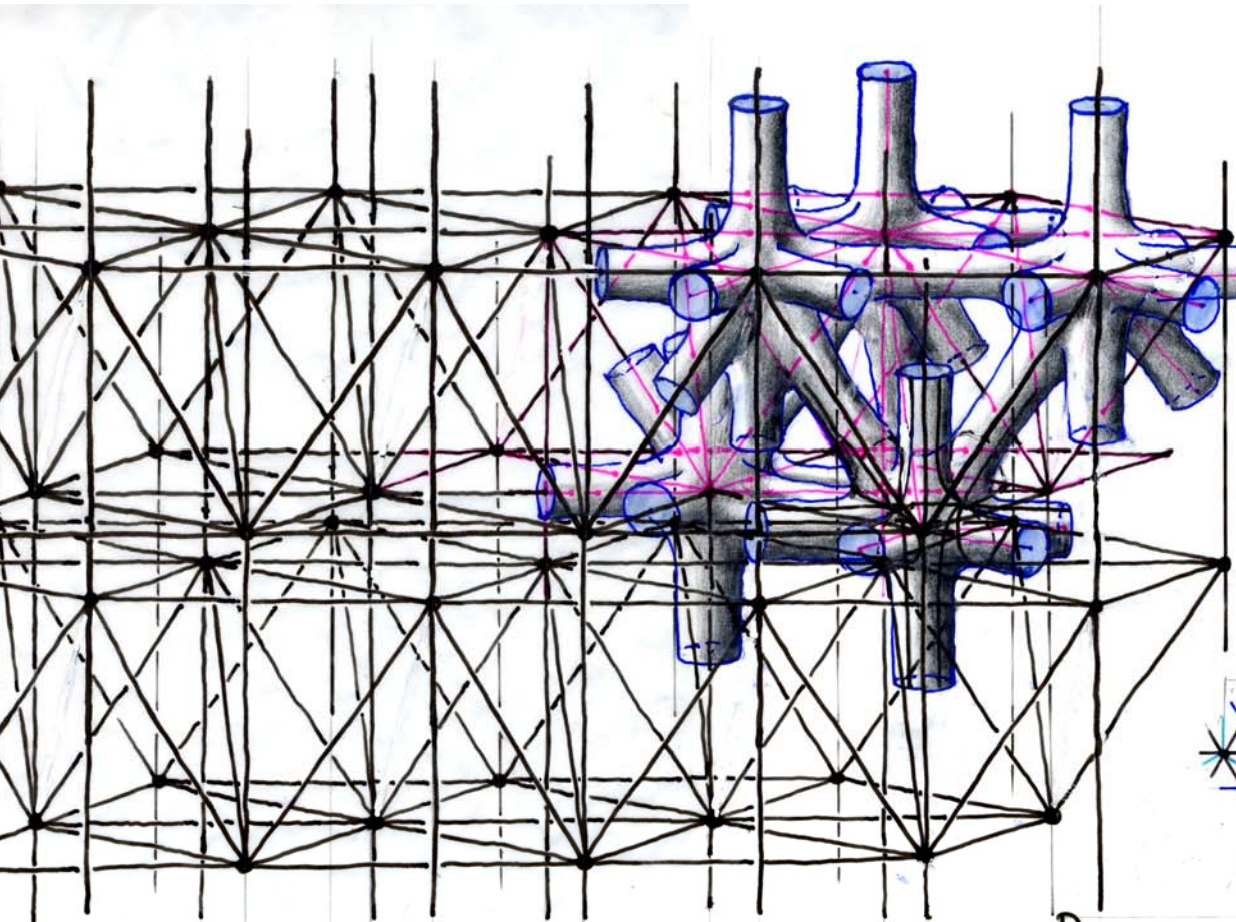
$$V_{TU} = 8$$

$$E_{TU} = 48$$

$$F_{TU} = 24$$

PM DECAVALENT  $10-3^{12}4^{12}$  SPACE LATTICE

Don't  $10-3^{12}4^{12}$  - 1000000/3



$$\frac{4^{10}}{10}$$


---


$$g_{TU} = 10$$

$$\sum \alpha = 5\pi$$

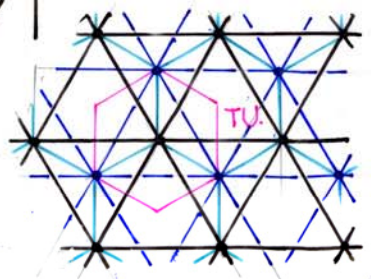
$$Val. = 10$$


---


$$V_{TU} = 12$$

$$E_{TU} = 60$$

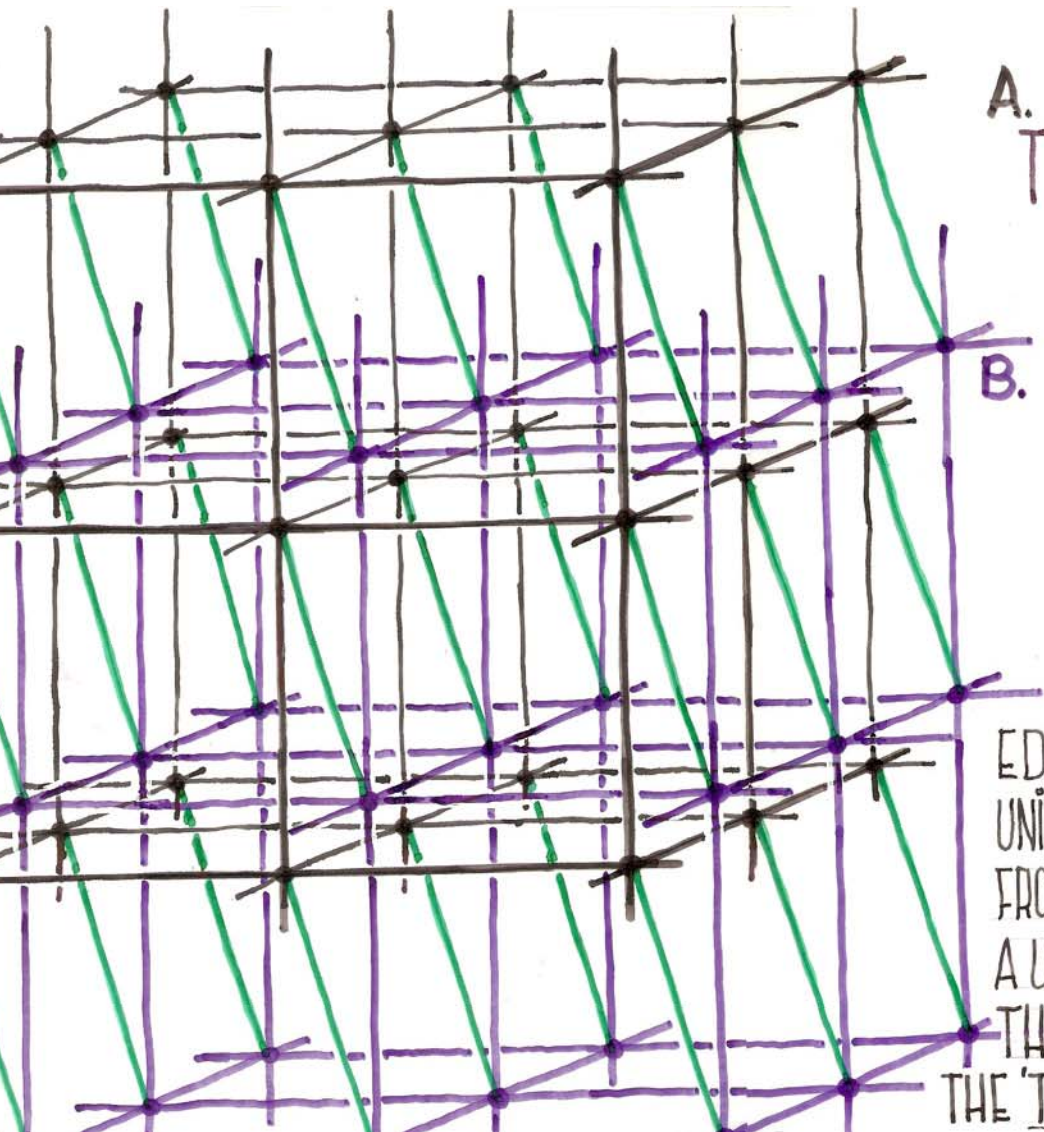
$$F_{TU} = 30$$



$$Den. (11-3^{15}4^{18}) = 12.70170592 a/a^3$$

M 11-VALENT 11-3<sup>15</sup>4<sup>18</sup> SPACE LATTICE



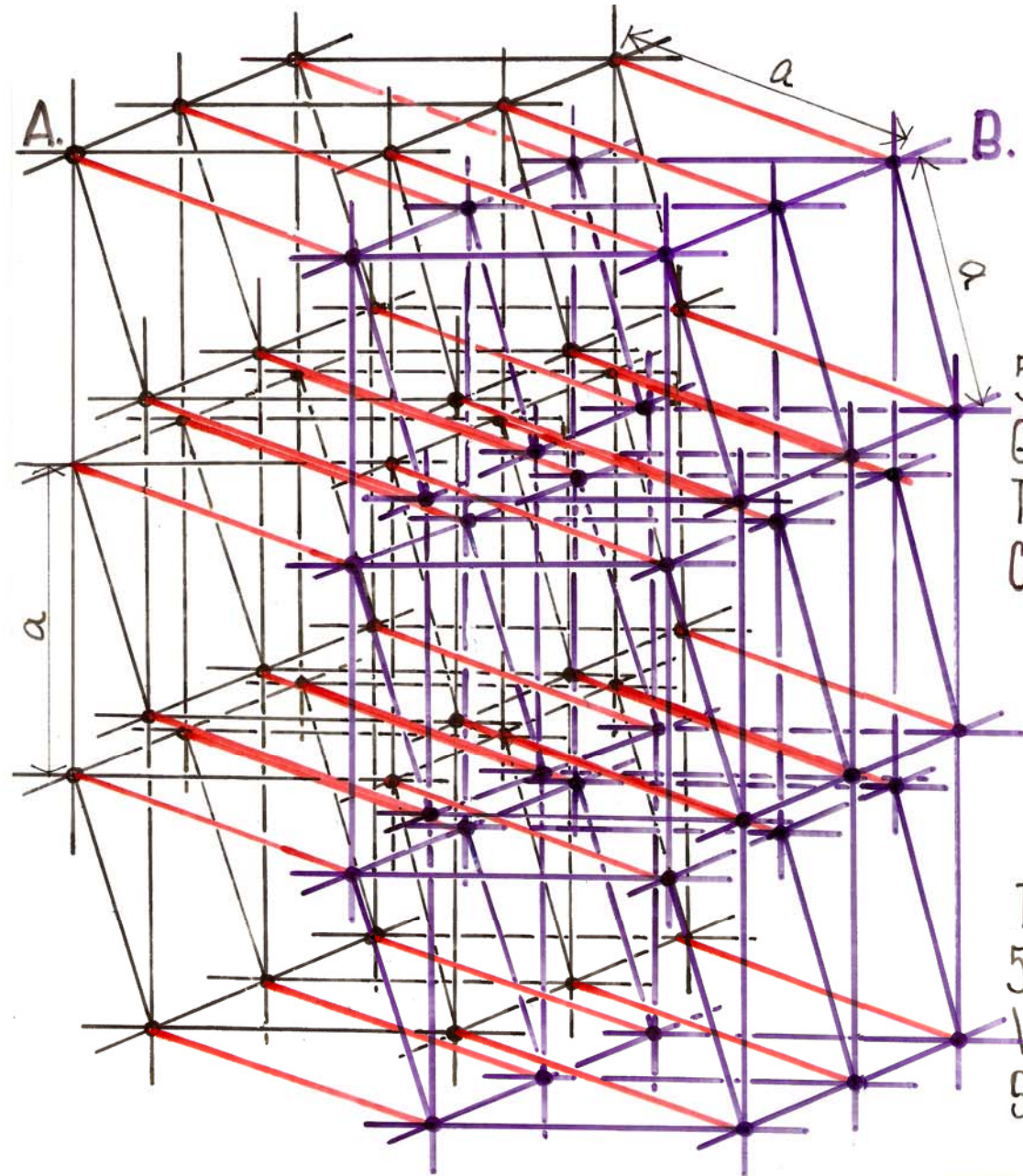


A.  
TRANSLATION NETWORKS

B.

EDGE-LENGTH TRANSLATION OF A  
UNIFORM HEXAVALENT (CUBIC) LATTICE  
FROM A-TO B-POSITION, RESULTING IN  
A UNIFORM SEPTAVALENT LATTICE,  
THE DENSITY OF WHICH IS  $7.00 a/a^3$   
THE 'TRANSLATION LATTICE' IS A 3-D





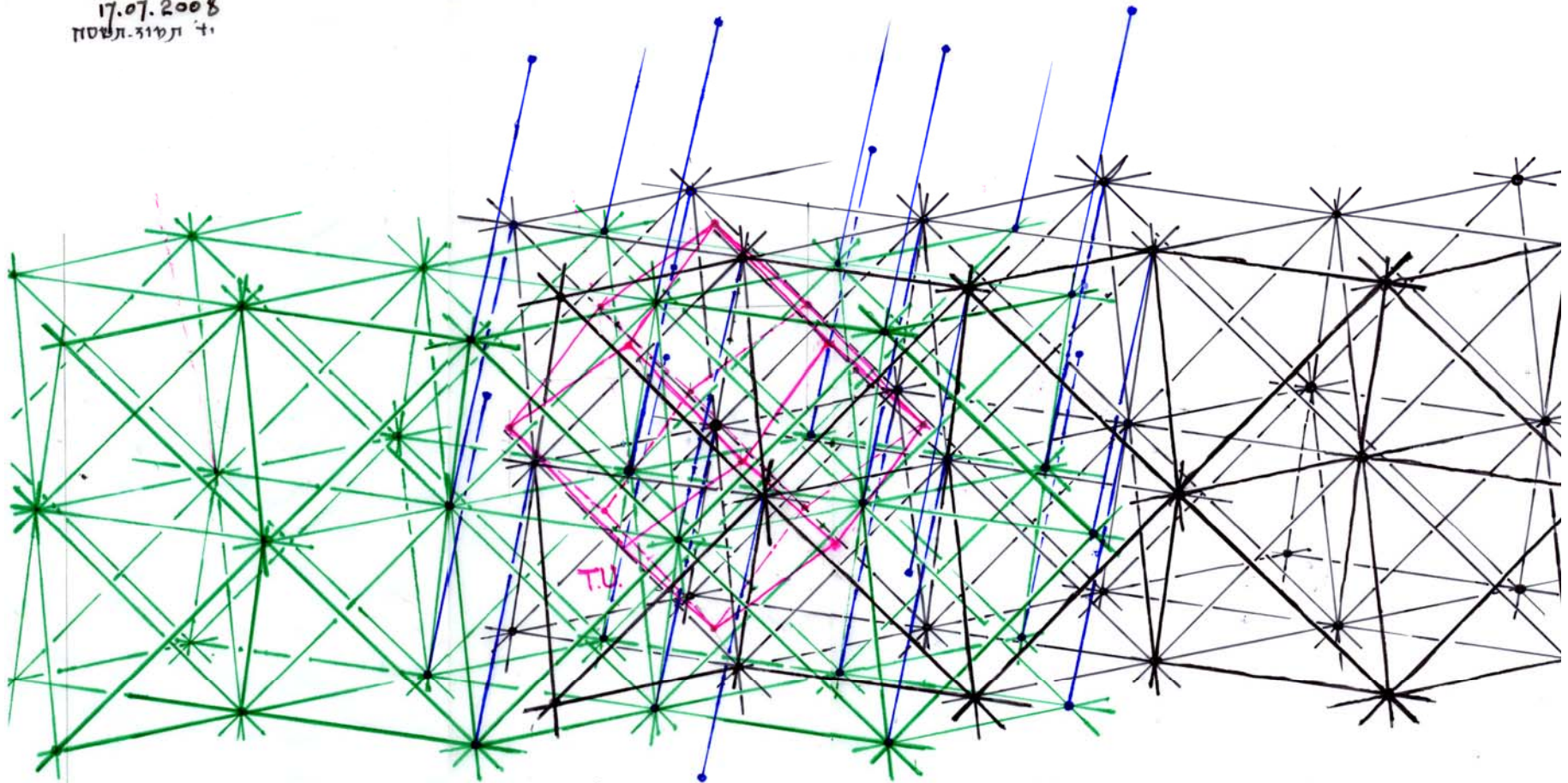
## TRANSLATION NETWORKS

5-DIMENSIONAL OCTAVALENT NETWORK,  
GENERATED BY A DOUBLE EDGE-LENGTH  
TRANSLATION OF A UNIFORM HEXAVALENT  
CUBIC SPACE-LATTICE.

THE 3-D REPRESENTATION OF THE  
5-D NETWORK IS A UNIFORM OCTA-  
VALENT SPACE-LATTICE WITH A  
SPATIAL DENSITY OF  $D_{en} = 15.00 a^3$



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ПОВЛ. 31271 41



$$\text{DENSITY}_{(13-3^{24}4^{12})} = 18.38477631 a/a^3$$

TWO INTER-PENETRATING UNIFORM OCTET SPACE LATTICES WITH EDGE- $a$ ,  
WHEN JOINED TOGETHER WITH A SET OF PARALLEL  $a$ -EDGES, GENERATE A  
UNIFORM 13-VALENT SPACE LATTICE.

The edge length translation could be performed  $m$  times, leading to a uniform  $(n+m)$ -valent space lattice, the spatial density of which will amount to:

$$\text{Den.}(n+m) = \frac{\text{Den.}(n)}{E_{T.U.}} \left[ 2^m \cdot E_{T.U.} + \frac{(1+m)m}{2} \right]$$

In fact  $m$  and the spatial density values can reach to infinity (!)



## CATEGORIES OF UNIFORM 3D NETWORKS

Number of networks  
( Found so Far )

1. Centroid related networks	5+13
2. Axis related networks	33 ( $\rightarrow \infty$ )
3. Plane related (Double Layer) networks	65
4. Centro-Axial-Plane related networks	6 ( $\rightarrow \infty$ )
5. Multi - Layer Space Networks	} ~ 220
6. Poly - Vectorial Space networks	
7. Translation networks	$\rightarrow \infty$

N

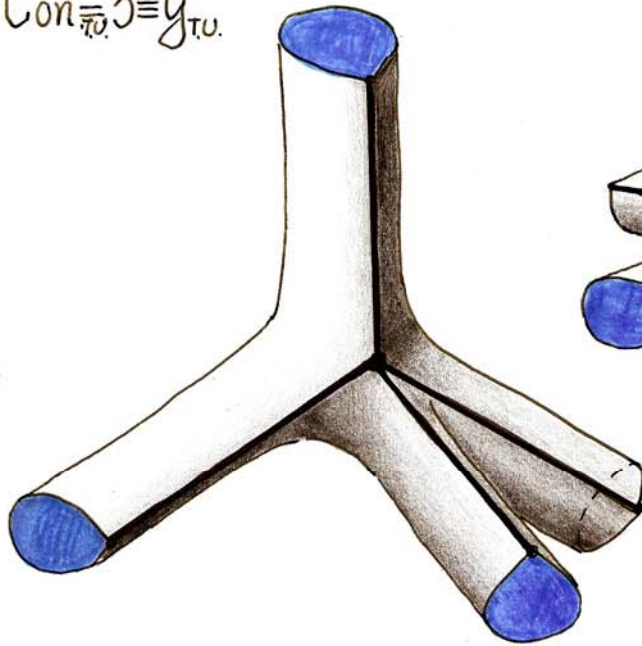
An assumption is formed that we are dealing with probably not more than few **hundreds of uniform space lattices in 3-D space and in view of the valency limiting values and symmetry constraints it seems that an exhaustive systematic search of these configurations is tenable.**

DIAMOND LATTICE PV.4-6 $\frac{1}{3}$   
AND THE RELATED DIAMOND UNI-HEDRON

$$\text{Val.} = 4$$

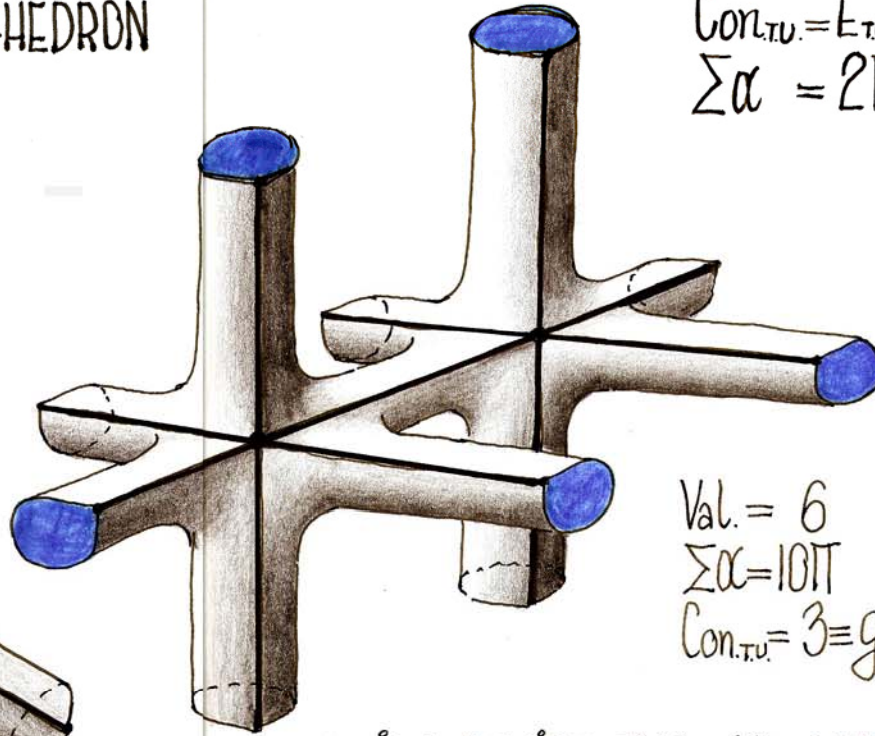
$$\Sigma\alpha = 6\pi$$

$$\text{Con.}_{\overline{TV}} = 3 \equiv g_{TV}$$



$$\text{Con.}_{TV} = E_{TV} - V_{TV} + 1 \equiv g_{TV}$$

$$\Sigma\alpha = 2\pi(\text{Val.} - 1)$$



$$\text{Val.} = 6$$

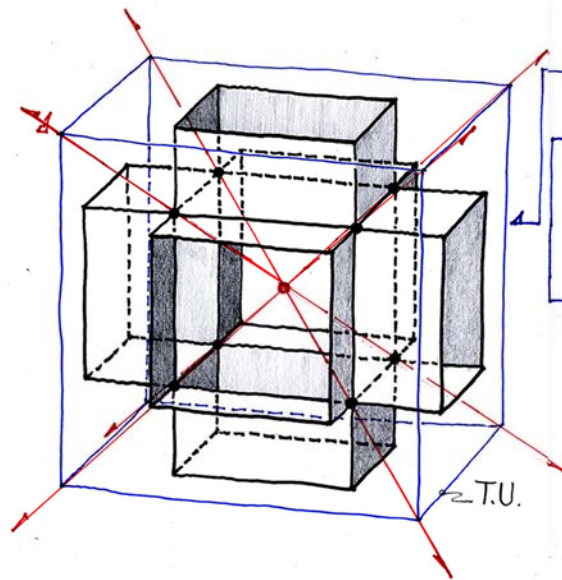
$$\Sigma\alpha = 10\pi$$

$$\text{Con.}_{TV} = 3 \equiv g_{TV}$$

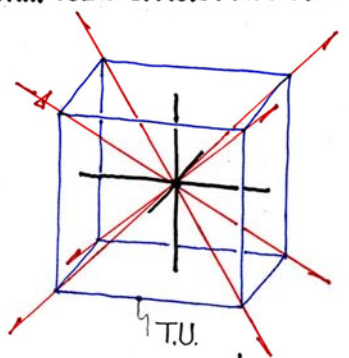
CUBIC LATTICE PV.6-4 $\frac{1}{3}$  AND  
THE RELATED CUBIC UNI-HEDRON.

ALL 3-D SPACE NETWORKS MAY BE CONSIDERED AS  
UNI-HEDRAL TESSELLATIONS OF DISTINCT SPONGE SURFACES.



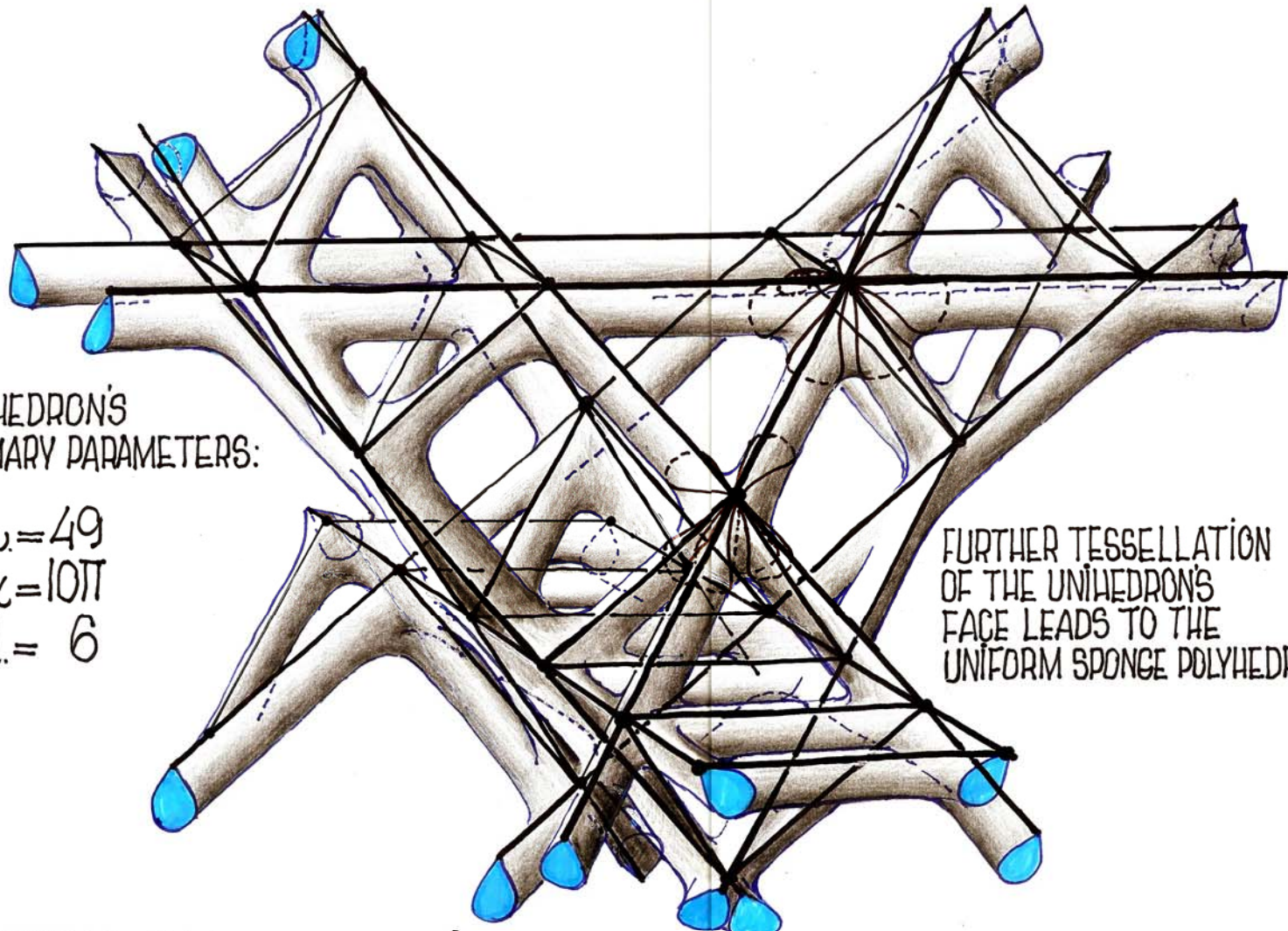


UNIFORM INFINITE POLYHEDRON -  $4\frac{1}{3}, (6; 3T; 3)$ .  
 UNIFORM CUBIC SPACE LATTICE PV6 -  $4\frac{1}{2}, (6; 10T; 3)$ .  
*Val;  $\Sigma\alpha; g=C$*



DERIVED FROM DESCARTES'S FORMULA:  
 $\Sigma\alpha = 2\pi [1 - \frac{2(1-g)}{V.T.U.}]$ ;  $\Sigma\alpha_{4\frac{1}{3}} = 2\pi [1 - \frac{2(1-3)}{8}] = 3\pi$   
 $\Sigma\alpha_{PV6-4\frac{1}{2}} = 2\pi [1 - \frac{2(1-3)}{1}] = 10\pi$

TWO LOOK-ALIKE HEXAVALENT NETWORKS DIFFER IN SYMMETRY FEATURES, TRANSLATION UNITS AND THE NUMBER OF VERTICES WITHIN



UNIhedron's  
PRIMARY PARAMETERS:

$g_{T.U.} = 49$   
 $\sum \alpha = 10T$   
 Val. = 6

FURTHER TESSELLATION  
 OF THE UNIhedron's  
 FACE LEADS TO THE  
 UNIFORM SPONGE POLYhedron:

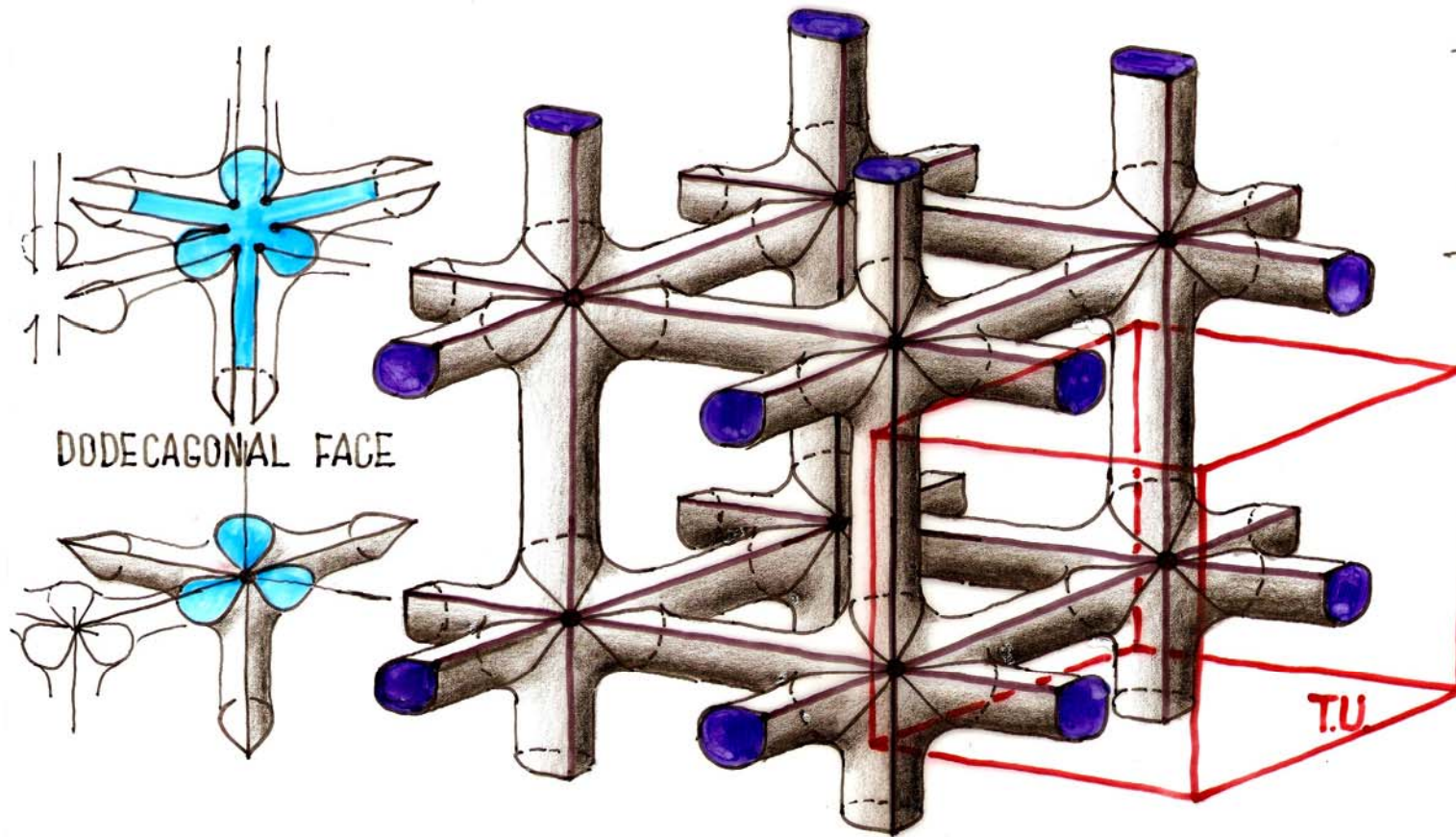
$(4^2 6)_{49}^6$   
 $g_{T.U.} = 49$   
 $\sum \alpha = 10T$   
 Val. = 18  


---

 $V_{T.U.} = 24$   
 $E_{T.U.} = 216$   
 $F_{T.U.} = 96$

UNIhedron BASED ON A UNIFORM HEXAVALENT  $PV.6-3^5 4^4 6^2 12_{49}^2$  SPACE LATTICE

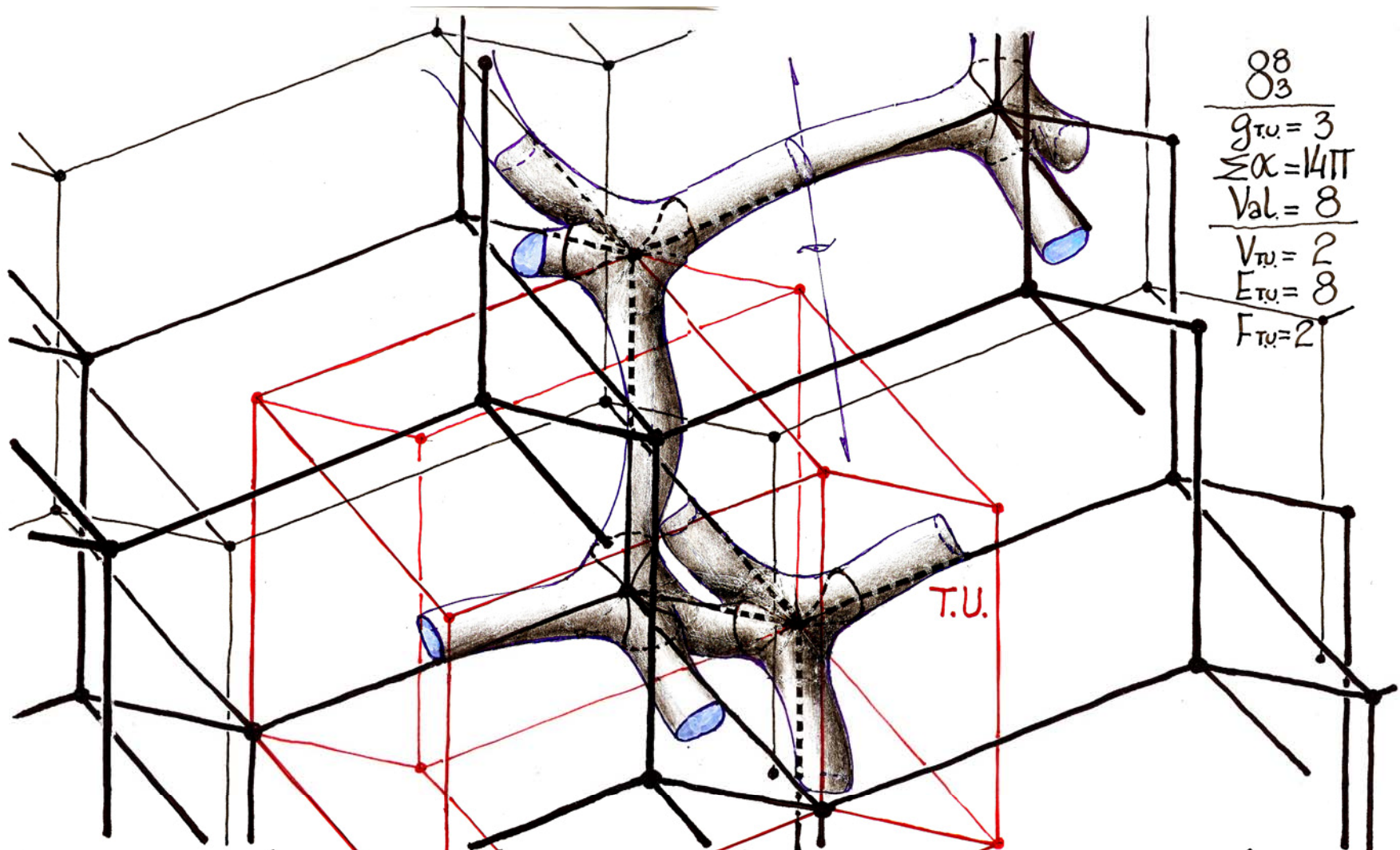




$$\begin{array}{r}
 12 \frac{12}{3} \\
 \hline
 g_{T.U.} = 3 \\
 \Sigma \alpha = 10\pi \\
 Val. = 12 \\
 \hline
 V_{T.U.} = 1 \\
 E_{T.U.} = 6 \\
 F_{T.U.} = 1
 \end{array}$$

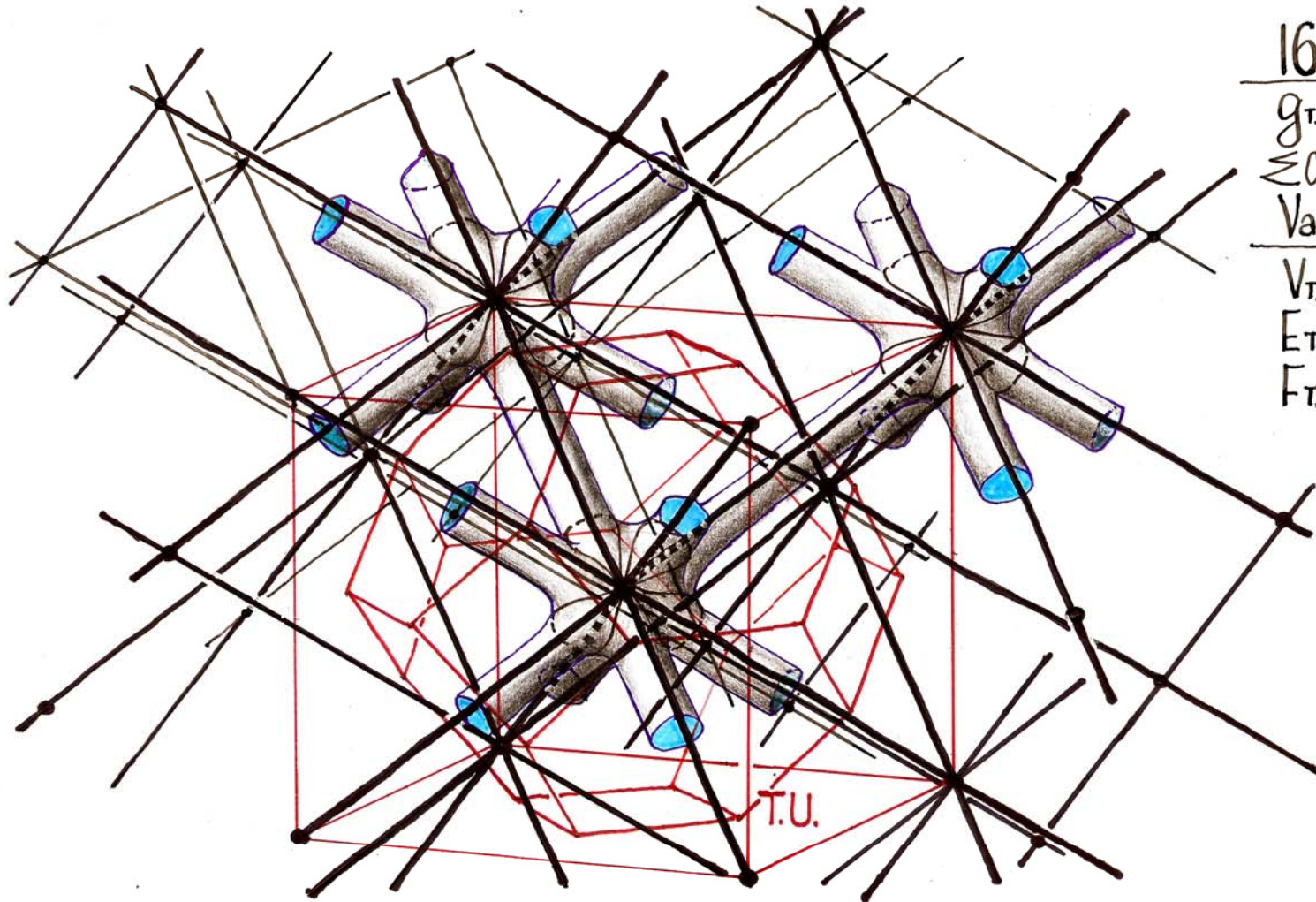
TESSELLATION OF A CUBIC UNI-HEDRON LEADS TO A UNIFORM SELF-DUAL  $12 \frac{12}{3}$  SPONGE POLYHEDRON WITH JUST ONE FACE PER T.U.





$$\begin{array}{r}
 8^8 \\
 8_3 \\
 \hline
 g_{TU} = 3 \\
 \Sigma \alpha = 14\pi \\
 Val. = 8 \\
 \hline
 V_{TU} = 2 \\
 E_{TU} = 8 \\
 F_{TU} = 2
 \end{array}$$

TESSELLATION OF A DIAMOND UNI-HEDRON LEADS TO A UNIFORM SELF-DUAL  $8^8_3$  SPONGE POLYHEDRON WITH JUST TWO FACES PER T.U.



$$\frac{16^{16}}{4}$$

$$g_{T.U.} = 4$$

$$\sum \alpha = 30\pi$$

$$\text{Val.} = 16$$

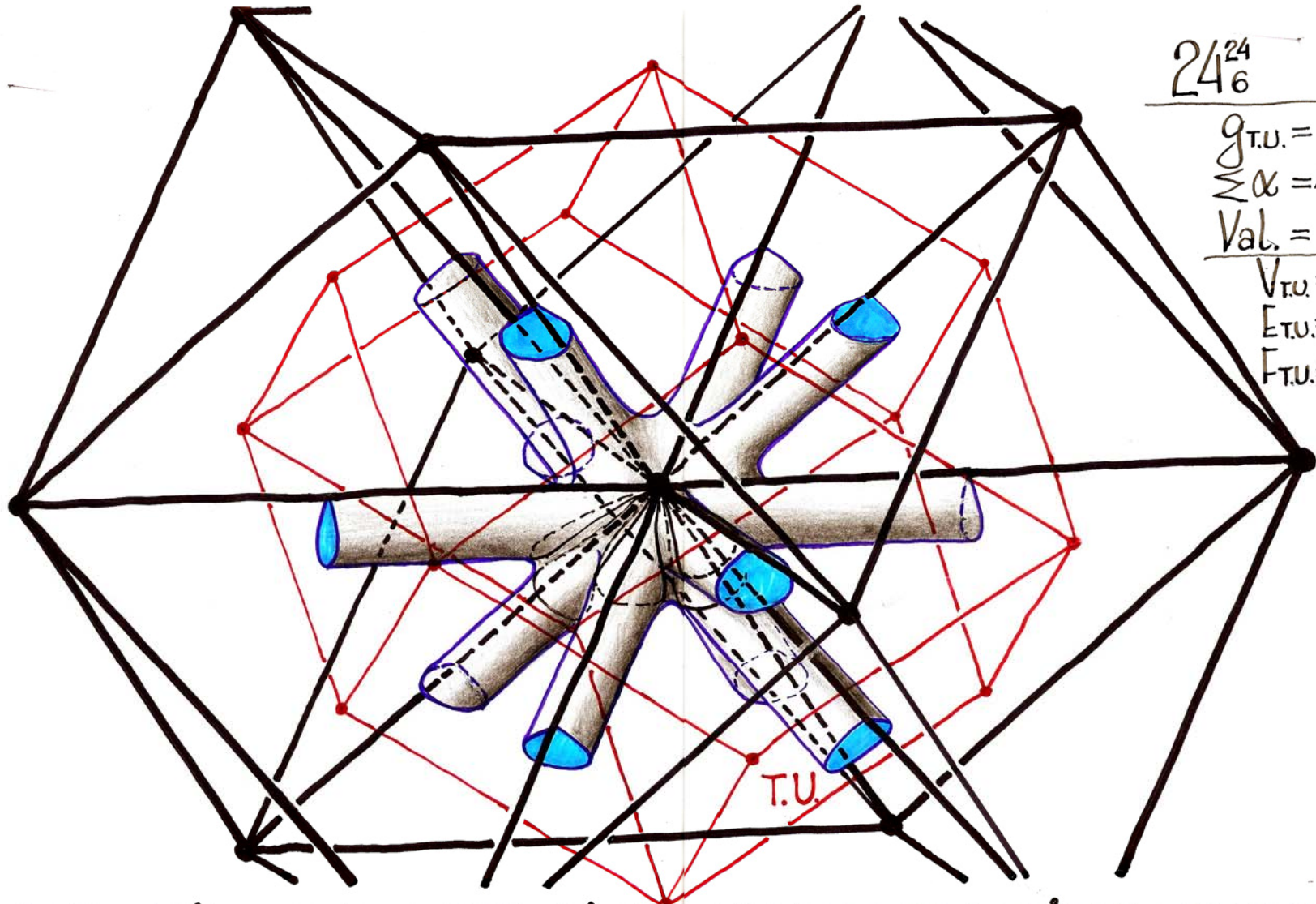
$$V_{T.U.} = 1$$

$$E_{T.U.} = 8$$

$$F_{T.U.} = 1$$

TESSELLATION OF A C.C. UNI-HEDRON LEADS TO A UNIFORM SELF-DUAL  $16^{16}_4$  SPONGE POLYEDRON WITH JUST ONE FACE PER T.U.

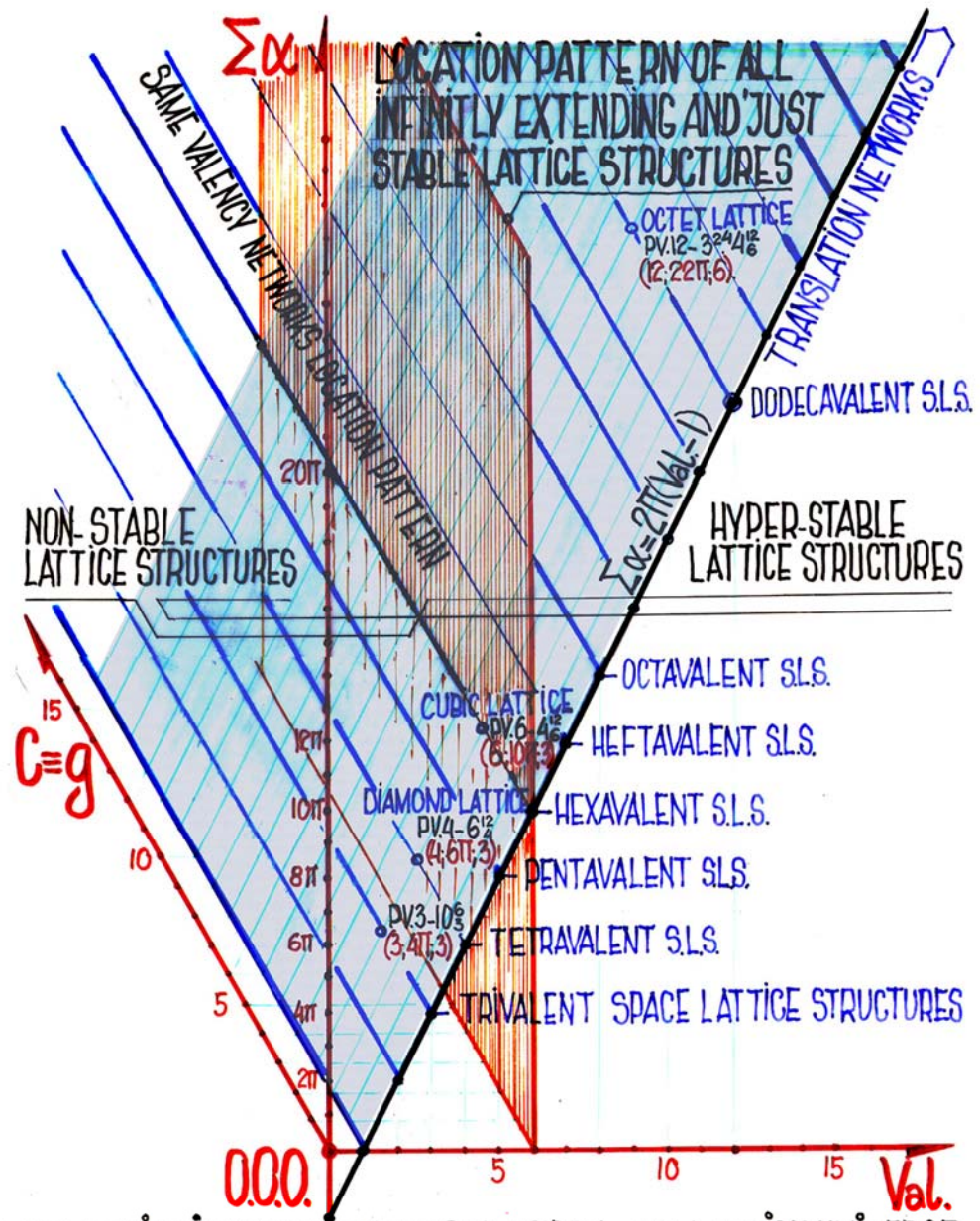




$$\begin{array}{r}
 24^{24}_6 \\
 \hline
 g_{T.U.} = 6 \\
 \sum \alpha = 46\pi \\
 Val. = 24 \\
 \hline
 V_{T.U.} = 1 \\
 E_{T.U.} = 12 \\
 F_{T.U.} = 1
 \end{array}$$

TESSELLATION OF AN OCTET UNI-HEDRON LEADS TO A UNIFORM SELF-DUAL  $24^{24}_6$  SPONGE POLYHEDRON WITH JUST ONE FACE PER T.U.





THE PERIODIC TABLE OF THE POLYHEDRA AND LATTICE UNIVERSE.  
LOCATION PATTERN OF UNIFORM SPACE-LATTICE CONFIGURATIONS.

IN CONCLUSION

*3D networks and the associated hyperbolic sponge surfaces seem to pose a critical aspect in all 'material sciences' and as an extension of graph-theory, dealing geometrically with any plurality that may exist, of focal entities and their inter-relations.*

*After investing in the systematic research of the topic, the author claims enumerating, categorizing and graphically describing, **so far**, about 350 uniform 3D space networks and related hyperbolic sponge surface configurations.*

*The effort is meant to support an evolution of new imagery which might influence scientific exploration and inspire art, architecture and innovative space structures.*



F

**By defining as 'morphic' those processes which display a movement toward greater 3-dimensional spatial order, symmetry or form (Whyte-1969) and morphology as the logical preoccupation with and manipulation of those processes, than the research into the nature of networks and the associated sponge surfaces may be classified as the essence of morphology.**