Kaleidoscopes - Kaleidospaces on a building scale and their inner orchestrated spatial choreography

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Introduction

Space is not a pas sive vacuum but is controlled by forces that express organization and ol der and compels all the bodies and forms which inhabit it to adhere to extremely powerful constraints.
The understanding of that order is vital to the functioning of the architect and of any person connected with or responsible for the design of human habitat space.
Space possesses a s tructure (a system among whose components exist well-defined relationships) of hierarchic and periodic (geometric and t opologic-mathematical) character that can be represented by mathematical models and its symmetries.

Every periodic complex form can, through a c ontinuous process of reduction and symmetric subdivision, be broken down to its basic atomic spatial elements and, conversely, by activating the appropriate mechanism of reproduction, deriving from the symmetry of its basic cell, reconstruct the entire complex periodic configuration.

According to this conception, the essence of the periodic complex dwells in each of its basic particles. These particles (in crystallography science called: the 'fundamental domains') should contain a full representation of all the traits of the complex and t he key to both its dismantling and its reconstruction.
The representing features of this relations between the simplex and the periodic complex are the symmetry elements and their group-agglomerations.

Kaleidoscopes

The subject of kaleidoscopes is associated in many minds with childhood toys, constructed of mirrors, in a c onfiguration which generates a per iodic replication, through the action of

reflection symmetry operations only, resulting
mostly in kinematics 2-D ordered mosaics. The toy is with us about 200 years.
The original "Kaleidoscope" invented by Sir David Brewster, in about 1816 and the meaning of Kaleidoscope is 'seeing a beautiful form' (Greek), the essence of which is:
Two parallel mirror reflectors generate an infinite group of virtual mirrors which appear to act like real mirrors.
The issue of 'symmetries' invades and dominates many field theories, concerning art, mathematics and widely researched physics and chemistry domains.
"When we say that a figure is **symmetrical**, we mean that there is a **congruent transformation** which leaves it unchanged as a whole, merely permuting its component elements… such a congruent transformation is called a **Symmetry operation**" (Coxeter).
Clearly all the symmetry operations of a figure together form a group … that is called the **symmetry group** of the figure.
Groups of (real or virtual) mirrors generate sometimes translation symmetries …

…. Discrete groups generated by reflections, including as special cases the symmetry groups of the regular polyhedra and of the regular and quasi-regular honeycombs, have emerged in the last 300 years or so.
The trihedral kaleidoscope which exhibits the transforms of a point under a group generated by reflections, is due to Möbius (1852). Fig. 1, Fig. 2.
Observed conceptually, the kaleidoscope is a derivative of a consuming optic-geometric-mathematical phenomenon.
The kaleidoscopes are solved to replicate a specifically designed motif-form in a finite-spherical or two or three vectorial expansions to infinity, of either toroidal or hyperbolic patterns.
Usually, these space units comply with the definition of Elementary Periodic (fundamental) Region (E.P.R). The number of

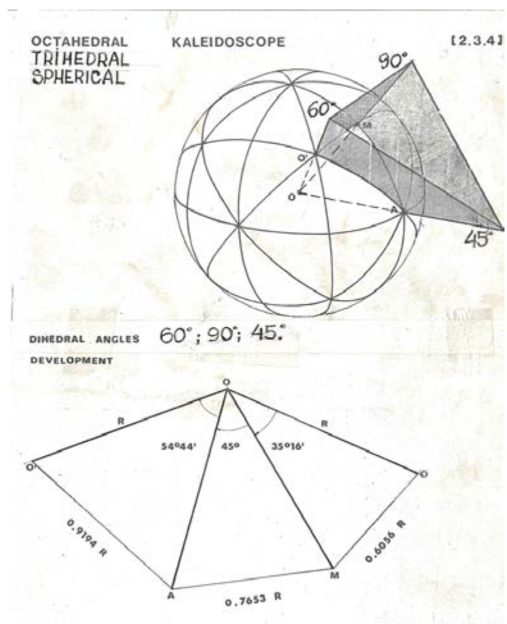


Fig.1 *Octahedral Trihedral Spherical Kaleidoscope*

such kaleidoscopes is mathematically exhaustible. Less familiar are the 'complex kaleidoscopes', consisting of an arbitrary number of E.P.R units. Their number is, of course, infinite and their exhaustive enumeration is a matter of complex mathematical combinatorics.

- The kaleidoscopes represent a critically important aspect and chapter in the science and morphology of space: of symmetry groups in the 2D and 3D space with a di rect generic relation to crystallography and morphology of the matter world; the plain and the hidden world of crystals, on i ts atomic and molecular level.

We may represent the translational 3D symmetry group by a s pace lattice or a " Bravais Net". It is obvious that we can define the physical arrangement of the whole crystal structure if we specify the contents of its single **unit cell**. (Ziman)

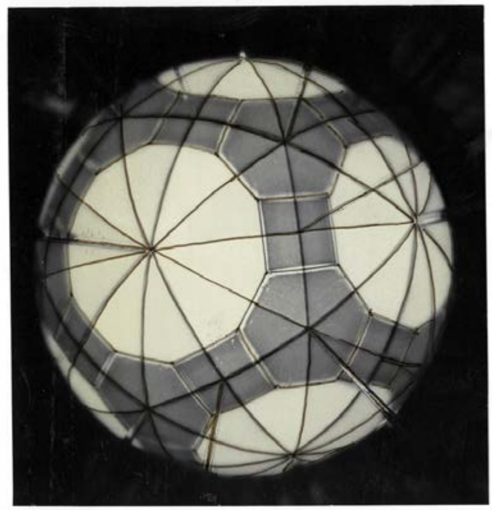


Fig.2. *Icosa-Dodecahedral Trihedral Spherical Kaleidoscopic image, with one vertex located within the E.P.R. unit.*

It should play an important role in the built and the urban architectural environment, as well, immersed, as it is, in glass and mirror cladding and partition solutions, resulting from the prevalent technology and the design spirit of our times.

The kaleidoscopes and the whole issue of periodic replication are not established as a c oveted knowledge domain, which could promote objectives of architectural design, although some inkling of the 'potential' already penetrates and becomes visible through the architectural environment. Designers and ar chitects are still mostly unaware and ignorant of the potential of this topic to inspire creative treatment of the urban habitat and its environment.

Kaleidospaces

The magic of the Kaleidoscope is in representing that evasive boundary between the real and the virtual world. It is a domain of many paradoxes and visual deceptions; a c hallenging world imbued with mystery, illusion and profound questions regarding the nature and the structure of the space we live in.

Probably, the first realization of a kaleidoscope on a building scale was the **Canadian pavilion** in the Expo-67 in Montreal. Fig. 3. The essential impact on a visitor was achieved through an orchestrated (predesigned) of 12 minutes only of exploding colours.

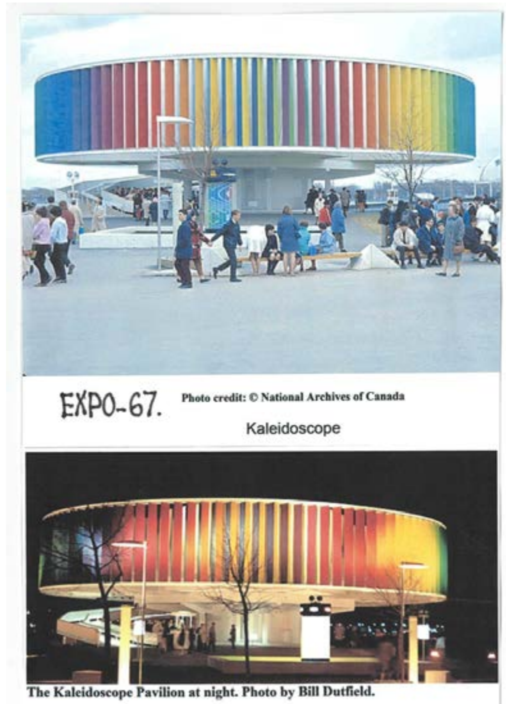


Fig. 3 *The Canadian Kaleidoscope Pavilion at Expo- 67, in Montreal, Quebec.*

The 'wonderment walk'

The 'kaleidospace' may be resolved within one s ingle building-scale kaleidoscopic structure or developed as a 'wonderment walk' through a successive composition of pre-determined kaleidoscopic spatial features.

The kaleidospaces will be an al l-encompassing sensual experience and an ultimate illusory entertainment vehicle.

One kaleidospace structure or a conglomerate of different types of kaleidospaces, connected by short passageways, could serve as a multi-media adventure space, a real 'wonderment walk'.

The 'wonderment walk' should be disassociated, as much as possible, from the everyday experience of the urban space, as we know it, striving to suffuse the real with the virtual, illusory sensation. The 'wonderment walk' should assault the ingrained visual 3D perception and spatial orientation to a point of reaching a departure from the real, the familiar and the solidity of our space conception.
That is the essence of Escher's bewildering space ambiguities and that should be m obilized as a starting point of the wonderment walk.
To some extent it is an i nvitation to immerse ourselves in the 'Magic' Mirror environment of M.C. Escher (1898÷1972) and experience his 'pseudoscopic effect'. Fig. 4.

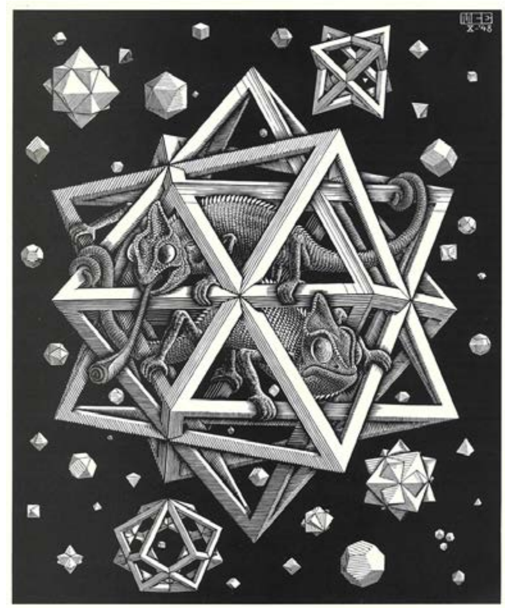


Fig. 4 *Wood engraving by M.C. Escher, 1948.*

"Escher also created spheres whose curved surfaces are filled with a single repeating motif-form. It is likely that in covering these spheres with adaptations of his flat designs he first envisioned the pattern wrapped around a suitable solid such as a cube or octahedron, than projected the designs outward to the surface of a sphere surrounding the geometric solid" (M.C. Escher Kaleidocycles). Fig. 5.

Kaleidospaces are kaleidoscopes realized on a building scale, solved to accommodate
groups of active visitors-participants-spectators **as the**

replicated motif-form, thus turning their (even) random interactive movements into an orchestrated, ordered, all-embracing (virtual) environment.
Within the Kaleidospaces an exciting transformation takes place, replacing the

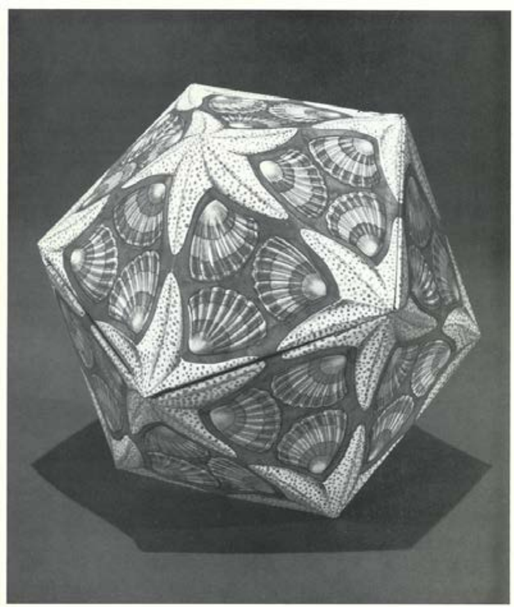


Fig. 5. *Enamelled tin icosahedron by M.C. Escher,1963*

intellectual perception with an intense artistic-sensual experience. The ir phenomenology and conceptuality and the associative means of creative and e xpressive design perceptions are not yet understood and d eveloped, which poses a c rippling effect on an y effort to communicate and discuss the issue. Fig. 6. Fig. 7.
A special attention should be given to what I suggest calling-'kaleido-choreography'-in which all the participants and t heir random or orchestrated movement generates periodic kinematics choreography, characterized by an exciting fusion of the arbitrary and the totally ordered and hi ghly symmetrical movement regime.

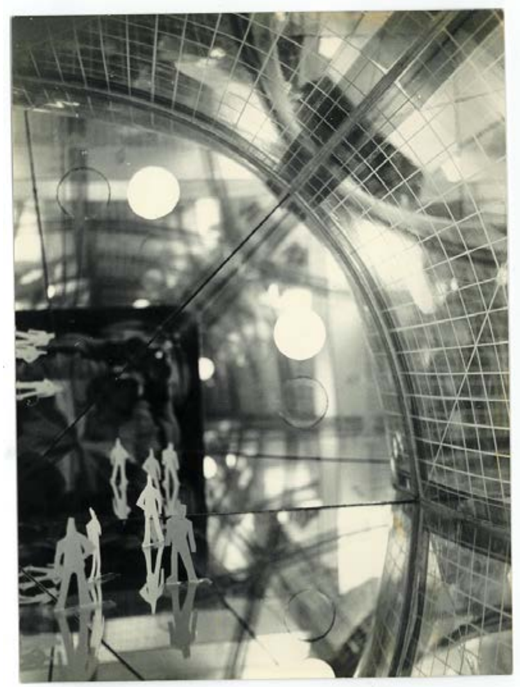
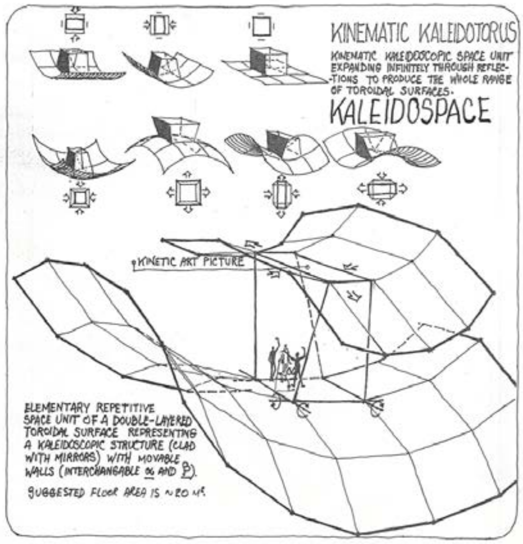


Fig. 6 *A kinematic Cubic Kaleidospaces, (Kaleidocube).*

Essentially the Kaleidospaces are mirror-clad interiors of very particular geometries and are within the practiced building technology and i ndustry, with

economics of glass-mirror facades construction. The s ize is of a particular importance, to insure the sensual knock out,
and … **the bigger the better**.
It should be s tated that the kaleidospace conception, as described, goes much beyond the 'Canadian Pavilion' concept, as realized and presented in the Expo-67 in Montreal.
Its principal contribution novelty is in turning the visiting crowd into its main, most effective replication motif-form.

Icosahedral Kaleidospace: an elementary region of space which represents 1/120 of the total illusory spherical space. Fi g. 8. Fig. 9. W ith a r ight triangular basis of 18m x 27m, it will rise to the height of ~50m and will recreate an i llusion of a s pherical space of 100m in diameter.



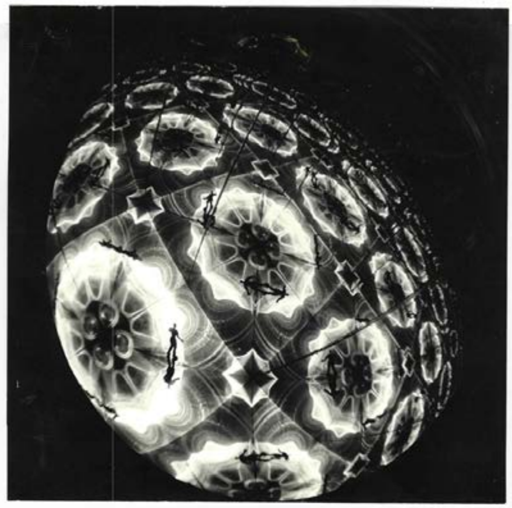


Fig. 7 A Kinematic Toroidal Kaleidospaces (the Kaleidotorus).

Whatever is inside will be reflected and replicated 120 t imes. Visitors (300 at a t ime) will generate a "human kinetic carpet, "covering the entire inner surface of the sphere.

The kaleidospace array of interiors may be engulfed in a multi-layer spatial environment, suffused with vertical-spatial park of green bio-mass and a spatial grid of pedestrian (and mechanized) walk-ways and 'sky promenades, with a servicing visual-functional supportive environment.

Fig. 8 *Spherical Kaleidospace, referring to 2.3.5. (Icosahedral) symmetry group, with a pedestrian bridge as its replicated motif form.*

As such, and especially when utilizing the 2.3.5.(Icosahedral symmetry) trihedral mirror clad space, it was never realized and never experienced before, and therefore will constitute a complete novelty and 'a first' of its kind. Fig. 10.

Its starting point was in 1972 with the author's small-scale experiments, encouraged by an esteemed colleague Prof. Paul Conrad Hoenich (1907-1997), 2D design instructor at the Technion's Architecture Faculty, who was a generator and worshipper of Sun-Art design and sun painting and a very distinguished photographer, with some of his photographs presented here.

Some of the early design and research efforts of the author on the Kaleidospaces phenomenology were presented in an 'art exhibition' at the Haifa Art Museum (Israel) in 1984.

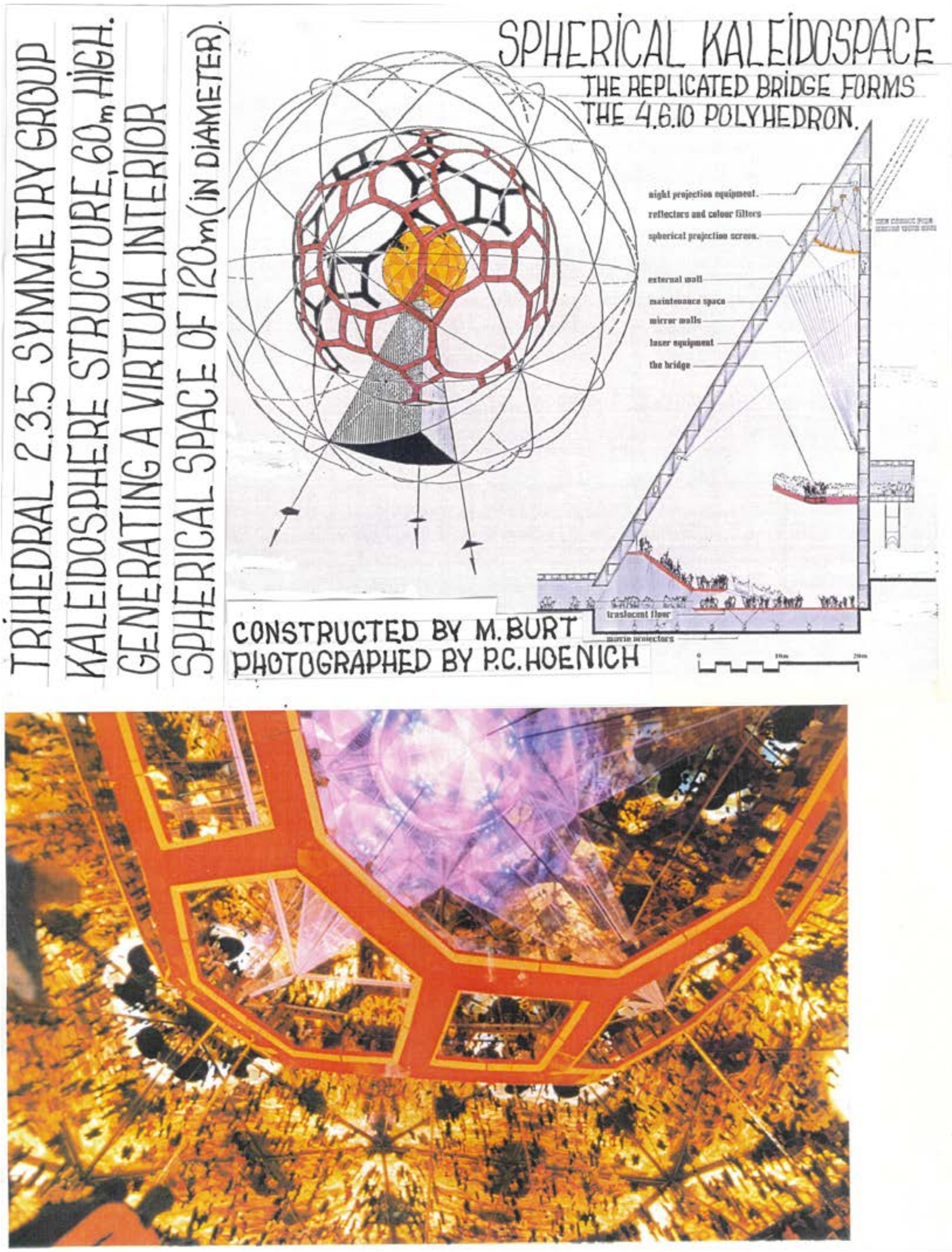


Fig. 9. ***A Spherical Kaleidospaces,*** *referring* ***2.3.5****. Icosahedron) symmetry group.*

Fig. 10 *Kaleidospace of 2.3.5. symmetry group.*
Photograph by P.C. Hoenich, with his sun-paintings as a replicated motif-form at the truncated top of the Kaleidospaces.

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