Cosmic-Scale Structural Features Explained

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... the reason of many phenomena which are quite incomprehensible according to the views commonly accepted.
–Galileo[1]

A cellularly structured universe allows us to readily explain large empty voids and the distribution of galaxy clusters that surround them. An excellent beginning for a cosmology theory. And by giving the cells certain dynamic properties we can go much further. By incorporating a dynamic space that expands and contracts in separate regions we can explain vastly more (especially when this dynamic space is intimately tied to the concept of gravitation as we will see later).

Understand that the dynamic cells, which are configured by dynamic space, do not mould into just any shape. They do not, for instance, form cosmic cubes; they cannot form into spheres for no cell is ever isolated from its neighbors. Dynamic space acts to structure the universe into predominantly close-packed dodecahedra. And because these polyhedra are non-regular in shape (by which we mean they do not conform to the geometric rules that define the five Platonic solids) we can immediately explain the variation in the size of galaxy clusters. I am referring here to significant clusters, and not to mere galaxy groupings. (Variation in the size of groups of galaxies is simply a display of randomness.)

1 VARIATION IN THE SIZE AND DENSITY OF GALAXY CLUSTERS

As we saw previously, the major and minor nodes of the dodecahedral structure account for the explanation of cluster size and density. *Minor nodes* have four arms that link to other nodes and represent the sites of normal scale galaxy clusters. The *major nodes* have double the number of arms connecting to neighboring nodes. Each major node is the site of a galaxy cluster of significant stature and density.

Furthermore, since there are more minor nodes than major ones we have an explanation that accounts for the prevalence of clusters of moderate size and the relative scarcity of major concentrations. Examine a close-packed dodecahedron (such as the rhombic dodecahedron of Fig. 1) and confirm that it has 8 minor nodes but only 6 major ones.

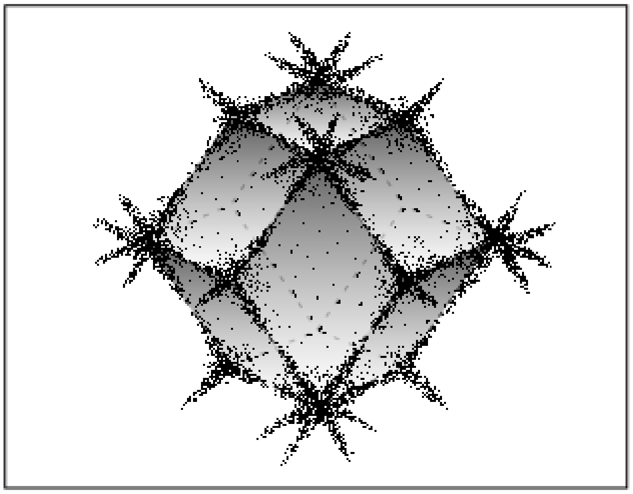

Fig. 1. Dodecahedral cosmic cell representation with galaxy clusters concentrated at the nodes and boundaries. One major and two minor nodes are hidden in this view.

Of interest, and importance to the discussion in the next section, is that the minor nodes each have a single link projecting to the exterior of a cell; while the major nodes each have four links to the exterior.

Another source of variation in the structure and appearance of clusters is explained by the fact that minor and major nodes are not always directly linked to each other as they are in the *rhombic dodecahedron* (as shown in Fig. 1). Note carefully that in the *rhombic-trapezoid dodecahedron* (the other closest packing unit that constitutes our universe) the pattern is different. In the latter unit, two minor nodes may be directly linked. Also two major nodes may be directly linked. In fact, almost all the nodes of a *rhombic-trapezoid dodecahedron* are so paired; 12 out of 14 nodes. See the chapter *Dodecahedra, Exploring the Characteristics of the Dodecahedral Shapes.*

When the cosmic cell is a rhombic structure (as it is in Fig. 1), galaxy clusters are all equally spaced. When the cosmic cell is a *trapezoid* structure, the distance between nearest node clusters may vary by a factor of two. And so, size and spacing variation arises. Two node clusters that are quite close to each other may appear to be a single extra-large galaxy cluster. There is an underlying order to the geometric position of clusters. But the order, for a variety of reasons, is not obvious; rather, clusters appear to be more or less randomly spaced.

And what about the explanation of extended superclusters? ... Some superclusters are said to extend for over 500 million lightyears, a cosmic expanse that dwarfs the usual nodes and is far greater than the entire diameter of a cosmic cell. Such superclusters represent a network of connected nodal galaxy clusters whose visibility happens to be particularly favorable.

Now consider a concentration of galaxies of truly extraordinary enormity — a concentration so stupendous that astronomers give it a special name. They call it the Great Attractor, and they have gathered evidence indicating that such a structure actually exists. The question arises: can the DSSU model provide an explanation?

2 The EXPLANATION FOR EXTRAORDINARY OVERDENSITY IN GALAXY DISTRIBUTION

In the theory of a cellular structured universe we have a most elegant and wonderfully simple picture of the Cosmos. By anyone's standard it is a beautiful construction —a crystal-like universe of dodecahedral cells aligned row upon row, layer upon layer. What could possibly spoil its beauty —its symmetry? Could there be flaws in the regularity of the cosmic cells? Like any system that forms a cellular network there could very well be structural, or linking, flaws. Such flaws are known to occur in the surface patterns of thermal convection cells in liquids during carefully controlled lab experiments.[2]

To visualize one such flaw consider what would happen if one of the cells were to collapse. For a two dimensional analogy we use a grid of hexagonal cells and imagine shrinking one of the cells. The cell's six walls contract while the links to the surrounding cells stretch. The cell collapses to a point and in the process becomes a single node. Six nodes have become one. The result is an anomalously large concentration of links —a planar super-node if you will. See Fig. 2.

Now for the visualization of a collapsing dodecahedral cosmic bubble: Each minor node of the collapsing cell is connected to the nearest neighboring cells through ***one*** projecting arm. The major nodes, however, extend multiple connections. Each major node draws on the galaxy in-flow through no less than ***four*** external arms. During the cell's collapse these external arms are

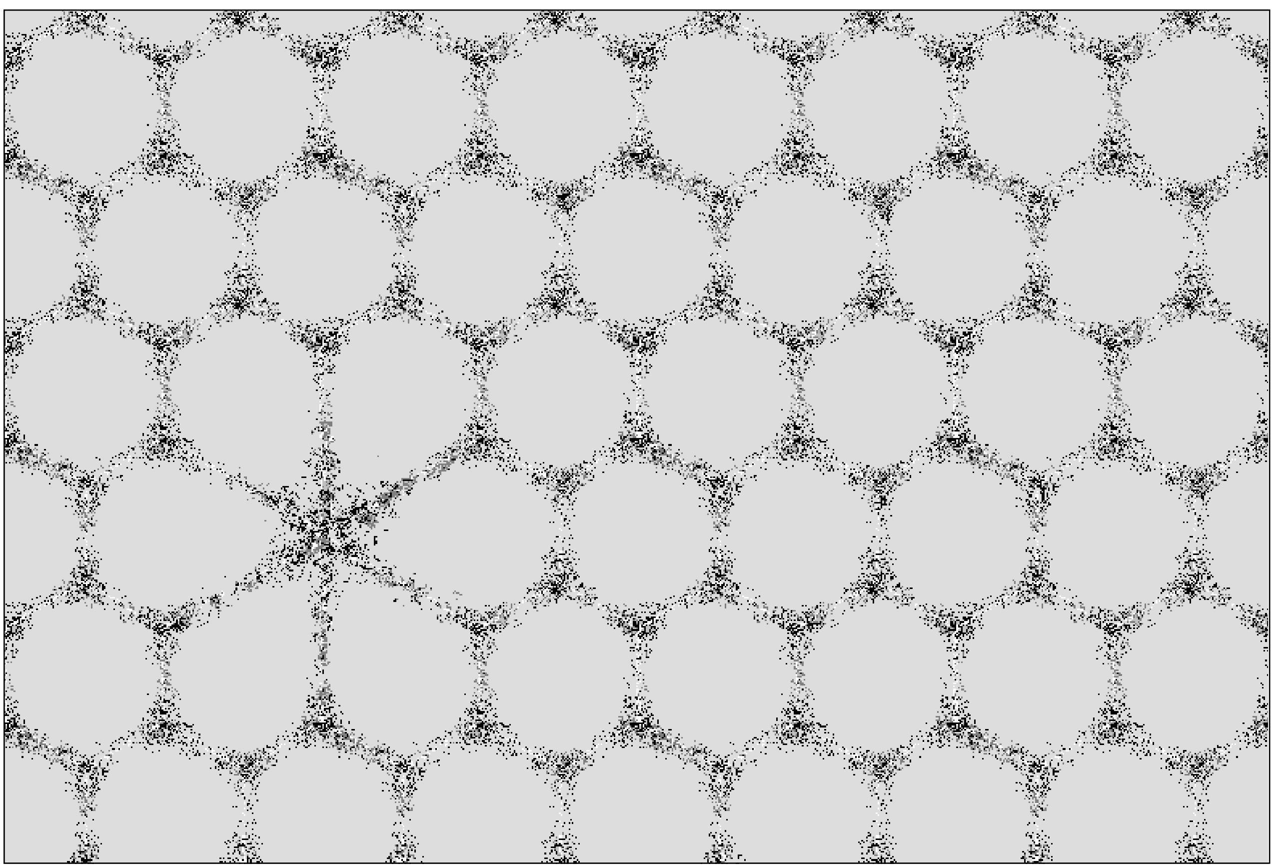

Fig. 2. ***Supernode*** occupies the site of a collapsed cell within an otherwise uniform array of idealized cells in this 2-dimensional representation which is used here as an analogy for the 3-dimensional cellular universe. The ***Supernode*** provides a plausible explanation for heretofore unexplained super concentrations of galaxies and the accompanying extraordinary amount of space-and-matter inflow.

stretched, but are maintained. Here are the numbers: there are 8 minor nodes each with one external link, and there are 6 major nodes each with 4 external links, for a grand total of 32. Thus there are up to 32 links in a spatial ***Supernode***.

When a cosmic polyhedron collapses, all its membrane material becomes concentrated at the *Supernode*, thereby, providing a plausible scenario for the observance of extraordinary overdensity in the distribution of galaxies.

IS THE GREAT ATTRACTOR AN EXTRA-ORDINARY OVERDENSITY? One candidate for *Supernode* status is the region in and around the cluster of galaxies called ACO 3627, popularly known as the Norma Cluster. Some astronomers claim it is the center of the "Great Attractor."

The "Great Attractor" is a distant mysterious entity, first discovered in 1986 (by Rubin and Ford, 1987 AJ 81, p719), that seems to be pulling into itself tens of thousands of galaxies. It is mysterious because its main concentration is hidden behind the dust, debris, and stars permeating the plane of the Milky Way. Astronomers have been trying to identify its detailed structure for years. Current reports indicate that it contains the weight equivalent of tens of thousands of Milky Way galaxies, and is around 200 million lightyears away, although its precise shape is difficult to define —not at all surprising if there are up to 32 branching arms involved.

In conventional cosmology the Great Attractor is a large-scale gravity anomaly, within the range of the Centaurus Supercluster, which reveals the existence of a localized concentration of mass equivalent to tens of thousands of galaxies (each the size of the Milky Way). It is an anomaly observable by its effect on the motion of galaxies over a region hundreds of millions of lightyears across.

If the reputed mass concentration is real, it might be a rare occurrence of a Supernode. It just may be a predicted structural feature of the cellular universe, a feature affecting the motion of galaxies over a region hundreds of millions of lightyears across.

A second candidate for Supernode status is the Shapley (b) Supercluster at a distance of 654 MLY (based on a space expansion constant H=21.5km/s/MLY). It is the most massive supercluster known. Its central core cluster, A3558, is dominated by an enormous elliptical (ESO444-46) with a diameter exceeding 340,000LYs.

Whether or not the Great Attractor or the Shapley (b) Supercluster are as massive and dense as they appear to be, and really are structural Supernodes is inconclusive; however, the DSSU Supernode provides a clear and ready explanation should the concentrations be affirmed.

3 EXPLAINING THE RIGHT-ANGLED WALLS OF GALAXIES

Our universe is observed to be constructed of four main components: galaxy clusters, sheets of galaxies, filaments of galaxies, and voids.

> *In the last 20 years, enormous effort and observation time has been devoted to map the galaxy distribution in space. It was found that galaxies are located predominantly in clusters, sheets and filaments, leaving large areas devoid of luminous matter.* –Renée C. Kraan-Korteweg[3]

Focusing our attention on galaxy sheets: It turns out that the structural feature known as a wall of galaxies is rather common. The Cetus Wall and the Sculptor Wall have been identified and mapped.[4] There is also a Centaurus Wall, and a particularly noteworthy sheet called the Great Wall which runs through the rich Coma cluster. Also, the Great Attractor overdensity is often described as a cosmic wall.

> *The results from the various ZOA [zone of avoidance] surveys now clearly imply that the Great Attractor is, in fact, a nearby "great-wall" like supercluster, ... The cluster A3627 is the dominant central component of this structure, similar to the Coma cluster in the (northern) Great Wall.* –Renée C. Kraan-Korteweg[5]

Astronomers using a variety of wave bands are resolving cosmic walls, confirming their existence, confirming a phenomenon indicative of some underlying order. Furthermore, they invariably find a rich cluster somewhere at the wall's center. These and other structural phenomena are out there, to be sure, and their discovery is exciting. But it is important to realize that the recognition of phenomena is different from understanding the causes.

Sadly, standard cosmology has no explanation for these walls of galaxies. No explanation of why they are so flat. No explanation of why they are marked by massive clusters at the center. No plausible explanation for why they would form or why they persist. The supporters of standard cosmology are committed to a model of an 'exploding' universe and are lost in a vain search for the causal mechanism of orderly structure in a cosmos predicated on disorder.

In a universe supposedly tearing itself apart with accelerated expansion, why would, or how could, such orderly structure take shape? How indeed, when there's that one-way restriction called entropy? It tends to point all large-scale activity in the direction of increasing disorder! Ultimately the entropy law demands disorder — not coherent structure.

Meanwhile, there are new observations. A new phenomenon to deal with. Amazingly some of the Great Walls meet at ***right angles***!

> *We have investigated the reality of the [right-angle] bends ... of the Cetus Wall. ... Thus we*

conclude the bends are real features in one continuous structure. –Anthony P. Fairall[6]

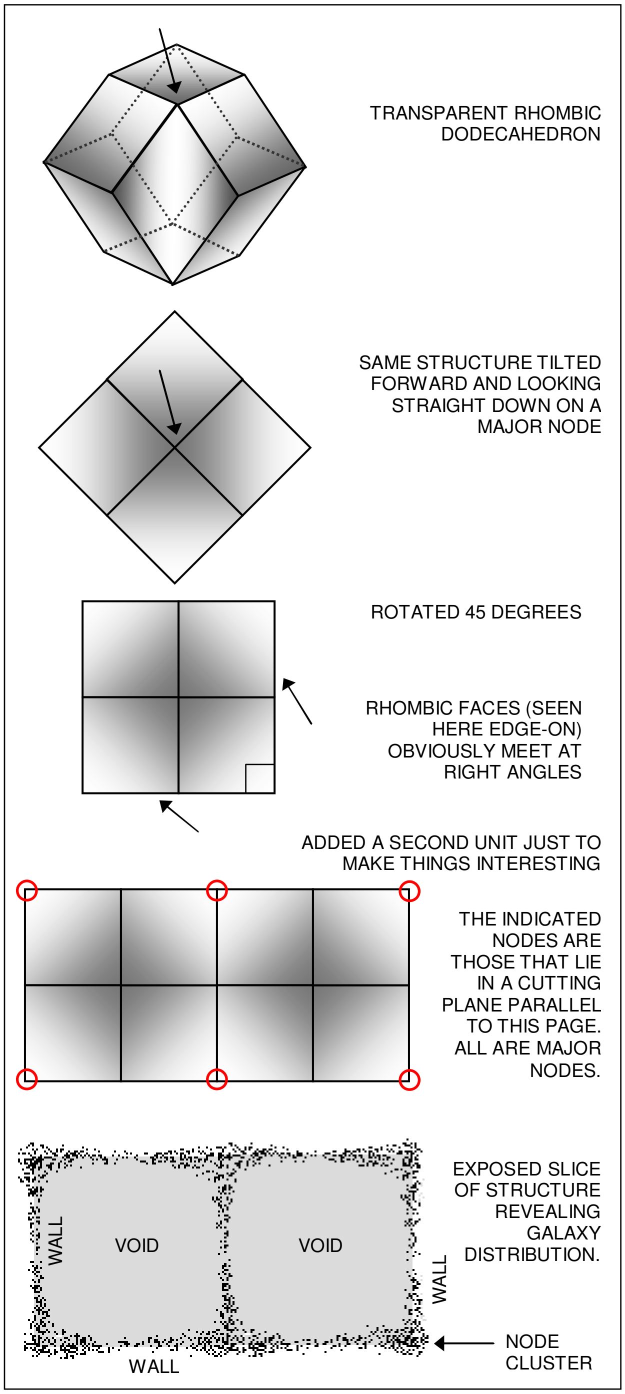

Fig. 3. Planes of the sides of a rhombic dodecahedron meet at right angles. This fact, in conjunction with DSSU dynamic space, provides the explanation for the observance of right-angled "walls of galaxies." A hypothetical slice through a pair of dodecahedral cosmic bubbles (bottom) reveals the main features of galaxy distribution: rich clusters, voids, walls of galaxies, and right-angled walls.

Astronomers must surely be scratching their heads. First they find these node-like galaxy clusters (but can't figure out what mysterious dark matter is holding them together); then they find that these clusters surround vast empty voids (why are they so empty?); gradually, detailed studies reveal 3-dimensional sheets of galaxies; lastly, when the extensive galaxy maps were assembled and analyzed, there emerges the unexpected evidence of right-angled walls. Astronomers must be asking themselves, *What's next? Are we going to find fully-formed geometric shapes —maybe a Great Polyhedron?*

Is some research group going to claim the detection of a cosmic-scale building block?

Exactly.

The next major breakthrough in resolving the puzzle of the large-scale structure of the universe will be the realization that the galaxies that surround a void form a polyhedron —ideally 12 sided— with galaxies clustered at the nodes, strung out along filamentous edges, and thinly spread along the flat interfaces.

The 3-dimensional positional data on distant galaxies are being collected and analyzed at a staggering rate. Year by year the picture grows clearer. While at the same time

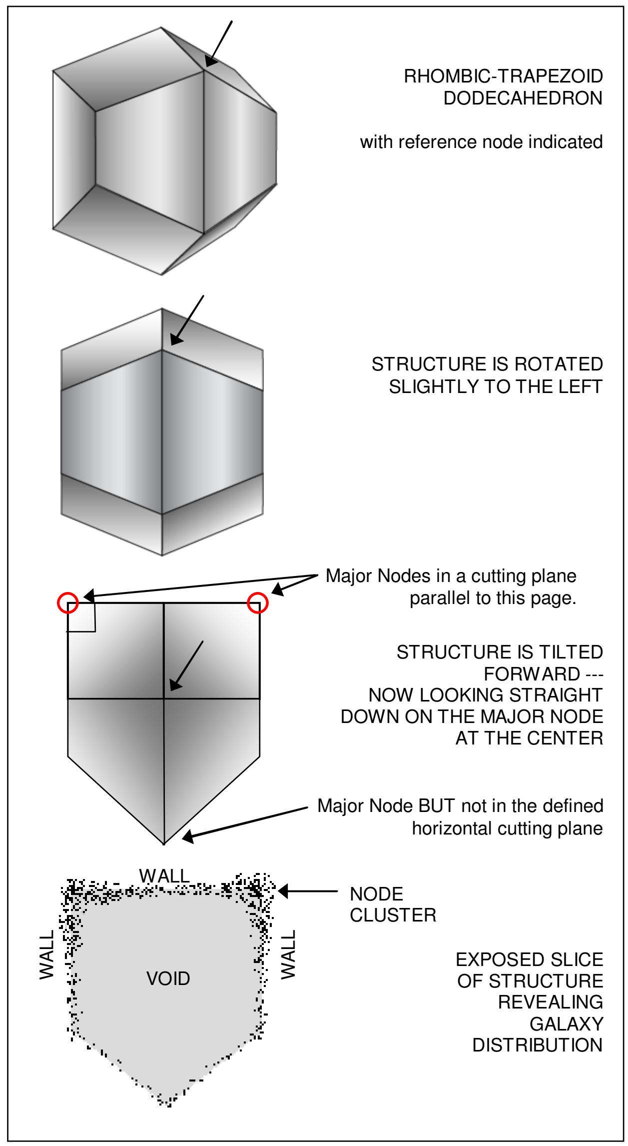

Fig. 4. Geometry of the sides of a ***rhombic-trapezoid dodecahedron*** similarly contains faces that meet at right angles. A plan view of a cut section of a corresponding cosmic cell again reveals a galaxy distribution with rich clusters, voids, walls of galaxies, and right-angled walls.

the old theories (based on expansion of the universe) seem ever more untenable.

For the theoretical explanation of the observed structure, one must inevitably turn to the cellular model of the universe. There simply is no alternative.

In the previous chapter it was explained how a pair of *space* postulates of the DSSU theory bring about the dodecahedral shape of the cosmic cells. It is this shape that provides the explanation for the observed right-angled walls of galaxies.

Take a close look at a model of a rhombic dodecahedron. Use a line-of-sight along any one of its axes running through opposite major nodes. It will be observed that the sides (of which only the edges will be visible) form a square. *The planes of the sides of a rhombic dodecahedron meet at right angles.* This counterintuitive fact, in conjunction with DSSU dynamic space, provides the explanation for the observance of right-angled "walls of galaxies." A hypothetical slice, or section, through a pair of dodecahedral cosmic cells (Fig. 3 bottom) reveals the very real features of galaxy distribution: rich clusters, voids, walls of galaxies, and right-angled walls —all of which astronomers have been unable to explain with conventional models.

Not surprisingly, the other dense packing polyhedron — the rhombic-trapezoid dodecahedron— also contains right angles. A slice through a pair of major nodes, as shown in Fig. 4, will contain two right angles. Such a cutting plane, however, does not intersect any of the other nodes.

Professor Anthony Fairall, as one of the leading astrophysicists involved in resolving the structure of the universe, was keenly aware of the importance of the right-angled walls when he wrote in 1990, "... they could be critical tests for any theoretical model." [7]

Centuries ago Galileo wrote, in *The Assayer*, that this grand book of the universe which stands continually open to our gaze is written in the language of geometric figures; without an understanding of the language of shapes, the universe will not be understood; the universe will remain a dark labyrinth.

4 INTERPRETING THE GELLER-HUCHRA GALAXY MAP

BACKGROUND. Prior to the 1960s, galaxy maps were mostly plotted in two dimensions using equatorial coordinates (with the Earth's equatorial plane as a reference), or sometimes using galactic coordinates (with the plane of the Milky Way galaxy as a reference). In effect, galaxies were plotted on a 2-dimensional curved surface representing the traditional *celestial sphere*. The *declination* (equivalent to latitude) and *Right-Ascension* (equivalent to longitude) of a galaxy position was relatively easy to measure. The problem has always been obtaining the third dimension. Measuring galactic distance was a painstaking and tedious task often requiring a night-long photographic exposure. And the process —whose aim was to record the spectral image of

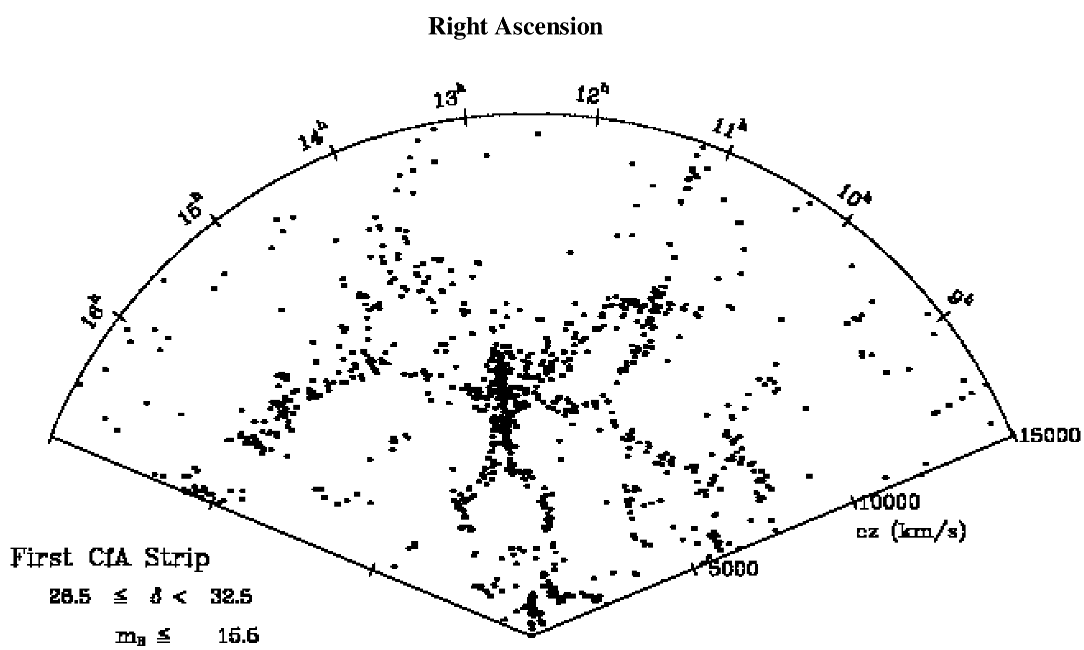

Fig. 5. Thin wedge galaxy map produced by Margaret Geller, John Huchra, and colleagues at the Harvard-Smithsonian Center for Astrophysics. Each point represents a galaxy within the thickness of the thin wedge. The 'stick figure' and the web-like pattern are readily recognized features. Our galaxy's position is at the vertex. (Used with permission courtesy of the Smithsonian Institution)

the faint light radiated by a distant galaxy's stars— had to be repeated for each and every galaxy. The spectral image was then analyzed and the all-important redshift factor extracted.

The spectral redshift is the primary 'tool' used by astronomers to determine cosmic distance. And *redshifting* is the process by which all electromagnetic spectral lines —the atomic fingerprints of photon emitting elements— are shifted towards a longer wavelength (the red end of the light spectrum) primarily as a result of the electromagnetic waves traveling through **expanding space**. Once the redshift is known, the Hubble equation is then used to calculate a cosmic distance, which is usually expressed as a recession velocity, and allows astronomers to plot in the third dimension.

In the 1970s the inefficient method involving photographic plates was replaced by digital devices known as charge-couple device (CCD) detectors. Spectra could be recorded in a matter of minutes. The new method was applied to creating three-dimensional galaxy maps.

With this method, astronomers Margaret J. Geller, John Huchra, and Valérie de Lapparent at the Harvard-Smithsonian Center for Astrophysics, were able to produce in the 1980s a set of galaxy maps and an image that was destined to appear in countless journals, magazines, and textbooks (Figure 5). It has become one of the most recognized images not just in astronomy but also in general science.[8]

The map's most striking feature is the unmistakable stick figure.

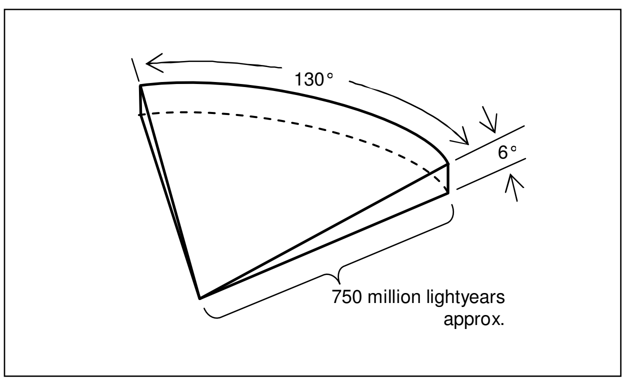

Fig. 6. Conical cross-sections. Shape of the wedge used to produce the Geller & Huchra galaxy map. The radial distance is approximate because it is dependent on the empirical Hubble constant.

The map represents a wedge-shaped region of the 3-dimensional celestial sphere from a Right Ascension angle of 8 hours to R. A. angle 17 hours —the width of the wedge. The thickness of the wedge is the region between the declination angles of +26°.5 and +32°.5. The radial length of the wedge, expressed as a velocity, is 15,000 km/s. Note that the use of "recession velocity" for the measure of distance is one of the archaic peculiarities of astrophysics jargon. The practice is to convert the redshift index of each galaxy into a radial speed.[9] But do not let the terminology mislead you. Please understand that these galaxies are *not* involved in a universal receding motion. ... The three dimensions then, form a pie-shaped wedge containing the plotted positions of well over 1000 galaxies.

A simple sketch of the wedge is shown in Figure 6 where Hubble's law for distance has been applied.

Let us once more look at the large-scale structure of the DSSU model. In a closely packed array of cosmic bubbles, a few of which are shown in Fig. 7(a), it is easy to pick out the major and minor nodes; the nodes and their links, of course, form the network of galaxies.

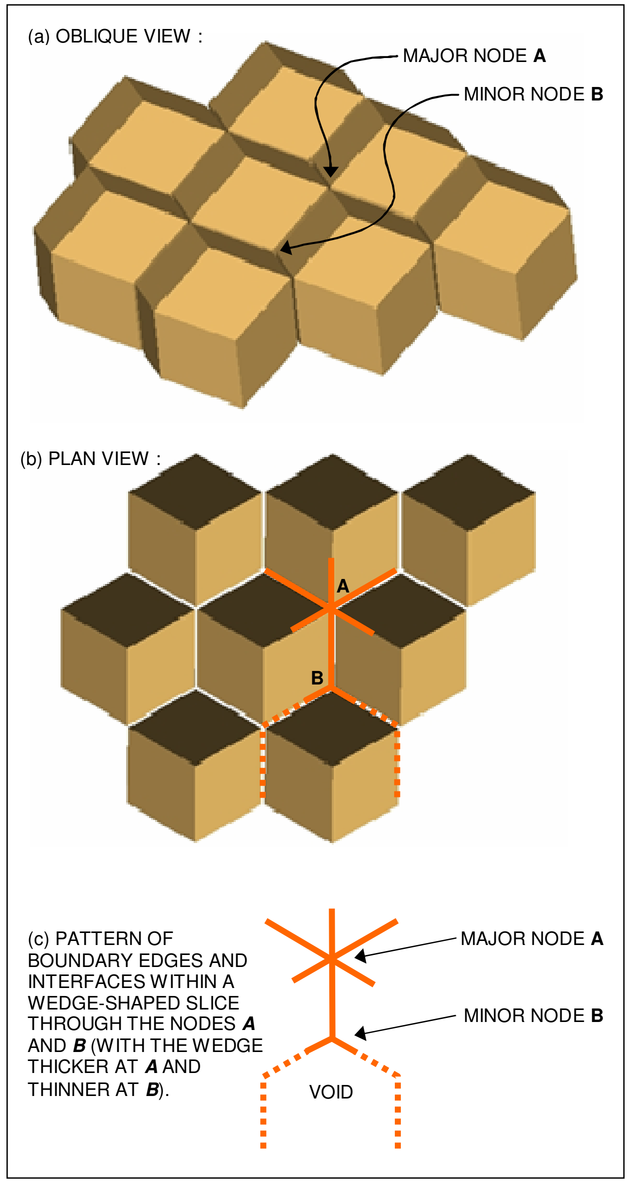

Fig. 7. Oblique view of an array of idealized Voronoi cells (a) reveals a pattern of major and minor nodes. An imaginary wedge-shaped slice is cut into a portion of the array in the area of ***A*** and ***B***. The wedge slice starts at the bottom of the plan view (b) with negligible thickness, increasing in thickness as it passes through ***B*** and even more as it passes through ***A***. The boundary edges and interfaces that fall within the "slice" are highlighted in solid orange and dotted orange respectively. The resulting pattern represents the expected distribution of galaxy concentrations.

With this in mind, we extract, from the model, a wedge-slice that includes a major and a minor node as well as the boundary link joining the two. Our wedge also cuts through the void within the lower structural unit as well as portions of its surrounding interface (shown as the dotted orange lines in Fig. 7(b) (c)). Since the wedge increases in thickness (depth into the page) as it progresses through **B** and upward beyond **A**, more of the boundary edges around **A** will be included.

Now compare the predicted distribution of galaxy concentrations, as sketched in Fig. 7(c), with the famous Geller-Huchra map. Are not the similarities truly startling? The model's major and minor nodes, boundary edges and voids all find correspondence with the image of astronomical structural arrangements of galaxies.

The main galaxy concentration that comprises the stick figure is the Coma Supercluster. It is one of those rare and fortuitous aggregation of galaxies with an orientation such that two nodes are almost perfectly aligned. That is, the line-of-sight into the Coma Cluster is directly along the link between neighboring nodes (labeled **A** and **B** in the schematic diagrams).

Also significant is the fact, long know to astronomers, that the Coma Cluster has a vast empty region in the foreground.[10]

5 ISLANDS OF GALAXIES

The observance of isolated galaxies far removed from others is almost unheard of. Wherever there is one galaxy there you will find (with overwhelming probability) others. And groups are found near other groups, and so on. Galaxies tend to cluster. Nevertheless, there are reports of galaxies having been detected in the center of a void! Images of the Pegasus void, within its circular profile, reveal an isolated clump of galaxies at its center. A similar situation occurs in the Bootes void.[11]

This is most unexpected. Galaxies at a geometric center is once again indicative of some kind of order. Conventional Cosmology simply has no explanation, and what is worse, it predicts the opposite. The conventional theory, committed as it is to the big-explosion concept predicts only randomness and chaotic galaxy distributions.

The explanation for the observance of galaxies in the center of large voids is detailed in a later chapter. Remarkably, DSSU theory supplies two explanations. One supports their island status; the other involves a redshift-distortion oddity.

6 SUMMARY AND REFLECTIONS

WALLS, FILAMENTS, VOIDS, AND WEBS. Margaret Geller described her team's findings as: "the pattern of galaxies in our three-dimensional slice of the universe suggested that sheets, or walls, containing thousands of galaxies mark the boundaries of vast dark regions nearly devoid of galaxies." Corey S. Powell wrote in the July 1992 issue of Scientific American: "Surveys of vast swaths of space reveal galaxies organized into vast sheets and filaments." Some formations stretch about 300 million light years across. Other researchers have referred to web-like patterns in describing the arrangement of superclusters. But the crowning description must be that of "long looping chains" to portray the endlessly linked rhombuses and trapezoids entwined within the DSSU architecture.

The evidence is overwhelming. Sheets of galaxies, right-angled walls of galaxies, filamentous chains of galaxies (called the "fingers of God" by some astronomers), size gradation of clusters, voids, and web-like patterns of galaxy distribution; all relate to geometric features of the dodecahedral bubbles of the DSSU model. The astronomically observed large-scale structures validate the cellular DSSU.

FAILURE OF THE OPPOSING MODEL. Unaware of the dual dynamic causal mechanism that leads to the cosmic cellular structure, conventional theorists have long (far too long) confined themselves in devising ever more complex and ingenious modes of large-scale structure formation within the premise of whole-universe expansion —and in the process have drifted ever farther from reality. Ever since Edwin Hubble in the 1920s popularized the expansion concept, cosmologists have been building on an unsound foundation. The weak foundation principles are never seriously re-examined. Whatever the reason, it underlies the state of academic astrophysics. Fundamental flaws notwithstanding, the process of theory construction continues.

It is now continuing into the early years of the Third Millennium; and if the construction site appears chaotic to the non-specialist observer, be assured it is. Not only is there a profusion of expansion models including many conflicting versions, but also the important details tend to be incomprehensible except to the ordained specialist. All that the average thinking-person really wants to know is *How does the theory connect with reality?*

The expansion-of-the-universe models are disconnected from reality. They are flawed. That is not to say that the various versions (and corresponding theories) are not supported by observations. Not at all. Every attempt is made to attain agreement. But *agreement of theory with observation* and *agreement of theory with reality* is not quite the same thing. The archaic Ptolemaic theory of the Solar System of planetary motions agreed, in practice, with observations —it emphatically *did not* agree with reality. It took Mainstream Science over 1500 years to realize this.

REFLECTING ON COSMIC DISTANCE. We think and speak of cosmic distances in terms that are far too casual in relation to the true magnitude of the spacetime scale. It is difficult to imagine the immense size of just one dodecahedral cosmic bubble, let alone an array of such structures. But imagine we must, because there is no other way. Imagine light beaming outward at a speed of 300,000 km/s, say from a powerful laser on Earth. The light shoots past the moon in 1.3 seconds, past the outermost planet, Pluto, in just over 5 hours. In one year it is only one-quarter of the way to the nearest star. Two and one-half million years later the light beam just reaches the outer edge of the local group of galaxies. After a total of 59 million years the nearest large cluster, Virgo, is reached. A vast cosmic distance stretches ahead in the direction of the Coma cluster. The distance between the Virgo node and the Coma node (approx. 318 million lightyears) is close to the nominal dimension across a cosmic cell —300 million lightyears.

From a staggering speed to an incomprehensible cosmic distance, one can only gasp in awe and not dwell too long on the relative insignificance of our local terrestrial scale. Beyond the Coma cluster and continuing in the same direction, stretch another 400 similar cosmic bubble-like units before the visible limit of the Universe is finally reached. And what lies beyond? Unimaginable infinity. One should not even attempt to perceive infinity. Whatever large quantity one strains to imagine, the balance to infinity will remain unimaginable.

But even the size of a single cosmic bubble is a challenge for the mind. How does one relate to something measuring *300 million lightyears*? There is no easy answer. In any event, a deep awareness of scale is essential for conceptually relating to the enormity of the unit building block of the cosmic architecture. □

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NOTES AND REFERENCES

[1] Galileo, writing in 1597, to his friend Johann Kepler. As in Stephen F. Mason, *A History of the Sciences* (Collier Books, N. Y., 1962) p159

[2] The following textbook contains a remarkable diagram ("Fig. 16-14 Top view of convection cells in a laboratory experiment.") which contains the exact same pattern "flaw" that I have shown in Fig. 2 herein as a *Supernode*. The fluid flows that form convection cells provide a superficial simulation of the space flow that forms cosmic cells. Textbook: Wolfson, Richard and Pasachoff, Jay M., *Physics, Extended with Modern Physics* (Scott, Foreman and Co., 1990) p419

[3] Renée C. Kraan-Korteweg, *Galaxies Behind the Milky Way and the Great Attractor,* (arXiv:astro-ph/0006199 v1 14 Jun 2000)

[4] A.P. Fairall *et al.*, *Large-Scale Structure of the Universe,* Monthly Notices of the Royal Astronomical Society (1990) **247**, p21-p25

[5] Renée C. Kraan-Korteweg, *Galaxies Behind the Milky Way and the Great Attractor* (2000)

[6] A.P. Fairall *et al.*, *Large-Scale Structure of the Universe,* Monthly Notices of the Royal Astronomical Society (1990) **247**, p21-p25

[7] Ibid

[8] CfA Redshift Survey and Catalog website: http://cfa-www.harvard.edu/-huchra/zcat/

[9] **There are three ways to use redshift as a measure of distance:** 1) A redshift index, all by itself, may serve as a measure of relative distance. This is common practice but not very intuitive. 2) A redshift index can be related to the speed of light (a true constant) and converted to a so-called "recession velocity" which is then used as a measure of relative distance. This also is common practice but totally misleading when discussing non-big-bang cosmologies. 3) The redshift can be related to the empirical (and therefore imprecise) Hubble parameter to supply an actual distance, say in lightyears. The problem here is in selecting the value of the Hubble parameter. The empirical nature of the latter method makes it the least popular among professionals; while its intuitive nature makes it the favored method among everyone else. For instance, technically the redshift distance of the core of the Coma Cluster (at NGC4874) is 0.02410 and leaves the average reader unimpressed. Interpretively, the distance to this spectacularly rich cluster is a mind boggling 390 million lightyears (when H = 18.5 km/s per MLY).

[10] Stephen A. Gregory and Laird A. Thompson, *Superclusters and Voids in the Distribution of Galaxies*, Scientific American, March 1982

[11] A.P. Fairall et al., *Large-Scale Structure of the Universe,* Monthly Notices of the Royal Astronomical Society (1990) **247**, p21-p25