THE SPATIAL SHADOW: LIGHT AND DARK—WHOLE AND PART

"Life's but a walking shadow"
Shakespeare, *Macbeth.*

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Introduction

Sunlight and shadow, day and night, solstice and equinox, lunar and solar eclipse–all are astronomical events that transform the surface of the earth into an event focused on the contrast between light and dark. The diurnal dynamics of the sweeping edge of the darkness are a foundation critical to the well-being of life on earth. Artistic expressions are numerous, ranging from Amish quilt patterns ("sunlight and shadow") to Indonesian shadow puppets. From a spatial standpoint, the mantle of night serves as a continuum linking disparate elements of the earth's surface; it is a whole composed of unseen parts.

WHOLE AND PART:
A Sculptural Unification of Unseen Parts.

The Four Corners Project

"The Four Corners Project," conceived in 1976 and completed in 1985, consists of an invisible tetrahedron spanning the inside of the earth with the four separate corners, made of marble, protruding from the crust of the earth (Figure 1). [1] These individual marble corner-markers (each about four inches high) were positioned in Easter Island, South Africa, Greenland, and New Guinea, with imaginary planes extending through the earth from each corner to the other three. The length of the imaginary line planned to link each pair of terrestrial markers is approximately 6465 miles. [2] One must know what a tetrahedron looks like and expand the scale of this knowledge to the scale of the entire earth to view this sculpture. In this respect, the art follows the pattern of the natural astronomical, global patterns of light and dark that require some sort of global perspective to envision a whole created from disparate unseen parts.

This tetrahedron is larger than proximate space. It is an abstraction that can be appreciated, as a whole, only in the mind; images of it created visually through written, printed, and verbal records encompass a broader view of it than does any collection of images taken from arbitrary physical vantage points in the universe. It is a shared perception, transcending language, that spans the minds of those who participate. [3] It requires abstract visualization, rather than physical vision, to "see" the entire sculpture.

This sculpture creates a conceptual unit from discrete parts that coalesces the evolutionary sequence of constructivistic, structurist art as well as the philosophical concerns of Zen gardens. In the structurist vocabulary, the art work draws the physical eye from one discrete component to another, and the unity of the work is revealed through the relationships of the components rather than through singular objects. In an early effort (1934), Henry Moore ("Four-Piece Composition") used the negative space of the sculpture to draw the physical eye, in proximate space, from one discrete component to another in order to suggest a single reclining figure [4]. The Zen garden at Ryoan-ji has stones arranged deliberately so that the whole can never be totally seen from a single perspective. Thus, the viewer, as in the Four Corners Project, must always be in a less than "divine" physical, perceptual position. Structurist reliefs emphasize the relationships among parts rather than the characterization of the parts themselves; [5] in this regard, "Four Corners" is a structurist concept at a global

Figure 1. The Four Corners Project. Four marble tetrahedra, each 4 inches high, mark the corners of a suggested, invisible, tetrahedron inscribed in the earth. Side length of the suggested large tetrahedron is about 6465 miles. Marker locations are in Easter Island, South Africa, Greenland, and New Guinea.

scale. In all of these cases, the unity of the entire piece unfolds naturally only when a leap of the imagination gives wholeness to the sculpture–whether that leap is in proximate or global space.

Geographical Background of the Four Corners

Barr fixed the general positions for the four corners on landmasses, using a globe and dividers; Nystuen pin-pointed each, using rotation matrices to align the North-South pole-based graticule with one using Easter Island and its antipodal point in the Thar Desert as poles. [6] Easter Island was chosen as the initial corner on account of its numerous cultural connections to the history of sculpture.

Embedding this tetrahedron in the earth-sphere (using the Clarke ellipsoid circumference of 24,873.535 miles [7]) required theoretical assumptions but also reflected the empirical facts of land/water distribution on earth--no corner was to be submerged in a lake or ocean. The environment and local surface materials surrounding the chosen corners are apt--from the igneous rock below a volcanic island, to the granitic sand in a desert, to the crystalline forms in an ice cap, to the organic material of a mangrove swamp. Indeed, the choice of the tetrahedron within the earth-sphere intentionally reflects the structure of the carbon atom as a fundamental component of life.

In 1980, Barr began to place the vertices of the tetrahedron; Table 1 shows the itinerary. The process that led to the completed product in 1985 involved the participation, from initial struggle to eventual respect and acceptance, of people from backgrounds not usually linked to the world of art: African veldt farmers, Eskimos, Irian Jayan missionaries, soldiers, police, politicians, and diplomats (for example, Table 1 shows the names of most of the airplane pilots who participated in the placement of these corners--they suggest the rich diversity of peoples associated with various aspects of this project).

TABLE 1
Log of travels associated with placement of the four corners
Listing compiled by Heather and Gillian Barr.

DESTINATIONS	**NAME OF AIRPLANE CAPTAIN**
DECEMBER AND JANUARY, 1980-81	
MACHU PICCHU, EASTER ISLAND, AND SOUTH AFRICA	
Detroit to Miami	John Bosh
Miami to Lima	Dick Rudman
Lima to Cuzco	Hugo Bisso
Cuzco to Lima	Eduardo Camino
Lima to Santiago	Javier Mesa
Santiago to Easter Island	Alphonso Estay
Easter Island to Santiago	Gustavo Vila
Santiago to Buenos Aires	Sergio Kurth
Buenos Aires to Cape Town	Carlos Bustamante
Cape Town to Johannesburg	Steev Kaup
Johannesburg to New York	Tony Laas
New York to Detroit	Hal Grenddin

JULY, 1981

GREENLAND

Windsor to Montreal	Mr. Golze
Montreal to Frobisher	Mr. Savage
Frobisher to Sonderstrom Fjord	Patty Doyle
Sonderstrom Fjord to Ice Cap	Patty Doyle
Ice Cap to Sonderstrom	Patty Doyle
Sonderstrom to Godthab (Nuuk)	Patty Doyle
Godthab to Frobisher	Sven Syversen
Frobisher to Montreal	Carl Gitto
Montreal to Windsor	Louis Ghyrmothy

JANUARY, 1985

IRIAN JAYA

Djajpura to Danau Bira	Poambang Kuncaro a.k.a."Bang Bang Koon"
Danau Bira to Djajpura	Bang Bang Koon
Djajpura to Biac	Mr. Fujiono
Biac to Ujung Pandang	Mr. Darynato
Ujung Pandang to Bali	Angus Tiansyah
Bali to Djakarta	Mr. Sunarto
Djakarta to Singapore	Mr. Tan

In December of 1980, Barr and his party (which included other fine artists and a professional dancer) went to Machu Picchu, where the tetrahedral marble pinnacles were washed at the ancient ceremonial site (at the sundial called "ini-huatana" ("hitching post of the sun")), prior to placement in the ground. From there they went to Easter Island; surveying equipment of William Mulloy [8], a member of Thor Heyerdahl's expedition to that island, was used to place the first vertex of the tetrahedron on January 4, 1981 (Table 2), one minute of longitude from the calculational center of 109° 25'30". This location has elevation just above sea level and is in a former leper colony.

TABLE 2
Geographic coordinates of the Four Corners

Site	Latitude	Longitude
Easter Island	27°06′20″ S	109°24′30″ W
South Africa	27°30′36″ S	024°06′00″ E
Greenland	72°38′24″ N	041°55′12″ W
New Guinea [actual]	02°20′50″ S	138°00′00″ E
New Guinea [planned]	02°06′36″ S	137°23′24″ E

imperfections are imperceptible. It is only with our imaginations that we can appreciate the difference between the ideal and terrestrial forms.

Mathematical Uniqueness of the Four Corners
—Extensions of the idea

When spherical trigonometry was applied to a map showing all landmasses whose antipodal points are also land-based (Figure 2) [10] it was possible to prove that the choice of a tetrahedron as a shape for this sculpture is unique within the set of regular polyhedra called "Platonic" solids. [11] Plato linked the set of five regular polyhedra (tetrahedron, cube, octahedron–polyhedron with eight triangular faces, dodecahedron–polyhedron with twelve pentagonal faces, and icosahedron–polyhedron with twenty triangular faces) with five basic components from which he believed the earth to have been formed. [12] No Platonic solid, other than the tetrahedron, can be embedded in the earth with all corners on land, one of which is on Easter Island. [13]

It also follows from the mathematics that, although the tetrahedron is unique as a choice, there are an infinite number of possible positions in which it might have been oriented within the earth (Figure 3). The possibilities for the corners other than Easter Island are, however, tightly constrained within the arcs of the circle of "latitude" (centered on C, the antipodal point of Easter Island in the Thar Desert) shown in Figure 3. (An azimuthal equidistant projection was used because distances measured from the center are true.) Once a point is chosen within one of these arcs as a corner site, the choices for the other two corners are forced (as the remaining vertices of an equilateral triangle inscribed in the circle of "latitude"). [14] These three sites form the triangular base of a tetrahedron with Easter Island (unseen in Figure 3) at the apex of the solid, on the other side of the earth from the center of the circle in Figure 3.

The after-the-fact discoveries that the choice of the tetrahedron was unique within the set of Platonic solids, and that the extent of infinite "play" in site selection could be constrained within specified bounded intervals, enhance the planned selection of Easter Island as the choice for the initial vertex of the tetrahedron. Indeed, other choices were considered as an initial vertex; however, the idea of using this tiny patch of land in the Pacific hemisphere as the anchor for this "titanic" tetrahedron of terrestrial sites, not only proved possible, but irresistible as well.

LIGHT AND DARK:
A problem of boundary.

Natural boundaries, such as those between water and land, are often crenulated and complex. Many words are necessary to translate a natural boundary into a cadastral sur-

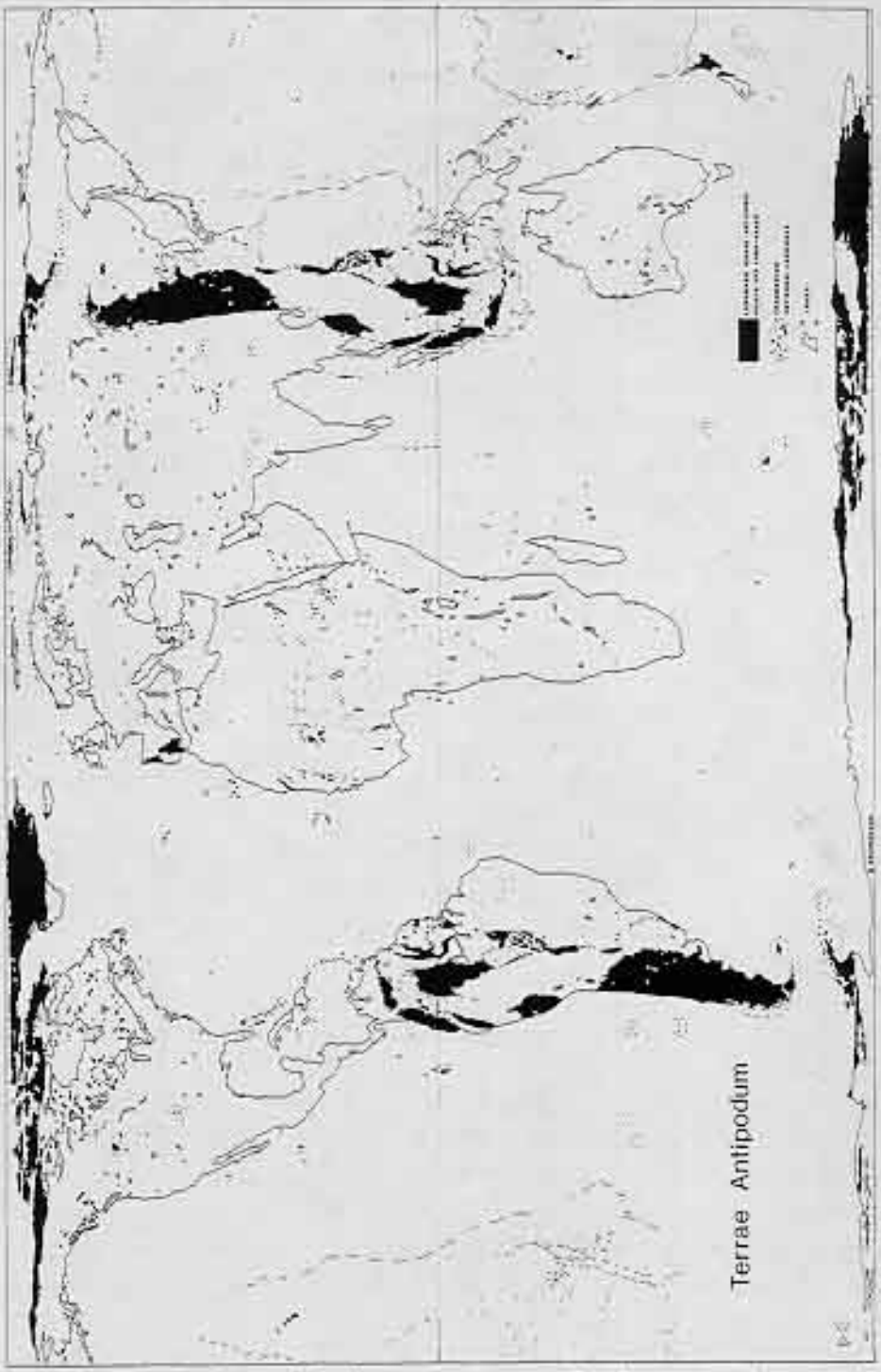

Figure 2. Terrae Antipodum. Dark areas represent landmasses whose antipodal points are on land. Fragmented antipodal landmasses (archipelagos) are encircled by dashed lines. Antipodal continental outlines are shown (where needed to understand the map) over the ocean as dashed lines. The base map is a Peters projection. The equator bisects the vertical neat line. This map was used to establish uniqueness of the choice of a tetrahedron within Barr's constraints.

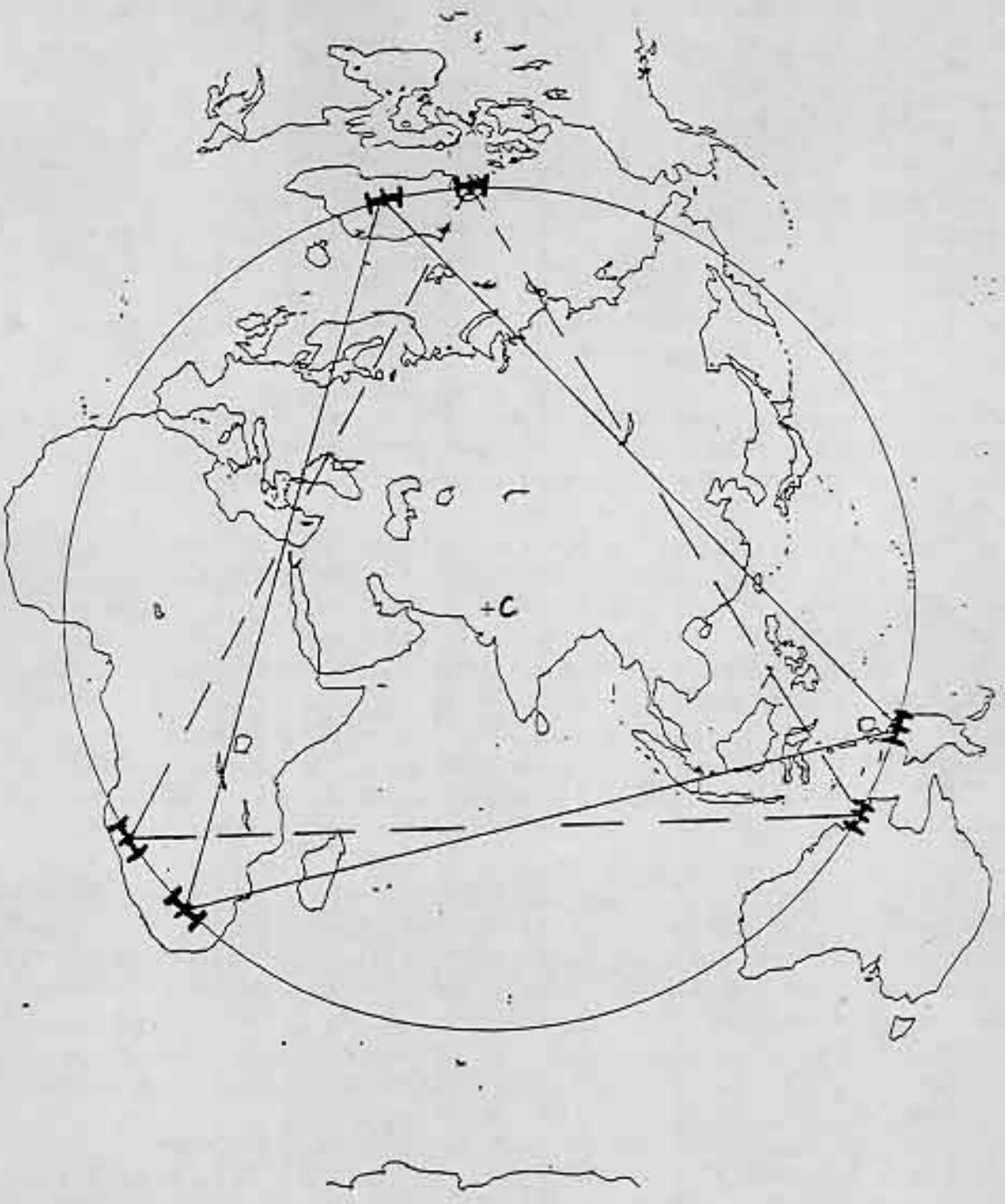

Figure 3. Shaded intervals show all possible land-based locations for three corners of the base of a tetrahedon with Easter Island as apex of the solid inscribed in the earth. Easter Island is antipodal to the center of the circle, C. The base map is an azimuthal equidistant projection. Any distance measured from the center, C, is true.

vey description. At places where the abstract and natural boundaries intersect, interesting arrangements can arise.

SunSweep

SunSweep is a sculpture in three separate locations along the U.S./Canadian border that was designed to commemorate the peaceful interaction across this border. Its three parts are located at places where natural and abstract boundaries intersect. The western terminus is on a bit of U.S. territory which can only be reached, on land, by passing through Canada. The eastern terminus is on a bit of Canadian territory which can only be reached, on land, by passing through the United States. Thus, a nice symmetry is created by the intersection of a natural and an abstract boundary; this symmetry is intentionally reflected in the choices for the locations and in the physical shapes of the elements of the SunSweep sculpture (Figure 4). The sculpture represents the arch of the sun in the sky from east to west. Coincidentally, perhaps, Barr noted a common social outlook among the people inhabiting these anomalous locations– they appeared to share a kind of independence coming from this blurred boundary, suggesting a unity in social perspective associated with this sculpture.

Geographical Background of *SunSweep*

The eastern-most piece, arching inland, is situated on Campobello Island in New Brunswick; the western-most piece, also arching inland, is on Point Roberts in the State of Washington; and, the keystone of the arch, composed of two separate stone elements, is on an island in the Lake-of-the-Woods in Minnesota (Figure 5: a, b, c). Each piece is about five feet tall and is formed from selectively polished flame-finished black Canadian granite carved, in Michigan, from one mass.

These markers that trace the sweep of the sun across the celestial sphere were sited close to the U.S./Canadian border to commemorate the spirit of cooperation between these two countries. A hand print, suggesting "I was here," has been lasered into the polished stone–a "Canadian" print on one side pressing against its mirror image "United States" print on the other side.

The choice of locations for the sculpture suggests the path of the sun; they were selected with an eye to displaying the interplay of ideas between astronomical sweep and political boundary–as geographic "boundary dwellers" in the world of art. [15] They were also selected for their characteristic of physically forcing (in terms of access) interdigitation between U.S. and Canadian boundaries.

Thus Campobello Island, maintained as an International Park, is the site for the eastern piece; the arch is situated on Ragged Point (Table 3), a Canadian location accessible by road only through the United States. The trail leading to the sculpture is the "SunSweep" Trail, formerly known as the "Muskie Trail" and re-named at the suggestion of Senator Edmund Muskie of the State of Maine. The western-most piece of the arch is situated in Lighthouse Park on Point Roberts (Table 3), a United States community at the southern tip of a spit of land that is accessible (by land) only through Canada. American Point (Penasse Island), Minnesota, the northernmost U.S. island (Table 3) in the Lake-of-the-Woods (Lake situated on the U.S./Canadian border), is close to a U. S. peninsula which is accessible by land only through Canada; it is the site of the keystone for the arch in the locale referred to as "Northwest Angle" which, other than those in Alaska, contains the only U.S. landmasses north of the 49th parallel.

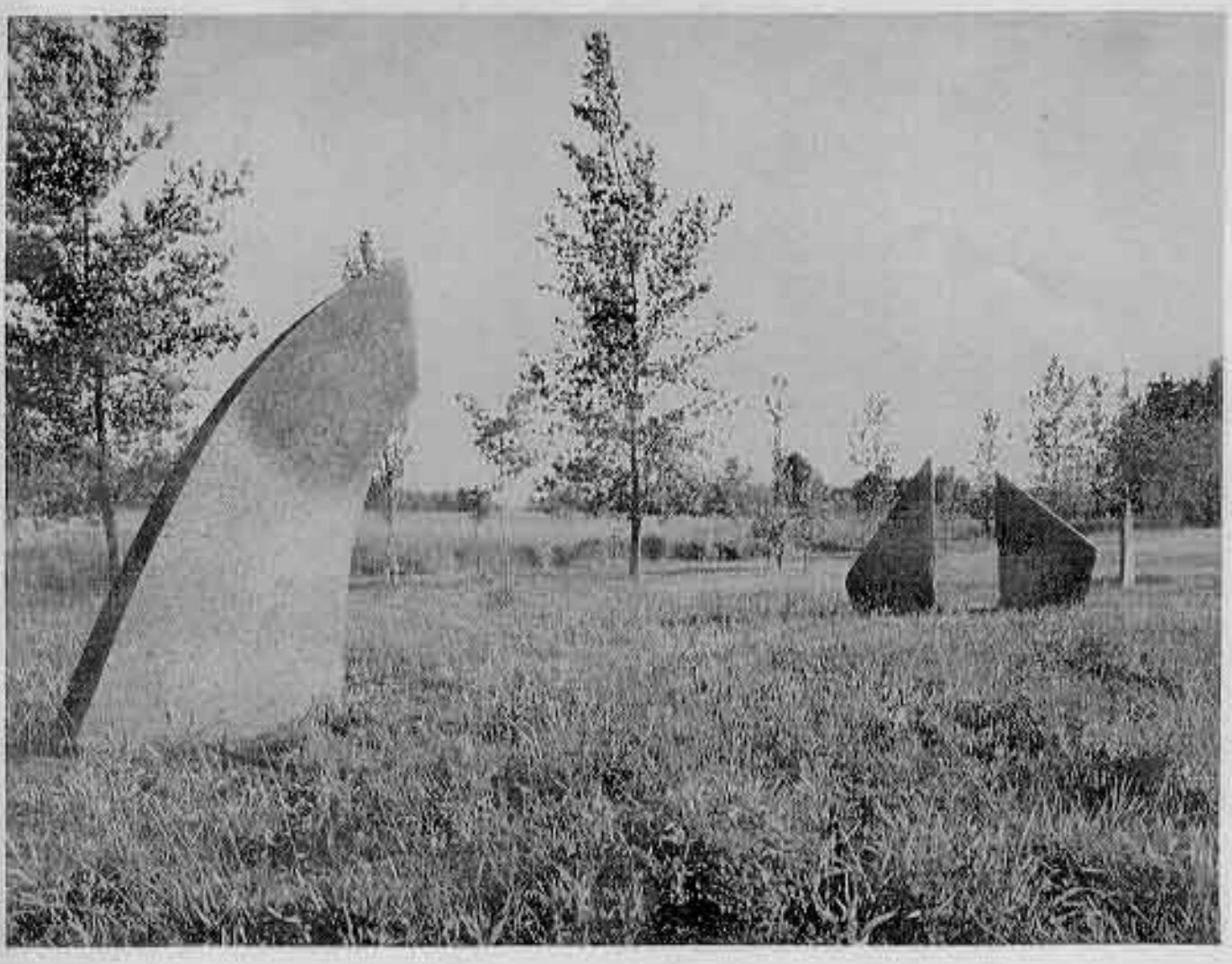

Figure 4. SunSweep. The 5-foot high earth-markers set out on a lawn, prior to placement along the U.S./Canada border.

Grooves lasered into the sides of one element of the keystone piece and the top edge of the sculpture offer visitors the opportunity to tie location to selected astronomical events. The top edge is angled so that a sunbeam is parallel to it on the summer solstice; a groove in one side is angled to align with the sun on both equinoxes; and, a groove on the other

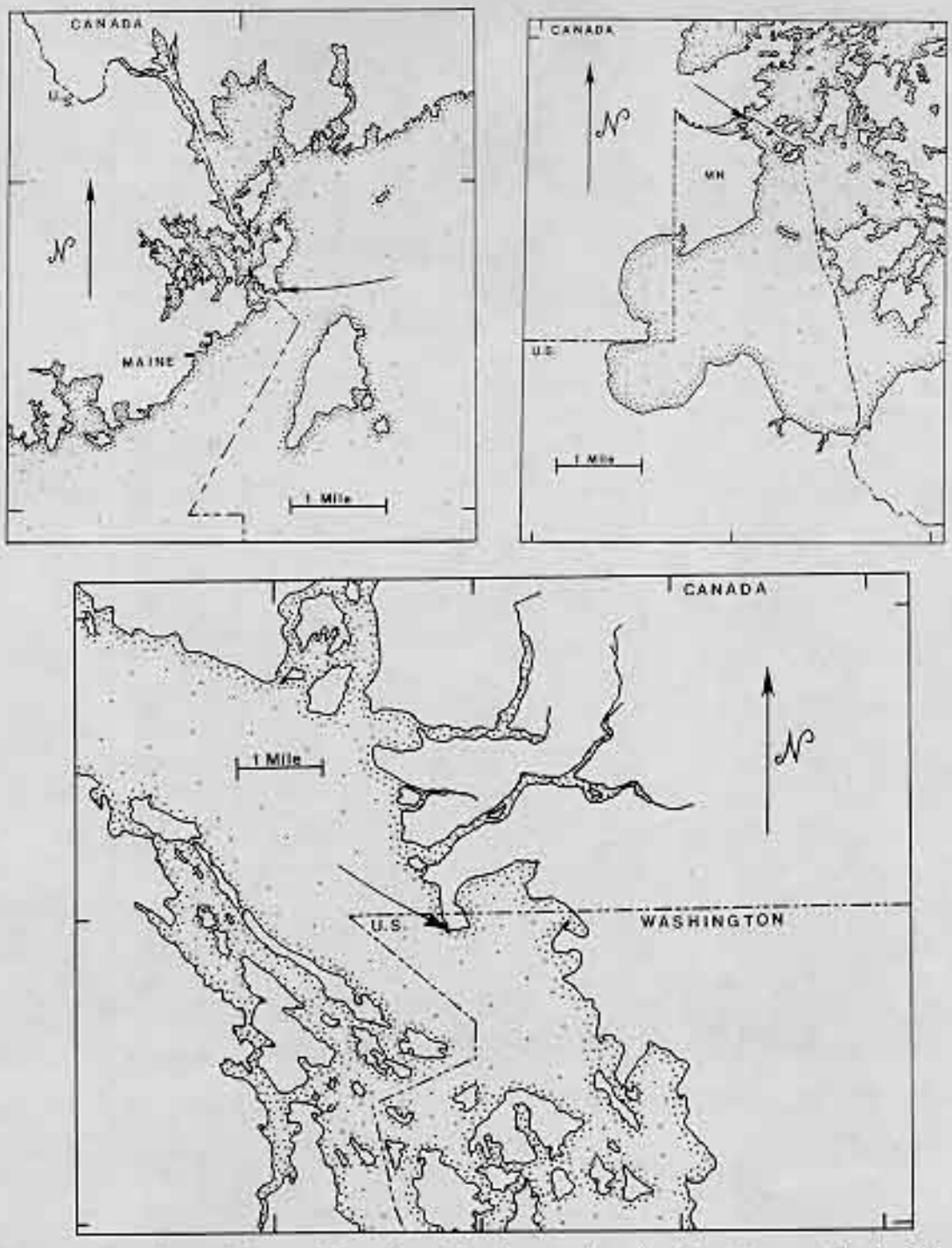

Figure 5. a, b, c. Maps of the three SunSweep sites (a, New Brunswick; b, Minnesota; c, Washington) emphasizing interdigitation associated with anomalous locations along the U.S./Canada boundary.

side is angled to align with the sun on the winter solstice. The shadows cast by a sunbeam at each astronomical event would suggest a tracing on the ground, with the succession of the seasons, in the shape of an analemma [16], calling to mind the equation of time and

TABLE 3
Geographic coordinates of SunSweep

Site	Latitude	Longitude
Campobello Island, NB	44°50′10" N	066°55′25" W
Point Roberts, WA	48°58′23" N	123°05′00" W
Lake-of-the-Woods, MN	49°21′45" N	094°57′40" W

ultimately Kepler's Laws of planetary motion. [17]

The second element of the Minnesota piece is aligned to the North Star. These markers were installed on the summer solstice of 1985. The alignments to the sun on this date and to the North Star appeared true. The pieces in New Brunswick and Washington were aligned subtly to each solstice and equinox position using the beveling planes of the granite and the orientation in the pattern of sited, smaller rocks surrounding the sculpture.

The markers at each site have a bronze plaque set in the concrete base describing their metaphor. At the installation of the sculpture in Washington, the arch arrived broken and was cemented together as it was set into concrete in the ground. [18] Future generations who come across this irregular crack might wonder what it "means," and whether or not it represents an alignment to some peculiar astronomical event. At best, it might be regarded as a remnant of a transportation system not geared to shipping heavy, brittle items with great success! The local citizenry is reconciled to the crack and in fact take delight in this sculpture as their "Liberty Bell."

Mathematical Extensions of the ideas behind *SunSweep*

These three locations, selected initially for unique boundary characteristics, closely approximate ideal geometric placement along an arc of a great circle. A summary of how the actual measurements differ from the "ideal" ones is shown in Table 4. The keystone location is, in fact, not halfway between the ends as one might hope for in a perfect arch. The great circle distance from the New Brunswick site to the Minnesota site is longer than the distance from the Minnesota site to the Washington site.

TABLE 4
Great Circle Distances between SunSweep Sites.

Sites	Distance in miles
Campobello Island to Lake-of-the-Woods	1347
Lake-of-the-Woods to Point Roberts	1263
[SUM:	2610]
Campobello Island to Point Roberts	2605
[Mid-point of entire great circle sweep	1302.5]

In addition, the three locations, as a set, do not lie along a single great circle; ideally, it might have been desirable to have them do so in order to keep the arch within a single plane passing through the earth's center. This sort of ideal arrangement was not possible, however, because of the requirement of interdigitation of U.S. and Canadian boundaries. Still, the actual placement of the markers is quite close to the ideal: the great circle distance from the New Brunswick location to the Washington location is 2605 miles–only 5 miles shorter than

the sum of the component distances. Indeed, the midpoint of the great circle arc joining the New Brunswick location to the Washington location is at about 49 degrees 5 minutes North Latitude, 93 degrees 56 minutes West Longitude–a great circle distance of about 60 miles to a site east and slightly south of the actual location of the sculpted keystone. As was the case with "Four Corners," the unity of the entire "SunSweep" unfolds naturally only when a leap of the imagination gives wholeness to the sculpture; in this case that wholeness is suggested by a sequence of anomalous locations along a political boundary.

Political boundaries are abstract and often simply defined, an advantage in conflict resolution. The "Oregon Question" that agitated England and the United States for a generation was resolved during the James Polk administration (1846) by the simple agreement to extend the northwestern boundary along the 49th parallel from the Lake-of-the-Woods to the Pacific, [19] an arc of 1263 miles (great circle distance 1256 miles). Vancouver Island extends south of this line but the continental boundary ends where the 49th parallel reaches Puget Sound.

The fact that the great circle distance between the western and middle sculpture sites rounds off to the same length as the length of the U.S./Canadian land border along the 49th parallel was unplanned in the sculpture. As was the case with the uniqueness of the choice of the tetrahedron for the Four Corners Project, this too was an after-the-fact discovery, linking both geography and mathematics to sculpture.

THE SPATIAL SHADOW:

A theoretical framework.

The emergence of the after-the-fact discoveries surrounding these sculptures suggests the suitability of looking for theory to link the concepts underlying these particular art projects, much as poetry might be after-the-fact theory linking already- existing word-images. To do so, we draw on the interdisciplinary ties linking mathematics to geography, and linking both to art.

Thus, we adopt a view in which mathematics includes the science of abstract space; in which geography ties this science of space to the real world; and, in which art offers abstract means to appreciate these ties. A set of postulates of the "science of space" were created in the late nineteenth century by William Kingdon Clifford drawing only on common-sense notions of continuity and discreteness, flatness, magnification and contraction, and similarity, that formed part of the foundation of the non-Euclidean geometries at the base of modern physics. [20] By considering a set of fundamental relations, simply expressed, it became possible to analyze spatial relations in a fashion that did not rely solely on Euclid's postulates, and particularly not necessarily on Euclid's parallel postulate. [21]

We consider a transformational approach to theory, echoing the emphasis of contemporary "global" mathematics in seeking properties which remain invariant when carried via transformation from one space to another. It might be tempting to consider sunlight as a basic unit, because light coming through the sculpture is what links the geometry of the sculpture with the reality of the earth. With the sun at an "infinite" distance from earth, its beams are parallel to each other (from our vantage point). Incoming solar radiation might therefore be considered an "affine" transformation (in which sets of parallel lines are invariant) that maps elements protruding from the earth's surface as shadows onto the earth's surface (as in a structurist relief). [22] There are a number of appealing elements to this par-

ticular transformational approach. The affine transformation is the basis of much computer software for displaying graphics, suggesting a natural alignment of theory and computer mapping in order to merge the mathematics of sculptural structures with the spatial relations of the earth. [23]

Because such an approach has the concept of affine transformation at its heart, however, it necessarily emphasizes the notion of parallelism. Our emphasis is, rather, on separate pieces whose relationship creates a single unit of art composed of separate parts intentionally devoid of interest in order to focus on that relationship, as (quotation attributed to Einstein)

"History [Art] consists of relationships rather than events"
A. Einstein.

It seems therefore, inappropriate to forge a linkage with theory based on parallelism. Far more suitable is to follow the lesson learned from Clifford and find basic elements that better match that which we seek to characterize. [24]

The concept of shadow, rather than the affine transformation that creates the shadow, seems a better choice as a fundamental unit with which to work. Single spatial shadows (of physical objects) are discrete units of individual character; yet, they change in response to diurnal fluctuations, eventually to become united in a single nighttime continuum under the global spatial shadow of the earth on itself. Indeed, the concept of shadow, itself, also embodies the notion of transformation–

"The shadows now so long do grow,
That brambles like tall cedars show,
Molehills seem mountains, and the ant
Appears a monstrous elephant."
Charles Cotton, *Evening Quatrains*.

"Shadow" is dynamic mathematically, as a transformation, as well as geographically, as the sweeping boundary separating light from dark that refreshes the earth on a daily cycle. Shadow is tied directly to time through the diurnal motions of the Earth, and it is tied indirectly to time, at a personal level, as well. Each individual casts a personal time-shadow–a long trail of experiences representing accumulated wisdom over a period of years (and growing longer all the time), together with a short extension into a "cone" of opportunity, generated by a space-time continuum, into the near future. [25] The analysis of the manner in which these temporal shadows might become unified in some global manner [26] is no doubt better left to philosopy and religion as

"Time watches from the shadow".
W. H. Auden, Birthday Poem.

With spatial shadows and temporal shadows, one might recast Clifford's postulates for a Science of Space as Postulates for light and dark based on the concept of shadow. The contrast between light and dark, and sunlight and shadow, gives insight into the shape of things; or, as Clifford put it,

"Out of pictures, we imagine a world of solid things,"

a statement reminiscent of Plato's "Den". [27] That is, a shadow is a creature that exists as a transformation of a three dimensional object onto a two-dimensional surface much as the relief format is the transitional step from two-dimensional paintings to full three dimensional art. The shape and position of the shadow are a function of

1. the shape of the three-dimensional object,
2. the orientation of the three-dimensional object in relation to the light source, and
3. the curvature of the receiving surface.

The concept of shadow links these elements and therefore represents a relationship that is "structurist" in nature.

Clifford's statement of his postulates for a Science of Space follows. [28]

"1. Postulate of Continuity. Space is a continuous aggregate of points, not a discrete aggregate.
2. Property of Elementary Flatness. Any curved surface which is such that the more you magnify it, the flatter it gets is said to possess elementary flatness.
3. Postulate of Superposition. A body can be moved about in space without altering its size or shape.
4. Postulate of Similarity. According to this postulate, any figure may be magnified or diminished in any degree without altering its shape."

Both "space" and "darkness" are diffuse, rather than linear, as concepts; their "lateral" character suggests that they, and other concepts possessing this characteristic, such as time, continuity, or inclusion/exclusion, have the power to unify. Thus, we rethink Clifford's postulates within his stated context, to see if they can be reasonably recast as a different set of postulates concerning light and dark.

Shadow Postulates

1. Postulate of Continuity. Total darkness is a continuous aggregate of shadow, and not a discrete aggregate of individual shadows.

Indeed, total darkness on the earth is continuous as it is formed from a single global shadow of the earth on itself; all other shadows are lesser. This global shadow is a limiting position that a sum of discrete aggregates of shadow might approach but never reach; the whole is greater than the sum of its parts.

2. Postulate of Equinox. On every surface which has this property, all but a finite number of points are such that they are in darkness and light an equal amount of time.

Clifford notes that any surface that possesses his property of elementary flatness is one on which "the amount of turning necessary to take a direction all round into its first position is the same for all points on the surface." This is suggestive of what happens on earth at the time of the equinoxes in which all parallels of latitude are bisected by the edge of darkness so that all but the poles spend half the diurnal cycle in light and half in dark. Hence the restatement of "Elementary Flatness" as "Equinox."

3. Postulate of Unique Position. The length and angle of individual shadows impart information, in a unique fashion, as to position on earth.

One consequence of Clifford's Postulate of Superposition is that "all parts of space are exactly alike." A body can be moved about in space without altering its size or shape, but its shadow changes at every different location on earth (at a given instant). Thus the Postulate of Unique Position is parallel to that of Superposition.

4. Postulate of Solstice. On every surface which has this property, all but a finite number of points are such that they are in darkness and light an unequal amount of time.

Using the idea in Clifford's Postulate of Similarity, any shadow of a single object may become magnified or diminished in any degree, through time. However, the shape of the object which casts the shadow remains unchanged. The Earth's shadow always covers exactly half of the earth-sphere (in theory). The dark/light boundary slips over the Earth's surface covering half of it in darkness, altering the extent to which shadows of unchanged objects become magnified or diminished. During this process, not all points experience the same amount of darkness. Hence, "Similarity" is replaced with "Solstice." The dynamics of this process are bounded between two parallels (the Tropics), so that there is also implied parallelism associated with this Postulate, just as Lobatschewsky noted implied parallelism associated with Clifford's fourth postulate and rejected it in order to consider using his geometry to understand astronomical space. [29]

Now this set of postulates "fits" with the earth and its shadow (indeed, the earth motivated it). The reader wishing to determine where the dark/light boundary appears at a given time at a given location need only perform the following construction, [30] using a globe on a sunny day. Point the north pole of the globe toward the earth's north pole (make compensating adjustments for southern hemisphere locations), where meridians of longitude converge. Rotate the globe on this north/south axis until your location appears on top of the globe–where a plane "parallel" to the surface of the earth is tangent to the globe. The shadow cast by the sun on the globe will trace out accurately the position of the light/dark boundary on the earth at that moment. This construction works because it amounts to putting the globe in exactly the position that the earth is in relative to the sun–it is a good example of Shadow Postulate 3 concerning Unique Position because the globe position required is unique for each point on earth, even though each unique position will generate the same position for the shadow. (Postulate 1 applies, and Postulate 2 applies on two days of the year and Postulate 4 applies otherwise.)

A natural next step is then to turn these postulates back around on the style of sculpture (that of discrete units that suggest unity) that motivated them. Shadow is a sort of underlying, continuous and rhythmical, [31] phrasing in a poetry of dark and light. The postulates offer a strategy to see what "poetic images" can be formed within this poetic phrasing.

SunSweep is a sculpture in three discrete parts. Thus, Shadow Postulates 1, 2, and 4, which are tied to continuity are not of particular interest, though they are significant in explaining the sun-sighting from each position. Shadow Postulate 3, dealing with Unique Position, is the natural, abstract "line" of logic joining the sites, as the "Sunsweep." Light coming through the keystone is what merges its geometry with the reality of the earth, as a seasonal analemma traced out on the earth by pencils of sunlight. The concept of light and dark, viewed within the concept of Unique Position, is what abstractly links the three SunSweep sites, and their sun-sighting capability, as a unit.

With the Four Corners Project, we have the possibility of considering the more global postulates because of the requirement of a global view from which to visualize the entire sculpture. In this case, the interesting alignments of sculpture with theory appear to be in the Equinox and Solstice Shadow Postulates. Four Corners may be referenced using standard geographic latitude and longitude, but it is most easily referenced using a spherical coordinate system of latitude and longitude based on a polar axis through one of the four corners and its antipodal point. Rotation matrices, from linear algebra, may then be used to move from one coordinate system to the other. Thus, if one views the Four Corners Project as having a

"North" Pole at the Greenland corner, it seems natural to ask whether or not "Equinox" and "Solstice" relative to this coordinate system coincide with astronomical equinox and solstice positions of the earth. Indeed, the concepts apply, but the results are different.

Because the only parts of this earth-scale sculpture touched by sunlight are the corners: "equinox" occurs when exactly two of the corners are illuminated and two are in the earth's shadow; "solstice" occurs otherwise. "Equinox" is clearly a more frequent occurrence with the Four Corners than it is with the Earth. In this view, the natural concept drawing the Four Corners together as a unit is that of spatial relations between Earth and the Solar System as Equinox and Solstice, and at the same time, this human construct of "Four Corners" enlightens the natural occurence of equinox and solstice.

In both cases, the postulates of light and dark serve as a natural abstract line to suggest unity, much as the physical positioning of proximate discrete pieces suggests natural lines along which to sight in a wide range of artistic efforts. This is an alignment of fundamental ideas. It is reasonable to consider therefore where this might lead, both in terms of art and in terms of formal theory.

Further directions appear two-fold: first, in the world of art, it may be useful to consider other existing art in this after-the-fact mode and then to employ these postulates as part of a plan in developing discrete sculpture to suggest unity; and second, in the world of formal theory, it seems appropriate to extend abstract theory from the postulates with an eye to possibly turning it back around on art. One direction that is currently being investigated by Kenneth Snelson is in the arena of mathematics applied to spheres, particularly to those applications developed in analogy with the earth's position in the solar system. Pauli's Exclusion Principle of quantum mechanics, which rests on likening the spin of an electron to the diurnal spinning of the earth on its axis, serves as a sort of spatial starting point for his alignments of modern physics and sculpture. [32] (According to Pauli's principle, no two electrons can be in the same orbit of the nucleus. [33]) In a related, but different, direction, the use of Clifford's postulates suggests that a suitable extension of ideas might arise in the world of various non-Euclidean geometries and particularly in those whose Euclidean models are often cast in terms of a sphere.

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Written July, 1990, revised, March, 1991, and June, 1991. All funds for the art projects described herein were supplied by David Barr.