From the desk of Pierre Beaudry

LEONARDO DA VINCI'S {*VIRGIN OF THE ROCKS*}: A FIELD-PERSPECTIVE EXPERIMENT IN LEIBNIZIAN DYNAMICS

by Pierre Beaudry 9/1/2008

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"{*Linear perspective...is calculated mathematically, [but] aerial perspective...can only be grasped by the sentiment. By comparing these two sciences, where one is sensual, the other ideal, the methodical course of one will help penetrate the mysteries of the other... [Aerial Perspective] is the art of generating ideas by means of the senses, of acting on the soul by the organ of vision. It is in this way that it acquires its importance that it competes with poetry; that it can, like poetry, enlighten the mind, warm the heart, excite and nourish higher emotions. We shall emphasize the contribution that it can bring to morality and to government; and how, in the hands of the skillful legislator, it will be a powerful means of instilling horror of slavery, and love of the fatherland, and will lead man to virtue.*}" (Lazare Carnot, from the "Drawing" section of the Public Works curriculum, Ecole Polytechnique, 1794.)

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INTRODUCTION

The central issue of classical artistic composition is always the crafting of some irony that reflects a moment of crisis, an axiomatic change, or a dark turning point that is also a bright moment of opportunity in the course of human history. Such ironies are unique because they can be readily recognized as expressing two opposite emotions at the same time: for instance, the fear of death and the hope of immortality. {*The purpose, here therefore, is to look into Universal History and locate works of art that embody such ironies which have the effect of being deadly and life-saving at the same time*; *deadly because, like a good joke, they destroy mediocrity, and life-saving, because they contain an unassailable crushing truth for changing the world.*}

Furthermore, as Lyn emphasized, "science without art, and art without science, neither works." In his 1998 paper on {*The Substance of Morality in Science and Statecraft*}, Lyn emphasized the importance of determining the scientific manifold by a cultural manifold in a dynamic way; that is, by applying, for instance, the principle which was elaborated and studied at the Ecole Polytechnique of Gaspard Monge and Lazare Carnot, in France, during the early part of the French Revolution, and later, applied in the United States, at the West Point Military Academy of Superintendent Sylvanus Thayer. Lyn has reiterated the same intention of statecraft in his more recent article {*How Space Is Organized*}, EIR, September 14, 2007, in which he emphasized the role of a higher visual and auditory function that he identified with the paradoxical notion of {*wavicle*}.

Such a paradoxical topic can only be examined properly when a reciprocal interference occurs between the object of observation and the instrument of measuring it's change; for example, when a spectator is self-consciously changed by a well-played tragedy of Aeschylus, Shakespeare, or Schiller. Max Plank had observed a similar phenomenon in sub-atomic physics when he wrote: "{*As a matter of fact every measurement, whatever the method of its employment, invariably interferes more or less with the event to be measured, as was seen above when we dealt with the electron in motion whose path is interfered with when it is illuminated, the interference varying with the intensity of the illumination, and the illumination being essential for the measurement.*}" (Max Plank, *The Philosophy of Physics*, The Norton Library, New York, 1936, p. 69) What this demonstrates is that science and art do not oppose each other, as if one were objective and the other subjective. Both science and art are subjective with respect to the human function of mastering and changing the universe, physically and socially. The point is that both science and art measure their progress by subjective change.

To emphasize Lyn's central point with respect to the same issue in dealing with Leonardo da Vinci's *Lady of the Rocks*, I recall for the reader what Lyn wrote on this subject, ten years ago:

> "{*In plastic art, for example, Leonardo da Vinci exemplifies the duality of all Classic art. This duality is expressed, on the one side, as the obligation to subordinate the composition of plastic art to scientific truthfulness. On the other*

side, truth demands that we recognize the ironies, the metaphors, to which we must be led by any truthful scrutiny of principle of composition. Leonardo's revolutionary view of the vanishing point is an example of this ironical principle. The role of two sources of light in Leonardo's {Virgin of the Rocks}, is a model of such metaphor.}" (Lyndon H LaRouche Jr., {*The Substance of Morality in Science and Statecraft*}, EIR, June 26, 1998, p.40.)

However, as Lyn reiterated the matter again recently, such a creative process of field-perspective experiment cannot be found in mechanics or in mathematics:

"{*It is here, in the higher domain, beyond any formal mathematical deduction-induction, that we encounter the quality of human mental action which generates the idea of an experimentally validated notion of a universal physical principle,* an insight *which can* then *be applied to the mathematical domain. Creativity does not lie within a mathematics scheme, but, rather is that which acts upon a mathematics scheme to change it. It is here, not in the mathematics as such, that the specifically human power of creativity lies originally. It is also true of all manifestations of actual human creativity, in poetry, music, and drama, as in the appropriate practice of physical science. Machines do not discover principles, nor do mathematicians, but only the creative powers unique to the human mind, the powers we associate with Classical irony, as Leonardo da Vinci would, in classical poetry, music, and drama.*}" (Lyndon H. LaRouche Jr., *The Fraud of 'Free Trade'*, EIR, August 8, 2008, p. 47.)

What I intend to show here is that two hundred years before Gottfried Leibniz, Leonardo da Vinci applied this revolutionary view of field-perspective by means of the same Leibnizian dynamic principle that he applied to both science and classical artistic composition; that is, to physical science, to painting, and to music alike. In other words, Leonardo applied this principle of a higher manifold of vision and hearing, of {*wavicle,*} to an esthetic treatment of a non-linear-field-perspective that was of a higher dimensionality than linear-central-point-perspective, which had been established earlier in the Renaissance by his contemporary, Piero della Francesca. Leonardo's field-perspective experiment represented a most revolutionary experiment, not only for his compositional work in the domain of artistic composition, but also, for his scientific work in optics and physics more generally. In other words, for the first time in the history of Western Civilization, Leonardo created, with the utmost scientific and artistic rigor, an esthetical manifold involving both vision and auditory harmonics subsuming a scientific manifold.

Leonardo discovered a new principle of dynamic organization of physical space-time by eliminating the idea of empty space and central perspective, and by dramatizing all aspects of space with a {*wavicle*}-like self-organization of light and darkness. He did this in such a way that his mind was able to both see and hear axiomatic changes that the normal visual and hearing senses could not capture otherwise, except separately and in contradictory manners, through either particles or waves. In other words, the master effects of his "{*chiaroscuro sfumato*}" brush strokes eliminated the contradictions

between *visual particles* and *harmonic waves*, and expressed a unity of composition such that could not otherwise have been realized.

Thus, Leonardo discovered a higher form of reconciliation of hearing and vision based on the experimental scientific truthfulness of metaphorical ambiguities, and ironies of light and darkness as means of generating axiomatic changes in the social fabric of society. For that purpose, he developed a field-perspective experiment of social change which is the true subject matter of the {*Virgin of the Rocks*} and which has become, therefore, a master lesson in the discovery of the creative process itself. In so doing, Leonardo not only created one of the most beautiful artistic compositions of all times, but devised one of the most exquisite crucial scientific experiments ever crafted by a human mind. Leonardo had resolved, in a combined artistic and scientific form, a problem that modern science had not been able to resolve until Leibniz invented his calculus. Leonardo proved to be a Leibnizian before his time! (1)

Above all, what must be emphasized, here, is the fact that such a higher purpose of classical artistic composition can only be achieved by giving priority to the moral education of all of mankind, that is, by using, as Lazare Carnot proposed, the visual elements of classical artistic composition to elevate the mind and foster the virtues of Justice, of Beauty, of Creativity. This is the purpose of the principle of the General Welfare, the higher purpose, for the benefit of the other, which is still, very much, the moral imperative for today's citizens who are, again, faced with the current destruction of civilization by the ongoing worldwide general financial collapse of the British-Dutch monetary system. Leonardo answered this higher purpose and challenge quite beautifully, especially in his extraordinary treatment of the paradoxes of light propagation in the {*Virgin of the Rocks*} for which he applied the same precept that Leibniz had recommended to his friend and geometry teacher, Christian Huygens:

"{*There always exists in nature something more than can be determined by geometry.*}" (Leibniz letter to Huygens, June 12/22, 1694.}

However, before addressing the Leonardo treatment of the question, it is essential to make a leap in time and look into the principle of {*dynamics*} of Leibniz from the vantage point of Lyn's more recent insights in {*How Space is Organized*}, and especially in light of his recent challenge to the LYM about a similar creative process that Gauss was involved in, with his discoveries in Astrophysics.

1. THE LEIBNIZIAN SELF-BOUNDING PRINCIPLE OF DYNAMIC CHANGE.

In his paper on {*How Space Is Organized*}, Lyn made the crucial point about the curvature of physical space-time as being reflected directly in the rigorous ideas of Cusa, Kepler, Leibniz, and Riemann. For the inquisitive mind, this is recognized in the fact that the small is expressed as a reflection of the self-bounding principles of the universe as a whole. In other words: as the creative process of a specific creative thinker develops, historically, so does the universe change universally. This reflection between a creative

mind and the universe is essentially a catenary function. On the specific case of Leibniz, Lyn put it as follows:

"{*These are the boundaries, such as Kepler's discovery of universal gravitation, which typify what are to be identified as experimentally-based universal principles, principles such as Kepler's discovery of gravitation, which contains the existence of the universe as a whole, and which serve as the form of self-bounding of that universe which is expressed by that same principle, of* {dynamics}*, which was introduced for its use as a conception of modern scientific method, by Leibniz, during the interval 1692-1695. Thus, these are boundaries of not only existing universe itself, but, therefore, of all processes within it.*}" (Lyndon H. LaRouche Jr., {*How Space Is Organized*}, EIR, September 14, 2007, p. 30.)

The period of 1692-1695 is the specific time frame during which this boundary of axiomatic change took place in science. For Leibniz, this was no doubt the most intense period of discovery of principle in his entire life. It is the period of his writings in the Leipzig {*Acta Eruditorum*}, and it is also the period during which he had an extensive and most fruitful correspondence with Christian Huygens. During that time frame, Leibniz developed what Lyn identified as his principle of {*dynamics*} in a series of very daring hypothesis for physics in general and for Keplerian astrophysics in particular. In his correspondence, which followed immediately his discovery of the catenary principle of least action (1691), which reflected the arithmetic-geometric harmonic boundary conditions of the process of gravitation, Leibniz discussed the phenomena of light, gravitation, and magnetism in congruence with Kepler's principle of gravitation of the solar system. He pursued this primarily in the form of a correspondence with Huygens, an exchange of about twenty-five letters in which he used a similar hypothesizing method of self-correction as that of Kepler and Leonardo. (2)

The investigation of ideas between these three areas of light, gravitation, and magnetism is expressed most strikingly by what Leibniz called the "living force" of a moving "{*ambient deferent ether*}", that is, a self-bounding field of propagation throughout the entire region of the solar system, which he also called "{*retarded ether*}" (Riemann later used the term {*retarded potential*}), and which Leibniz opposed to the linear trajectory of Newton's so-called "law of attraction." Reiterating the same caution as he did in the case of geometry, Leibniz reminded Huygens of Newton's mistake:

"{*The agreement among the planets of a same system and the analogy of magnetism make it highly probable that there exists something more than the simple trajectory of Mr. Newton.*}" (Leibniz letter to Huygens, April 26, 1694)

In most of his correspondence, Leibniz was challenging Huygens by addressing what was the dynamic curvature of the creative process of the solar system itself. However, Huygens disagreed, because Leibniz's conception did not satisfy his idea of a mechanical organization of the solar system based on a centrifugal force in the vacuum of empty space. Though he brought a significant contribution to physics in his {*Treaties on Light*}, Huygens suffered from the typical disease of the Newtonian "celestial

mechanics." He believed that astronomical interactions worked along the lines of the infamous {*Newton's Cradle*}. It is from that standpoint that the dialogue between Leibniz and Huygens is fascinating and important for clinical reasons, since it involved several axiomatically crucial aspects that are pedagogically very important to differentiate for our purpose, here, with respect to the principle of dynamics in opposition to mechanics. The central aspect of the difference between mechanics and dynamics lies in the axiomatic difference between the cycloid and the catenary. And such an axiomatic difference transpired in practically every letter that was exchanged between them during that particular four-year correspondence period, which ended with the death of Huygens.

Leibniz initiated this astrophysical dynamic dialogue in February of 1692 by kindly inviting the ailing and aging Huygens to take a vacation from his geometrical approach and study astrophysical phenomena, but from the standpoint of physical causality in accordance with Kepler. Leibniz was seeking the input of Huygens' insights, which he highly appreciated and respected. However, Huygens had certain axiomatic shortcomings and was not willing to oblige Leibniz in making the axiomatic change from the secure planes of geometric battlefields in which he was a champion. Huygens was not willing to risk the uncertain cloudy skies of astrophysics where he was a complete neophyte. Here, it is important that the reader make the crucial axiomatic difference, not only between the comfort zone of acquired knowledge and the uncomfortable domain of the unknown, but also between mechanics and dynamics, that is, between seeking to impose a finite geometrical form to the universe by formal geometry and seeking to discover the self-developing physical causes, or universal physical principles, underlying a finite yet self-bounded changing universe. For Huygens, that was a double whammy! Leibniz realized that "*only too well*" and he was considerate about it, when he wrote:

"{*You had me worried when you mentioned that you were not well. I know only too well how much the sciences are interested in your well-being. It is because you can accomplish such important things in Physics that I am acting as your conscience and that I am giving you the opportunity not to dream too much about Geometry.*} (Leibniz to Huygens, Hanover, February 9/19, 1692.)

A month later, on March 15, Huygens replied: "{*You consider too highly my strengths for studying thoroughly these matters of physics. You wish to get me excited about this study, to which I could contribute a lot, if only I knew that the reports I have put together in my last treatises [on light] were to find some approval on your part…*}"

Realizing the full implications of this call for approval, and how much it could stifle creativity, Leibniz replied to him by encouraging him to develop new insights around the question of gravitation, but Huygens had already made up his mind that the planetary system was a mechanical system of planetary hard balls orbiting around the sun by means of what he conceived as a straight-line centrifugal force -- as if some Sun-god were rotating around Himself a series of great hard balls attached to invisible strings. So, in April, after a brief response in which Huygens did not take up the challenge of physics, Leibniz sent another letter in which he reiterated the same urgent matter.

"{*I hope that you are completely restored from the inconvenience you told me about in your last letter, and wish you a strong health so that you may complete the beautiful meditations that you have begun. I shall always exhort you to turn your meditations toward Physics. I believe I have noted more than once that your last treatises have pleased me infinitely. That explanation of the Island Crystal is like the proof of the correctness of your ideas on the subject of light: there was only one remaining question about which you were not satisfied, but perhaps you have clarified that, since then.*

"{*In all evidence it appears that the roundness of the earth, as well as the roundness of rain drops would have the same cause, that is to say, the circular motion of the ambient in all direction. And this is also apparently the reason for the attraction of the planets towards the Sun, just like the planets maintain a certain magnetic direction, as, for example, the case presented inside of the Earth. If one conceives of the attraction of heavy bodies, as being caused by the emanations of rays coming from the center, we could explain why the weights of the planets are inversely proportional to the square of their distances from the Sun, which is confirmed by the phenomena.*

"{This law of gravitation joined to the trajectory of Mr. Newton, or with my theory of harmonic circulation, gives the ellipses of Kepler as confirmed by the phenomena. Consequently, it is evident that a body is illuminated by a light source that is in inverse proportion to the square of their distances. I am further of the belief that, following this manner of explaining gravitation by the centrifugal force of a very subtle fluid, we can conceive these efforts of the fluid as being nothing else, in fact, but rays of attraction, which make their bodies go down because their circular motion is slower. Furthermore, it appears that a sort of heavenly vortex is also necessary in order to explain the parallelisms of the [planetary] axis, the movement of which requires having poles and meridians otherwise we could not explain why the spherical action is going in all directions. Finally, the correspondence that exists between the planets or satellites of a same system is not opposed to a sort of common deferring liquid matter. }

[...] "{*In re-reading recently your explanation on gravitation, I realized that you were in favor of the Vacuum and of Atoms. I must admit that I have a hard time understanding the reason for such infrangibility, and I believe that for such an effect, one would need to call for a sort of perpetual miracle. I do not see either the necessity, which would force us to resort to such extraordinary things. However, since you have a propensity for approving this, it must be the case that you have found some important reason to support this.*}" (Leibniz letter to Huygens, Hanover, April 1/11, 1692.)

In other words, it is the Leibnizian harmonic circulation of {*ambient rays*} in the solar system as a whole and imbedded inside of each planet, and not the so-called inverse square law, which causes the weight of the planets to be approximately inversely proportional to the square of their distances from the Sun. It is the harmonic circulation of the {*ambient ether*}, not the so-called law of attraction, which causes the planets to move in Keplerian elliptical motion around the Sun. It is a self-bounding harmonic principle of dynamic change, not a fixed attraction at a distance, which determines the curvature of

the universe and causes both gravitation and magnetism. This inversion of the general scientific opinion must have significantly perplexed Huygens, especially since Leibniz was seeking his reflections not from the standpoint of geometry and accepted ideas, but from the standpoint of a principle of physical causality.

During the spring of 1692, Leibniz was eagerly awaiting Huygens' reply, but Huygens did not respond to Leibniz's April letter until July. By then, Huygens was genuinely perplexed by the new ideas of Leibniz. So, in his reply, Huygens addressed the Keplerian orbits from the vantage point of his previous formal knowledge of geometry and expressed his disagreement with Leibniz on most of his new hypothesis, especially the harmonic circulation of {*ambient matter*}. Huygens even invited Leibniz to address the astronomical questions from the vantage point of the Newtonian formula of the inverse square law. Huygens wrote:

"{*If you approve of my explanation for Gravitation, I do not see how you can understand that such a movement of {*materiae ambientis*} could cause the roundness of rain drops, the Gravity of lead falling on the ground, or of the planets toward the Sun. I find more likely that the roundness of raindrops comes from the rapid movement of some matter that circulates inside of them. But, if it were the effect of a movement of matter in all directions that is outside [of them], there would not be any operation of the centrifugal force with respect to the raindrop. I do not see either how the cause that I give for Gravity, could coincide with the attraction that you conceive as rays emanating from the center. In keeping with my principle, you would need to have the circulating matter moving at a certain proportion and at a faster speed near the center than at the outer areas, in order to explain why the weight of the planets counterbalance their centrifugal forces, in a proportion that I can easily determine, but I do not find, up to this point, the cause for this difference in speed.*

"{*It is certain that the weight of the planets being established in proportion to the inverse square of their distances to the Sun, this, plus the centrifugal virtue, gives the elliptical eccentricities of Kepler. But, how, by substituting your Harmonic Circulation, and retaining the same proportion of the weights, can you deduce the same ellipses? This is what I have never been able to understand with your explanation which appeared in the ACTA of Leipzig. I do not see how you find a space for a sort of deferent vortex that you want to maintain in the manner of Descartes; because the said proportion of gravity with the centrifugal force produce by themselves alone the Keplerian ellipses, according to the demonstration of Mr. Newton. For a long time, you have promised me to elucidate this difficulty.*} (Huygens letter to Leibniz, The Hague, July 11, 1692)

Huygens did not find {*the cause for this difference in speed*} in the Leibnizian {*ambient fluid matter*} simply because he was convinced he had found it in the inverse square law of Newton. This is a very instructive delusion which calls for closer attention. This question is extremely important because it shows how even an honest and well intentioned scientist, like Huygens, can easily have his attention diverted away from seeking a universal physical principle and slip into the trap of the comfort zone provided by a mechanical formula such as the so-called {*inverse square law*}.

This trap is insidious because the very formulation of the inverse square of the distance relative to the weight of a planet gives an appealing cover to the idea of attraction, and, therefore, gives the impression of having said the last word on the matter of gravitation. In reality, both the {*inverse square law*} and the phenomenon of attraction are mere effects of the universal principle of gravitation. Attraction is a result, not a cause, and therefore, not a law. The idea of attraction does not provide a reason for gravitation; it merely describes the resulting effect of the principle of gravitation, its consequence. But, Huygens does not see that, and Leibniz recognized that it was Huygens' propensity to seek geometrical formulas that precluded him from making that necessary breakthrough.

As a result of this Newtonian inverse square fraud, not only did British liberalism elevate this derivative of gravitation to the rank of law, but, like the financial derivatives of today, it was given a fictitious life of its own, whose primary function, in perfect conformity with the foggy mind of British imperial sophistry, was to hide and mask the real nature of the physical principle of gravitation that Kepler had discovered. For example, in his letter of March 10-20, 1693, Leibniz, made it clear that he disagreed with Huygens on his conception of organized space based on the ideas of {*atoms*} and of (*vacuum*), for that very reason. Note how Leibniz emphasized the {*dynamics*} of the self-bounding physical curvature of a {*fluid-ambient space*} as opposed to a mechanical push-pull linear attraction at a distance:

"{*But, my answer to you is that there exists no last little body, and my conception is that any small particle of matter, however small it may be, is like an entire world filled with an infinity of still smaller creatures; and this, in proportion to another body, even as large as the globe of the earth.*}[…]

"{*Finally, even though I have spoken earlier of firmness, or primitive consistencies, I am always inclined to believe that there exists no primitive consistency [atoms], and that only movement produces diversity inside of matter, and consequently cohesion. And, until the contrary has been demonstrated, it seems to me that we must avoid the supposition of such a new inexplicable quality, from which, if it were accepted, we would soon jump to other similar suppositions, such as to the gravity of Aristotle, or to the attraction of Mr. Newton, and to sympathies or antipathies, and to a thousand and one other such attributions.*}" (Leibniz letter to Huygens, Hanover, March 10-20, 1693)

During the 1692-1693 period, after going through a series of explanations on the question of the {*deferent ambient matter*} Leibniz found nothing but disagreements with Huygens. For example, relating his idea of gravitation rays to the harmony of the spheres of Kepler, Leibniz wrote:

"{*The planets are moving as if there was only a single pathway of motion or of proper direction linked to gravitation, as Mr. Newton observed. However, they are also moving as if they were all slowly deferred by a matter whose circulation is everywhere harmonic; and it seems that there exists a conspiracy between this [common] circulation*

and the proper direction of [each] planet. And the reason why I am still not giving up this [idea of] deferent matter, ever since Mr. Newton had given his explanation, is because I have been observing, among other things, that the planets are all going in the same direction, and [moving] in a same region, which is also noticeable for the small planets around Jupiter and Saturn. This means that without a common deferent matter, nothing would prevent the planets from going in all directions.}" (Leibniz to Huygens, Hanover, September 16/26, 1692.)

Leibniz was converging on what Lyn identified as the paradoxical visual and auditory notion of {*wavicle*} as exemplified by the nuclear physics debates over the ideas of wave and particle, during the twentieth century, as expressed by {*Plank's quantum.*} Leibniz was trying to encourage Huygens to submit a paper on the physics of the well-tempered musical system to Acta Eruditorum. However, for Huygens, this was another stumbling block. For the mechanical reason cited above, Huygens could not see in his mind this {*wavicle*} harmonic relationship that Leibniz was addressing and, as a consequence, he could not reconciliate vision and hearing into the physical domain of harmonic ordering in the solar system as a whole.

For example, in the same letter of July 11, 1692, Huygens made it quite explicit that he rejected the idea of Mr. Ouvrard on the conciliation of proportionality between seeing and hearing. "{*I met him in Paris*,}" said Huygens. "{*He had printed quite an extravagant little treatise in which he wanted the proportions relative to consonances to be established in the domain of Architecture, as if the eye was able to recognize these proportions at a distance in the same way that the ear does with singing.}"

Regardless of the fact that Ouvrard's conception was mediocre because, it was, nevertheless, for the same reason that Huygens could not see the mental differences and complementarities of sight and hearing that prevailed in the Leibnizian notion of harmonic circulation of {*ambient deferent rays*} and that he disagreed with his idea of a harmonic self-changing-self-correcting curvature of physical space-time. Regardless of this shortcoming, in his {*Treatise on Light*}, Huygens demonstrated that he understood perfectly well the field of proportionality expressed by harmonic caustic envelopes, but he would not attribute a similar characteristic to a higher ordering that included the collaboration of vision and hearing.

Leibniz kept reaching out to Huygens because he realized the significant influence that Newton had on his friend. Without naming names, but implying his definite opposition to Newton, Leibniz reached a very instructive conclusion about his method of hypothesizing against all of those who would sacrifice the role of a physical causality hypothesis in science for the sake of some a priori geometric action at a distance in empty space and some irreducible elementary hard particles. Regardless of these insurmountable differences, Leibniz always tried to emphasize whatever they had in common, and always tried to harmonize such a view before the court of universal truth. He wrote to Huygens:

"{*As I once told you in Paris, that it was most difficult to conceive of the true subject of motion, you stunned me by replying that this could be done by means of circular motion; and I remember reading some approximation of the same thing in Mr. Newton's book; but, that was when I was of the belief that no such circular motion had any particular privilege in this matter. And, I see that you have the same sentiment about this. Therefore, I hold that all hypothesis are equivalent, and that when I assign certain motions to certain bodies, I do not have, and cannot have, any other reason than the simplicity of the hypothesis, being of the belief that (everything considered) the simplest hypothesis is the true one. Therefore, I have no other criterion, and I believe that the difference between us is merely in the manner of speaking, which I try to accommodate as much as I can to a common usage, SALVA VERITATE.*}" (Leibniz to Huygens, September 4-14, 1694.)

This amazing dialogue between Huygens and Leibniz is very useful to reflect back to Leonardo's method of classical artistic composition, because it was developed out of the same search for a universal physical principle and the same commitment to truth. In an extraordinary way, Leonardo had the same understanding as Leibniz with respect to the self-development processes of light and darkness. Both addressed the phenomena of light and darkness from the same vantage point of hearing harmonic motion and seeing dissonant changes in the physical universe, as opposed to looking for a geometrical or mathematical explanation with a formula. They were not trying to explain the phenomena by some interpretation, but trying to discover the cause of change in the universe. The question was not: what does it mean; but: how does it change harmonically? How is it generated, how is it created? Both Leibniz and Leonardo had developed their methods of inquiry from the seminal discoveries of principle of Nicholas of Cusa, who had established the modern form of hypothesizing for measuring change.

2. THE IRONICAL ANGEL OF THE {*VIRGIN OF THE ROCKS*}

There are two different versions of Leonardo's {*Virgin of the Rocks*}. In both the Paris and the London versions, Leonardo executed a complex scene in which he depicted his characters with contradictory expressions and ironies that require some serious attention to details. It is the role of the studious observer to discover how the mind of the artist works and how he dresses the soul of his subjects with the garment of shadows. We must, therefore, pay close attention to how Leonardo created such ambiguities, and developed a science of shadows. Here is how Leonardo recommended the artist proceed to represent the intention of human figures in a painting:

"{*The most important consideration in painting is that the movements of each figure expresses its mental state, such as desire, scorn, anger, pity, and the like. In painting the actions of the figures are in every case expressive of the purpose in their minds. Every action must necessarily be expressed in movement. To know and to will are two operations of the human mind. To discern, to judge, to reflect are actions of the human mind. Our body is subject to heaven, and heaven is subject to the spirit. A picture, or rather the figures therein, should be represented in such a way that the spectator may easily recognize the purpose in the minds by their attitudes... Represent your figures in*

such action as may be fitted to express what purpose is in their minds; otherwise your art will not be good.}" (Leonardo da Vinci, *The Notebooks,* Oxford University Press, 1980, p. 176-77.)

So, if we are to follow Leonardo's recommendation, we must first recognize that in the {*Virgin of the Rocks*}, Leonardo did not merely represent a scene of the Holy Family inside of a dimly lit cave. He represented specific intentions underlying their physical attitudes. That is what we have to discover. What is the cause of their motions and how can they express the creative process by means of light and shadows?

The original commission for this painting was made on April 25, 1483, by the Brotherhood of the Immaculate Conception in Milan, and was to be completed for the following December 8th, the day of celebration of the Immaculate Conception. But the work became the object of great controversy as soon as it was delivered on that date, and a 25-year long legal fight against Leonardo ensued. Elements of such an outcome can be found in the partial iconographical documentation from: {*TOUT L'OEUVRE PEINT DE LEONARD DE VINCI*}, Les Classiques de l'Art, Paris, Flammarion, 1968.

Paris Louvre. London National Gallery.

Figure 1. The two versions of Leonardo's {*Virgin of the Rocks*} (1483-86): a study of axiomatic change in classical artistic composition. (3)

The heart of the controversy actually centered around the pointing gesture of the Angel's right hand and his external glance at the spectator, both of which the Brotherhood considered fundamentally "{*irreligious and distracting for the spectator who would not understand.*}" As a result of this, Leonardo's painting was rejected and he was asked to compose a second painting on the same subject, but without these controversial features. Leonardo complied and produced a second version. The central irony of the {*Virgin of the Rocks*}, therefore, centers on the very nature of the ambiguous difference between those two paintings. See **Figure 1**. As Lyn made the point explicitly: the ambiguity resides in the difference in treatment between two sources of light! What then is in contention, here, and what is the characteristic feature of this conflict? Study most closely the two reproductions.

Rather than simply dishing out a portrait of Mary as the Virgin of the Immaculate Conception, which would have certainly pleased the religious Brotherhood, Leonardo had something else in mind. He chose to elevate the members of the Brotherhood and to educate them by executing a painting in such a way that it would help them make an axiomatic discovery of principle, that is to say, the principle of Leonardo's own creative process. Indeed, a simple observer who is willing to seek and discover the creative principle of Leonardo can see that from comparing the two versions of the {*Virgin of the Rocks*} there is a glaring anomaly staring at him! One cannot fail to notice that, even if the Virgin Mary is the dominating central figure, the Angel, in relationship with baby Jesus, represents a definite question mark. Why is the angel pointing? Why is he looking at you, the spectator? All of a sudden, it is the angel that becomes the focus of attention. This is what the Brotherhood reacted against. So, why did Leonardo choose to do that?

First of all, it should be noted that whenever, in a Classical artistic composition, there is a single figure looking at the spectator, while the other figures of the group are busy looking elsewhere, inside of the painting, the attention of the observer is immediately forced to be distracted away from the apparent subject of interest inside of the painting, and is automatically made to focus on that "look" that is addressed to him on the outside. There is an inside-outside dynamic that begins to come into play, a sort of interplay going on between the artist and the observer. This is a self-reflexive device of the creative process itself, a window opening from the inside of the creative mind of the artist that is projected into the mind of another in the outside world, and whose function has a dual ambiguous purpose. On the one hand, it emphasizes that the subject matter of the painting is not some simple self-evident scene, in and of itself, an object of sense-certainty, but rather the thought object of creativity, a {*Geistesmassen*} representing the self-reflexive process of the artist's creative mind. On the other hand, the function also forces the spectator to participate actively in the creative process of the creator who is telling him: "{*Hey! My friend, {De te fabula narratur}: this painting is also about you and about the change that you have to make in your life. Here is what you need to know in order to become God-like*!}"

Such a self-reflexive device is even more powerful when the painted figure, looking outward, is a self-portrait of the artist, himself, as in the case of the self-portrait of Raphael Sanzio, in the {*School of Athens*}, or of the self-portrait of the "sleeping"

Piero Della Francesca, in his famous {*Resurrection of Christ*}. [See my papers on {*Piero della Francesca's Resurrection*} and on Raphael's {*School of Athens*}, in the ARTISTIC COMPOSITION section of ftp.ljcentral.net/unpublished/Pierre_Beaudry/.] This is precisely what was most disturbing for the Brotherhood of the Immaculate Conception. The Brotherhood did not want the attention to be focused on the creative process of the artist, or on them, but on Mary.

Moreover, this self-reflexive anomaly of the Angel is not the only indicator of Leonardo's intention. The pointing finger plays the same role. It is the finger pointing to the light of Reason, as Raphael will also represent Plato, in the traits of Leonardo, at the center of his {*School of Athens*}. And this is why the pointing finger is not meant to imply any sort of irreverence, nor does it express any sort of remonstrance. On the contrary, it is like a signal, a warning of something to come, something to be discovered, like a forecast about the function of John the Baptist, or a focus point of attention directed at the spectator urging him to take a warning under serious consideration. But, what warning? What events are we suppose to expect? The Passion of the Crucifixion? The passion of the creative process? Both? So, one look at the inquisitive eyes of the Angel, combined with his ambiguous smile and gesture, leave the spectator perplexed as to what the angel has in mind. That is not an accident. That is deliberate on the part of Leonardo. He wants you to ask these questions and investigate his method of artistic composition.

Next, look closer at the apparent contradictory gestures of the Angel who appears to be sternly pointing at John the Baptist with his right hand, and, at the same time, is very gently protecting Baby Jesus with his nearly invisible, but clearly defined left hand. What does that mean? Compare the two hands of the Angel: one reflects firmness and the other tenderness. Although the left hand is practically entirely rendered invisible by the covering "sfumato" of darken rays, a close scrutiny reveals a very soft but secure hold of the infant Jesus, protecting the child against a possible slip which could take him over the edge of the rocks. Similarly, Mary has her right hand gently protecting John the Baptist. Why such a precarious setting of two children? What is the nature of the danger? What is the language of the hands telling us? Any approach to the state of mind of this angel, or Mary, from the standpoint of simple sense-certainty would fail to make any sense of these ambiguous features, which can only be discovered through investigating the creative reason of Leonardo's mind. From that standpoint, the least we can say is that Leonardo's Angel represents a very important ambiguous function before mankind, a sublime individual who is almost a self-portrait of Leonardo himself.

Think of the world historical identity of Leonardo as being reflected in this Angel, the role of the renaissance man, the Promethean man; not at all irreverent, or irreligious, but, rather, as acting like a very commendable and hard working Guardian Angel concerned for all of mankind, and illustrating the Power of Reason by demonstrating the mastery of the universal physical principle underlying the science of light. Bring the fire knowledge to mankind! Leonardo is quite conscious that this Promethean role is to secure the future of classical culture for all future generations, and, therefore, he is developing for the inquisitive mind, the not so hidden secrets of his own creative process. Quite a busy little Angel, this Leonardo, wouldn't you say?

3. THE FIRST SOURCE OF LIGHT AND THE FIELD-PERSPECTIVE OF SHADOWS IN THE PARIS {*VIRGIN OF THE ROCKS*}.

This is where the issue of the ambiguity of light sources begins to come into play. Leonardo first established a very disturbing paradox with respect to light. When Lyn first raised the question of the two sources of light, my first instinct was to look for the two sources of point light projection in the same painting. But that didn't do it. Why? What I first found was an interesting ambiguity, which stemmed from what appeared as a double source of illumination: one source seemed to come from behind the grotto, illuminating the rocks from the back, and the other source, appeared to come from the front, which illuminated the different subjects in the foreground. But, what was the nature of this ambiguity? What were the intention, the purpose, and the objective? I could not answer these questions and I did not know why.

Then, I looked at the other painting of the same subject, the London version. The light source appeared to be the same, but the illumination effects of its projection seemed completely different. How could the same source of light produce such different effects? If the light came from the same source, in both cases, why were their effects so different on the mind of the observer? I could not answer these questions either, because I was looking for a source of central-point-perspective. How could the treatment of the visible elements of the painting coming from point projections tell us about those two different sources and how could they succeed in elevating the mind of the spectator to the truth of a discovery of principle that is visible to the mind only? I was getting even more perplexed, because I was looking for a solution to a problem as it was posed by Piero della Francesca as opposed to by Leonardo da Vinci. This first approach could not answer those questions. So, I decided to look for the intention behind this first source of light and examine all of its effects in details. I went back to study the Paris version again.

This time, I stopped looking for the source of light as a point source. I remembered what my old painting teacher use to tell us. "{*Don't look for the truth in the sunlight, you will burn your eyes. The truth you are looking for is in the shadows.*}" So, I started looking at the effects of the light source, its reflections and shadows. The ambiguity of the light source was beginning to take shape, but these effects did not clearly established what Lyn was pointing at. Where were the two sources of light and what was their intention? What are we looking for? I kept thinking that whatever I was to find, the intention had to be in congruence with a classical artistic rendering of Plato's Cave. That is to say, I had to look for how two sources of light reflected the metaphor of the creative process, as if we were looking through a glass darkly.

On my second attempt, I went back to examine the source of light in the Paris {*Virgin of the Rocks*}. What does that source of light tell us about Leonardo's intention? Then, I started to pay attention to Leonardo's treatment of light and the manner in which it is reflected from the different figures. Ah ha! Imperceptibly, something had changed!

Look at the display of shadows on the different hands. Do not look for a symbolic interpretation, just look for the truth, and look for the invisible principle behind the visible. Look for the music between the shadows. Seek the principle of composition, the polyphonic harmonic ordering principle underlying the different shadows. It's all there dancing before your eyes. Examine especially the four sets of hands? What do these four sets of hands have in common? What is their uniform diversity? Study them closely; scrutinize the treatment of light and darkness filtering through the fingers. Listen to the air of the metaphor. What is going on in Leonardo's mind? Think of the idea of in-between the notes, like Lyn proposed, and study the delicate hands of Mary and of the angel as they express the agapic state of their minds. Then, compare those hands with the pearly fingering quality of the 1999 rendition of Chopin's Concerto # 1 by the Polish pianist Krystian Zimmerman.

Chopin's Concerto #1 is a beautiful metaphor of the creative process that is reflected and refracted through the pearly fingering rendition of pianist Krystian Zimmerman, as a celebration of what Chopin described as "a childhood place of great happiness." His memories are being generated like a late summer shower mixing waves of raindrops with sunlight. You could not find a better accompaniment to the two versions of the *Virgin of the Rocks* by Leonardo. In the first movement, Chopin is waging a fight against the darkness of his failing memory, but rejoices at rediscovering it coming out of some dark clouds. The second movement executes the actual memory content of Chopin's mind and the generative process of recovering his "childhood place of great happiness." The third movement is a totally brilliant celebration of Chopin's discovery process, as pearly undulating waves of sunlight flood through the warm showers of his happy memories. I bring to your attention the second movement especially. The interesting relation of Chopin's piece to Leonardo's method of composition is found there, in the last part of the second movement, and is expressed by a beautiful inversion of what Leonardo had identified as the {*reflex stream*} of dark rays in which the creative process is not rendered by the image of pearly intervals of raindrops falling to the ground, but rather by how the pearly harmonic intervals are generated or extracted from the heavenly cloud, as if Chopin had made the notes rise from the keyboard and made the piano sing. Zimmerman understood that Chopin idea perfectly.

Therein lay also the secret of Leonardo's dramatic use of {*aerial perspective*}. It is the inversion of the field-perspective of shadows, and not central point perspective of light, which determines what you see in the {*Virgin of the Rocks*}. That is why what you see is not what you see, and surely not what you should be looking for. The distances between the different subjects is no longer determined by linear projections from a vanishing point on the horizon, it is not measured as a ratio of linear partitioning of space, but by non-linear projections of a field of shadows acting as a {*process of change*} expressing the mental state of the subjects by a special kind of inversed {*reflex stream.*} Leibniz would say by the {*ambient of deferent rays*} of change. Leonardo provided a carefully crafted reflection that would suggest where to start looking for the answer to all of my questions. Examine closely the reflecting broach that the Virgin of the Paris painting is wearing on her cloak. See **Figure 2.**

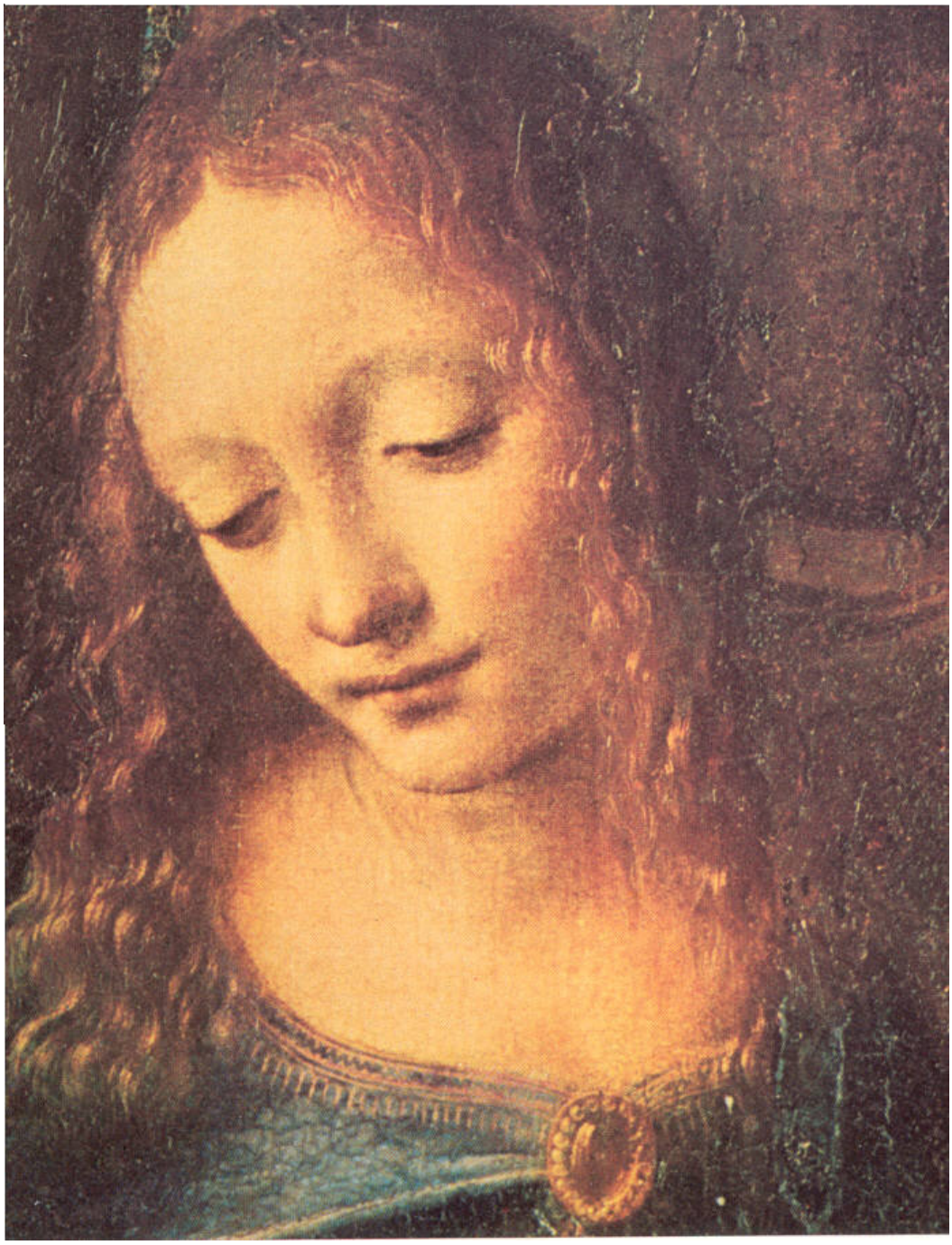

Figure 2. Detail of the Virgin in Leonardo's {*Virgin of the Rocks*} (Paris). Note the reflection on the broach of the Virgin. There is a field-source of light being projected through an open doorway in front of which the silhouette of the artist is shown standing.

The hues of evening colors indicate that this field-source of light, in front of the grotto, is not a natural source, but an artificial one. On the broach, there is the reflection of a large fire projected from outside of the door into a dark room, generating firelight

and producing everywhere evening and nocturnal hues at much more reduced degrees of density of light than direct sunlight would do. In point of fact, Leonardo painted not only the {*Virgin of the Rocks*}, but also the {*Mona Lisa*}, and several {*John the Baptist*}, at night, using the same light source from a large regulated fire projecting everywhere orange-reddish hues. This first source of light is worth investigating in some detail because Leonardo gave it priority in all of his late paintings. In two very important notes of his {*Notebooks*}, Leonardo explained why he preferred to paint in the evening with firelight.

> "{*If you should have a courtyard that you can at pleasure cover with a linen awning, that light will be good. Or when you want to make a portrait do it in dull weather, or as evening falls, placing the sitter with his back to one of the walls of the courtyard. Note the faces of the men and women in the streets, as evening falls, and when the weather is dull, what softness and delicacy you may perceive in them. Therefore, O Painter! Have a courtyard arranged with the walls tinted black and a narrow roof projecting within the walls. It should be 10 brachia wide and 20 braccia long, and 10 brachia high, and covered with a linen awning when the sun is shining; or else paint a portrait towards the evening, or when it is cloudy or misty; and this is perfect lighting "* [...]
>
> "{*That which is entirely bereft of light is all darkness; since such is the condition of night, if you wish to represent a scene herein, arrange to introduce a great fire. Then the thing, which is nearest to this fire, will be most tinged with its color. The figures which are seen against the fire look dark in the glare of the firelight because that part of the object which you see is tinged by the darkness of the night, and not by the fire; those who stand by the sides should be half dark and half in ruddy light; while those visible beyond the edges of the flames will be all lit up by the ruddy glow against the black background.*}" ({*The Notebooks of Leonardo Da Vinci*}, Oxford University Press, 1952. p.185 and 222.)

It is because of the proximity of this fire that one can see how the shadows are more or less softly pronounced on each of the subjects, who reflect tinges of the darkness of night, as well as tinges of the firelight. Note, also, how the elimination of eyebrows and of eye lashes of the Virgin enabled Leonardo to apply very precisely and delicately the gradual fading of shadows around the eyes, and around the bony structure of the forehead to better capture the Virgin's emotional state. However, why would such details and such minute attention be given to the application of increasing fading of light in proportion with increasing fading of darkness? It is as though Leonardo was giving us a master's lesson on the nature of esthetical infinitesimals, as if he had succeeded in painting such a masterpiece because he understood the principle that Leibniz had developed in his calculus, 200 years later.

This, at once, raises two more questions: first, how did Leonardo proceed to transform light and darkness into multiply reflected shadows by means of surfaces of more or less opaque and translucid objects, and second, how could he better express, in

this manner, the epistemological state of mind of his subjects by means of a nearby artificial flickering source of light as opposed to a steady natural flow of direct sunlight?

As will become apparent with the London version of the same subject, if the different figures of the {*Virgin of the Rocks*} had been illuminated by direct natural sunlight, the distance and the degree of intensity between the source of light and the illuminated objects would have been so great that the relatively small distances between such figures would have shown no perceptible differences in light and darkness between them. The situation would have been such that the intensity of light, being reflected from the diverse points of such subjects at such close distances, would have been considered everywhere equivalent; that is, without any possibility of rendering the polyphonic action of light that Leonardo captured. As if looking through the dimly lit window of a Leibnizian monad, Leonardo described his {*wavicle*} making process:

> "{*Just as the stone thrown into the water becomes the center and cause of various circles, and the sound made in the air spreads out in circles, so every body placed within the luminous air spreads itself out in circles and fills the surrounding parts with an infinite number of images of itself, and appears all in all, and all in each.*}" (Leonardo, Op. Cit., P.38.)

For Leonardo, the question then became the following: how do you determine the infinitesimal science of differentiation of shadows between light and darkness in such a manner that they express profound human emotions? Just to show the importance that he attributed to this ambiguous Platonic domain of the Cave, Leonardo proposed to write seven books, only on the metaphorical function of shadows. He wrote:

> "{*Shadow is the obscuration of light. Shadows appear to me to be of supreme importance in perspective, because without them, opaque and solid bodies will be ill defined; that which is contained within its outlines and the outlines themselves will be ill understood unless it is shown against a background of a different tone. Therefore, I state as my first proposition concerning shadows that every opaque body is surrounded and its whole surface enveloped in shadow and light. And to this I shall devote the first book.*
>
> *"{Moreover, these shadows are of varying degrees of darkness, because they have been abandoned by a varying quantity of luminous rays; and these I shall call primary shadows, because they are the first shadows to form a covering to the bodies concerned. And to this I shall devote the second book.*
>
> *"{From these primary shadows there issue certain dark rays, which are diffused through the air and vary in intensity according to the density of the primary shadows from which they are derived; and consequently I shall call these shadows derived shadows, because they have their origin in other shadows. And of this I will make the third book.*

"{Moreover, these derived shadows in striking upon anything create as many different effects as there are different places where they strike; and of this I will make the fourth book.

"{*And since where the derived shadow strikes, it is always surrounded by the striking of the luminous rays, it leaps back with these in a reflex stream towards its source and mingles with and becomes changed into it, altering thereby somewhat of its nature; and to this I shall devote the fifth books*.

"{*In addition to this I will make a sixth book to contain an investigation of the many different varieties of the rebound of reflected rays, which modify the primary shadow by as many different colors as there are different points from whence these luminous reflected rays proceed.*

"{Furthermore, I will make the seventh book treat of the various distances that may exist between the point where each reflected ray strikes and the point whence it proceeds, and of the various different shades of color which it acquires in striking against opaque bodies.}" (Leonardo, Op. Cit., p.130.)

This is how Leonardo established the esthetic principle of his calculus. Leibniz himself also addressed the same principle, briefly, in a letter to Huygens, and in which he stated his implicit agreement with Leonardo: "{*The whole question lies in the manner with which you have yourself (Huygens) considered that each point of a ray is itself radiating, and how you have composed a general wave for all of these auxiliary waves.*}" (Leibniz letter to Huygens, June 12-22, 1694.) Now, complement this statement of Leibniz and the Leonardo function of the shadow with the following Leonardo descriptive method of radiating points of light and dark rays as if in the {*ambient atmosphere*} of Leibniz:

"{*Every body is surrounded by a limiting surface.*
Every surface is full of infinite points.
Every point makes a ray.
The ray is made up of infinite separating lines.
In each point of any line, there intersect lines proceeding from the points on the surface of bodies, and they form pyramids. At the apex of each pyramid there intersect lines proceeding from the whole, and from the parts of the bodies, so that from this apex one can see the whole and the parts.
The air that is between bodies is full of the intersections formed by the radiating images of these bodies.
The images of the figures and their colors are transferred from one to the other by a pyramid.
Each body fills the surrounding air with its infinite images by means of these rays.
The image of each point is in the whole and in each part of the line cause by this point.
Each point of the one object is, by analogy, capable of uniting the whole base of the other.

Each body becomes the base of innumerable and infinite pyramids. One and the same base serves as the cause of innumerable and infinite pyramids turned in various directions, and of various degrees of length.
The point of each pyramid has in itself the whole image of its base.
The centerline of each pyramid is full of an infinite number of points of other pyramids.
One pyramid passes through the other without confusion...}" (Leonardo, Op. Cit., P.127.)

This Leonardo method of intersecting a family of caustic envelopes (cones) is obviously genial in both its complexity and its rigorous application when one thinks of the Leibniz dynamic of {*ambient rays*}. In point of fact, his conception is best exemplified, again, by what Lyn had identified as the paradox of the notion of {*wavicle*}, the ironical compromise between wave and particle in modern nuclear physics. For those who seek to describe the nature of the atomic periodical chart of Mendeleev, or the underlying ordering principle of isotopes, they would do well to study closely the Leonardo treatment of shadows. Leonardo is also describing the polyphonic and rich idea of the "{*general wave of auxiliary waves*}" that Leibniz had recommended to Huygens; that is, the {*ambient atmosphere*} of multiply connectedness of light propagation in its infinitely diversified actions of self-development, self-reflection, and self-transformation. These are the boundary conditions of classical artistic composition that Rembrandt van Rijn later brought to the highest point of artistic refinement in the greatest masterpieces of the Dutch Renaissance. All of Rembrandt's art resides in this Leonardo prescription for a field-perspective of shadows.

But moreover, could this Leonardo principle of composition also reflect some sort of {*ambient atmospheric mask*} surrounding a group of bel canto singers as Lyn proposed? Although this {*ambient atmospheric mask*} would not be perceptible to the senses, could it not act as a sort of inversion of the mask function in a classical Greek tragedy? Instead of simply projecting the different voices outwardly, the {*ambient atmospheric mask*} of intermingling shadows of the surrounding air would also be projecting back from the faces of each subject a reflection of all in all and all in each of their own states of mind, thus expressing the same process of creative change called for in a classical tragedy.

Whatever may be the specific experimental nature of this ambient phase-space, both physical and mental, the point to be remembered, here, is that it is universal and that Leonardo's method is not simply a formula for organizing space on a canvas, like central-point-perspective had been used before him. Neither is it the application of a simplistic Sarpian or Newtonian formula like the silly painting by numbers of the {*inversed square law*}. The problem with formulas is that they are merely derived number-shadows that obfuscate the principle of change. Worse, before you even realize it, they have become the usurpers of scientific principles, the fixed parameters that replace change. Formulas may be derived from principles, but principles cannot be derived from formulas. Formulas are mere secondary or tertiary derivatives, providing a delusionary comfort zone for lazy people and generating a very nasty habit of destroying creativity by fogging up the mind and hiding the underlying universal physical principle that is the true object

of the quest. The same problem confronts the American Senate today and the economic role they have to play in solving the current financial mess of the banking system.

So, what we are looking at, here, is precisely Leonardo's method of non-entropic change. This is the higher understanding of how the {*Aerial Perspective*} of Lazare Carnot works as the anti-entropic art of {*acting on the soul by the organ of vision*}, the art of statesmanship, the art of breaking axioms and of showing how the universe changes under the influence of introducing new universal physical principles to reach higher orders of performance and truth in the domain of statecraft. There are no shortcuts in obtaining such results from this rigorous method. There is only hard work. There are no highest or lowest points of reflection to set a pace or a measure as in central perspective. The measure is change itself. There is only change, and this is why the composition of the {*Virgin of the Rock*s} was completed and finished only when the whole symphony of interactions and transformations had established all of the required modulations. Now, let's look at Leonardo's treatment of the paradox of the {*wavicle*} a little more closely.

First and foremost, in the Paris version of the {*Virgin of the Rocks*}, Leonardo resolved the paradox of the infinite point source of light; that is, the "infinite distance," and the "infinite intensity" of direct sunlight, by bringing the dynamic source of light closer to his subject. He created a proportional decrease of the distance, and decrease of the degree of intensity of light by establishing an original source of emission that would not be further away than about fifty feet from his subject. Leonardo chose this limited light source distance in order to better determine and adjust the various degrees of intensity of shades and colors that are reflected on his subjects for the purpose of defining a specific state of mind.

Close range firelight is the best source of light to achieve such a purpose because all of the harmonic proportions between the different subjects are easier to recognize and the different distances between primary and derived {*ambient deferent rays*} are closer to each other. This is polyphonic music between the tones. The key, here, is to be able to perceive how the {*ambient rays of light and darkness*} create such musical shadows, and how the composition of shadows express specific emotions in the faces of the subjects. The mental states of the subject are expressed by nothing else but the harmony of ambiguous state and interplay that exist between the Lydian effects between light and darkness. By its very nature, therefore, shadow is metaphorical: it is the measure of change between two opposite kinds of emotions. As Leonardo put it: "{*Shadow is the diminution alike of light and darkness, and stands between light and darkness.*}" (Leonardo, Op. Cit., p. 131.)

Indeed, compare the shadow reflections emitted by the blessing hand of Jesus, and those reflected from the pointing finger of the Angel. Note the strong shadow contrasts in the hand of Jesus and the soft ones in the hand of the angel. The difference in intensity of the shadows is remarkable, even when the distance separating the two hands is only about a foot, which is 1/50 of the distance to the source of light. Why? Why is the density of shadow definitely of a lesser degree on the hand of the Angel? The same shadow contrast density appears also on their respective faces. Why? Leonardo gives a very specific

answer. There are two types of shadows: there are primary shadows and there are derived shadows. Leonardo wrote: "{*From these primary shadows there issue certain dark rays, which are diffused through the air and vary in intensity according to the density of the primary shadows from which they are derived; and consequently I shall call these shadows derived shadows, because they have their origin in other shadows.*} (Leonardo, Op. Cit., p. 130.)

And, this is the reason why a close examination of the position of the different individuals in the {*Virgin of the Rocks*} will reveal that, even though they are separated by very short distances of only a few feet or inches, the degrees of intensity of light rays and of dark rays, which are reflected from them, will increase slightly, but continuously, from the Virgin to the Angel, and then, from John the Baptist to Baby Jesus, who will exhibit the maximum intensity of a multi-facetted polyphony of only primary lights and primary shadows.

Next, compare the softness of the Virgin's face, with its mild luminosity smoothly fading with delicate receding shadows, and the brilliance and glaring reflections of the firelight coming from the face, and body, of Baby Jesus. The contrast is striking. Note how Baby Jesus reflects entirely primary firelights from the front and primary shadows from the back of the cave, which means that the light reflections are not mingled with shadows, they are direct reflections from the firelight. The dark rays of the cave produce the darkest shadows on Jesus because they have not been exposed to any light rays, and have not been affected by secondary light or dark rays either. On the contrary, because the face of the Virgin is further away from the source of light, a mixture of derived light rays and derived dark rays affects her. Therefore, the light rays that are reflected from her face are not direct firelight rays, but derived firelight rays which are mixed with some light and dark rays that are reflected back, in a {*reflex stream*}, from Baby Jesus, John the Baptist, and the Angel.

In other words, by virtue of the {*reflex stream*} mixture of derived light and dark rays, the {*ambient field of shadows*} between Baby Jesus and the Virgin, representing an area of about four square feet, is, on the one hand, filled with derived reflected rays coming originally from the darkness of the grotto, and are also becoming mixed with the more distant primary light rays coming from the firelight. Moreover, on the other hand, these derived shadows are also becoming mixed with the dark blue rays reflected from the dress of Mary and the green rays coming from the dress of the Angel where tinges of these two colors are reflected and mixed in the shadows of the right arm of Baby Jesus, on the entire shadow left side of John the Baptist, as well as on the underside of the left hand of Mary. One needs only to compare the two hands of Mary to immediately see that difference, or compare the two arms of the two babies, respectively. Thus, "{*the truth is always in the shadows*,}" the old teacher Viateur Savignac used to tell his students, "{*it is never in the direct sunlight*.}" As if in a glass darkly, truth stands in the ambiguity between light and darkness.

4. THE SECOND SOURCE OF LIGHT AND THE AXIOMATIC CHANGE IN THE LONDON {*VIRGIN OF THE ROCKS*}.

The fight between the Brothers of the Immaculate Conception and Leonardo over what should have been the appropriate treatment of the {*Virgin of the Rocks*} is most instructive with regards to the general pedagogical point that Lyn is addressing on the ambiguity of the dual source of light. But, there is more, especially in light of Lyn's recent insistence on the Gauss discovery of Ceres and how the LYM will have to resolve the problem of this creative discovery with respect to modern day mathematics education. The point is that Leonardo also had to fight against the spread of Romanticism as Gauss did, and the question is how did Leonardo address the suppressing of his own process of discovery and manage to present the truth of his discovery, regardless?

As in the fight between the Romantic school of mathematics and Gauss, the clash between the Brotherhood and Leonardo came directly from the conflict that always arises between what is commonly regarded as acceptable popular opinions, that is, {*what people think they know and like to hear*}, and creative ideas, that is, {*what people need to know, but do not like to hear*}. The question is how do you force the envelope in such a way that the slave of public opinion has no choice but to submit to this inevitable change? And, in what way can that reliable knowledge be acquired?

Since Leonardo was unable to have his revolutionary treatment of the painting accepted by the Brotherhood, he was forced to give the Brotherhood what they had asked for, that is, an apparently flawless and pure "religious object," which excluded the ambiguities of the first version, but with the embodiment of an enclosed exploding truth. In other words, Leonardo gave the monks a shocking application of the Leibniz rule whereby "{*There always exists in nature something more than can be determined by geometry.*} Now, reflect that forward to the case of Gauss and see how the same regime might apply. Leonardo answered the Brotherhood as follows: "{*And as the geometrician reduces every area circumscribed by lines to the square, and every body to the cube; and arithmetic does likewise with the cubic and the square roots, those two sciences do not extend beyond the study of continuous and discontinuous quantities; they do not deal with the quality of things which constitute the beauty of the works of nature, and the ornament of the world.*}" (Leonardo Op. Cit., p. 128)

Nowhere can we find a more powerful application of this statement than in the case of the two fundamentally different and opposite settings of the {*Virgin of the Rocks*}, known as the Paris version, which we have just studied, and the London version, which we will now investigate. (See **Figure 1.**) To put it bluntly, Leonardo appears to have painted the figures of the London version of the {*Virgin of the Rocks*} almost as if they were lifeless, as if they were representing pure geometrical bodies. At first glance, the question that pops up in one's mind is: what is missing, by comparison with the figures from the Paris version? Why are the two paintings, composed by the same Leonardo so different? What is the nature of the source of light in this second {*Virgin of the Rocks*}? Is this where we are to find Lyn's second source of light?

One thing is certain, however: Leonardo did not paint his second version differently out of spite, but to make a very important pedagogical point. He wanted to show how to determine a change of intention of his subjects by means of changing the source of light, like a musical composer makes a change in the variation of the same theme. By changing from an evening firelight projection to a daytime direct sun projection, the entire dynamic of the {*general wave function*} was necessarily and appropriately modified and the field of {*ambient atmosphere of shadows*} was applied differently for each and all of the figures, though always in accordance with the same esthetical well-tempered calculus. As a result of that change, the internal emotion of each subject was changed.

Again, it is useful to compare the two versions of Leonardo's paintings in some detail. Take a good copy of each scene, and put them side-by-side. The anomaly will suddenly become startling. Concentrate on the faces of the two Virgins and study each one closely with the knowledge that you now have of Leonardo's method, as he described it above. What happens? You are no longer capable of applying the same differentiation scrutiny to the London version. Why? The {*general wave function*} does not apply in the same way, because the mixtures of shadow differentiations are no longer the same. The intention of the Virgin is completely changed and has become suddenly more dramatic. All of a sudden, the Virgin has gone through an axiomatic change, and this effect comes from the treatment of the other source of light that Lyn talked about. You are immediately forced to recognize that Leonardo has used direct daytime sunlight instead of nighttime firelight. He returned to the point source of light of linear perspective. And, because of that crucial change of the light source, the total dynamic of the pictorial space has been axiomatically changed.

Do the following two experiments. First, identify the physical change between the two Virgins, and then, identify the epistemological change caused by that.

In the first case, you will find that, physically, you have now passed dramatically from a nightly, humid, and soft luminous face, in the Paris version, to a daytime-dry, and harsh face in the traits of the Virgin of the London version. All of the contrasts are more pronounced. Even the rocks in the foreground, reflect a daytime atmosphere, as if you had suddenly come outside of Plato's Cave. All of the differentiations between the intensity of light and darkness have sharp shadow definition, and the complex dynamic reflected from the different subjects in the field perspective is no longer perceptible. In other words, the multi-facetted infinitesimal differentiations of the Paris version no longer exist in the London version. They are missing because the entire scene has been submitted to direct sunlight. Consequently, all of the shadows have become very sharply defined as darker primary shadows.

Not only is the complex of self-reflexive and self-differentiation of the dynamic {*general wave function*} no longer perceived, but also, because of that omission, and for that precise reason, the internal life of the figures has almost become suspended, as if they had been submitted to some kind of retarded potential. The vital force is apparently

no longer there. The spectator even has difficulty in recognizing the purpose in their minds by means their physical attitudes. The scene has suddenly become cold and geometrical, almost lifeless. This physical difference is so striking that it bears the burden of the proof of our entire argument about the Carnot principle of {*aerial perspective*}. How did Leonardo represent his figures "{*in such action as may be fitted to express what purpose is in their minds?*}" The proof you are seeking is in the epistemological domain.

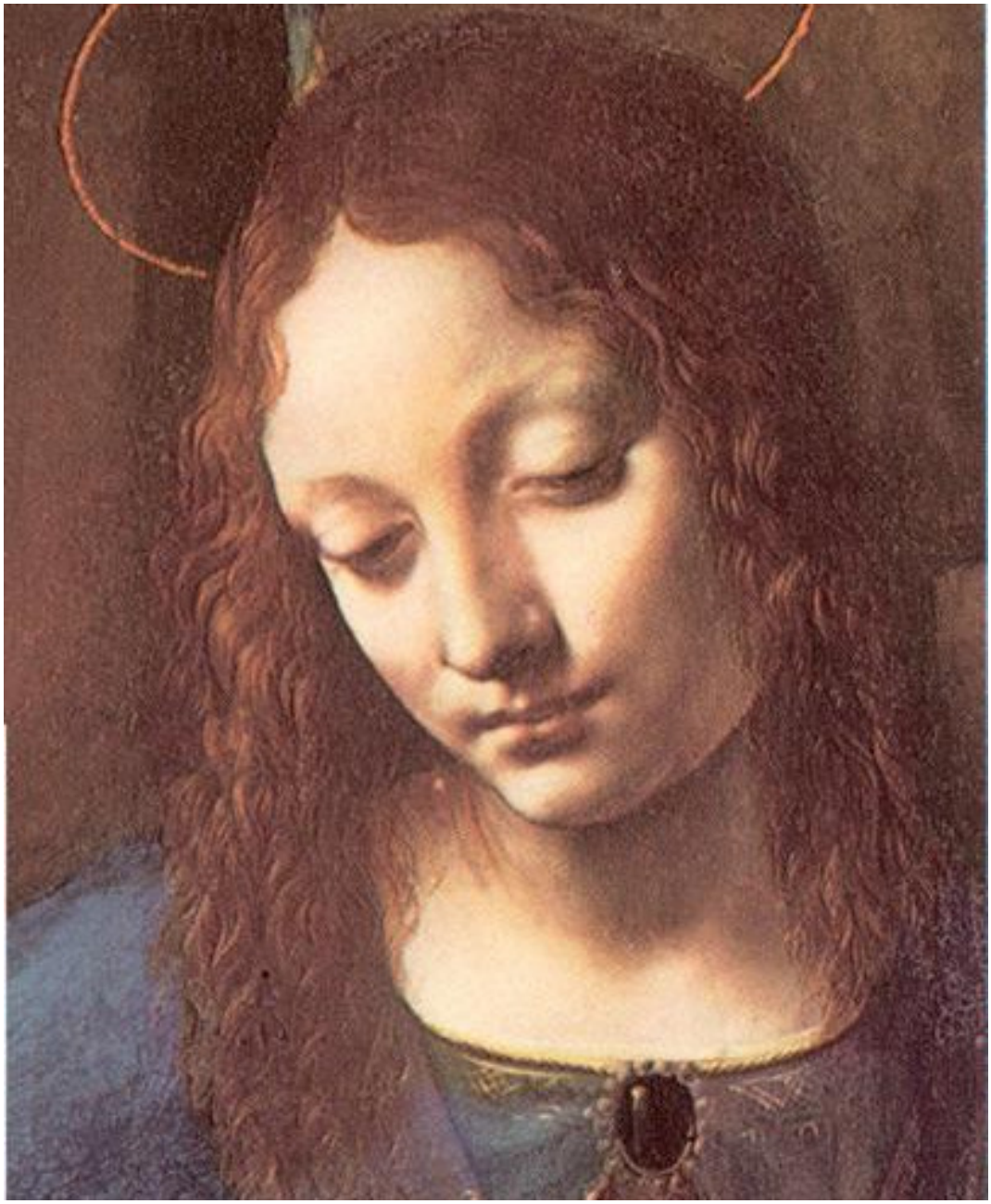

Figure 3. Detail of the Virgin in Leonardo's {*Virgin of the Rocks*} (London). Note the reflection on the broach of the Virgin. There is a point source of sunlight being

projected through a small opening as opposed to a field-source of firelight through an open door.

In the second case, identify the epistemological change in the state of mind between the two Virgins. After a careful examination, you will not fail to discover that the truth in the difference between the two sources of light, in the two renditions of the {*Virgin of the Rocks*}, lies in the axiomatic difference between the sublime and the tragic expressions on the faces of the two Virgins. The Virgin of Paris is calm and serene, while the Virgin of London is burdened and sad. In the first instance, you can hear Mary thinking the sublime loving thought: "{*I am offering you my son joyfully, the most loving redeemer who is willing to die for the sins of all of mankind.*}" In the second instance, you can hear Mary thinking the tragic desperate thought: "{*I am resigned to accept such suffering and to sacrifice my son who must die for the sins of all of mankind.*}" See **Figure 3.**

This is a crucial axiomatic difference that Leonardo has chosen to express for the benefit of the Brotherhood of the Immaculate Conception, but, also, for the benefit of all of mankind. Leonardo is telling the world, and the generations to come, that these two states of mind are a permanent feature of the Roman Catholic Church itself. These are two axiomatically different ways of understanding the forecasted passion of Gethsemane and the passion of the Promethean man of the Renaissance. Furthermore, in regard to the mystery of redemption, I might add that this point is also valid for any other Christian Church. Even though this irony goes back to Christ, himself, it has become known more recently as the paradox of {*felix culpa*}: the anomaly of the {*happy fault*}.

It was Pope John Paul II who verbalized this sublime paradox of the original sin by stating: "{*Oh happy fault, which deserved to have so great and glorious a redeemer!*}." The entire period of the fifteenth century represented a crucial moment of the fight inside of the Catholic Church between the Benedictine and the Franciscan orders over the issue of whether or not Mary was born with the original sin. The Benedictines said yes and the Franciscans said no. The case was resolved in favor of the Immaculate Conception of Mary at the 1439 Council of Bale, and it was precisely in 1483 that Pope Sixte IV forbade the Benedictines from attacking the belief that Mary had been preserved from the original sin. Therefore, this was a very hot issue, and it was this article of faith that Leonardo treated as the paradox of the {*happy fault*} representing also the axiomatic difference in the Catholic Church between the Thomist (Aristotelian) tendency and the Augustinian (Platonic) tendency respectively. Raphael de Sanzio touched on the same anomaly in his masterful painted dialogue between the {*School of Athens*} and the {*Dispute of the Holy Sacrament.*}

The point, however, is that, as a result of this living paradox of {*felix culpa*}, Leonardo has succeeded in reproducing for the first time, in a classical artistic composition, two of the most profound human emotions, {*sublime love*} and {*tragic love*}. And it is only from the more profound understanding of the first that the second can be understood: because the first action is the resolution of the paradox and the other action is the failure to resolve it. However, for Leonardo, the resolution of the paradox of

{*sublime love*} could not have been accomplished without {*agape*}, and without a profound understanding of unity between both well-tempered music and well-tempered painting, that is, without resolving the paradox of tempered vision and tempered hearing in its artistic form. And for Leonardo, this paradox gets resolved explicitly in the same way that all regular solids and semi-regular solids get resolved from the principle of the spherical starred dodecahedron, as Kepler showed it in his *Mysterium Cosmographicum*.

Similarly, all of the key intervals of the well-tempered system, the fifth, fourth, major third, sixth, minor third, augmented sixth and diminished seventh are similarly derived from the dodecahedron. Therefore, once any pair of visual or musical intervals is conceptualized in that manner, that is, from the totality of such phase-space of intervals, then, any composition of human emotion can be generated from such paradoxes, because it is the dodecahedral function that unites the field of vision and the field of hearing into a higher dimensionality.

Both Pacioli and Leonardo had an understanding of this harmonic correlation between the dodecahedron and the twelve intervals of the solar system based on the Bel Canto C-256 tuning of the human voice. For them, well tempering meant that both visual space and musical space were essentially dodecahedral in character, and that all possible consonances and dissonances of such a dodecahedral phase-space could be generated and made to express human emotions. Raphael later demonstrated the architectonic truthfulness of that dodecahedral-harmonic phase-space in the {*School of Athens*} and in the {*Dispute of the Holy Sacrament*}.

As Lyn put it recently on the subject of Leonardo, "{*You have to see hearing – actually see hearing—as in a relationship with the visual field.*}" Therefore, when you look at these two paintings, and you pay attention to their intentions, then, you can actually see the Lydian harmonic differences being sung between the two Virgins. You can actually see, in the visual field of your mind, the cross voicing of the {*Four Serious Songs*} of Brahms resonating in their minds through the subtle harmonic arrangements of the shadows.

There is nothing fictitious or exaggerated about such a projection because both Leonardo and Brahms have made the same universal use of Lydian field harmonic intervals in their compositions. In fact, the Lydian field reflects visual dissonances which are also auditory dissonances: your sight perceives them as light and dark dissonances in the same harmonic proportions as the hearing perceives them as light and dark dissonant voices. This way, you can see what you hear and you can hear what you see. Lyn's reference to the "Royal Theme" as developed between Bach, Mozart, and Beethoven, stems from the same Lydian field. Those dissonances may be perceived as being different according to your individual senses, even sometimes contradictory, but they are actually produced together by the same phase-space in your mind, because they are generated by the same underlying universal physical principle of harmonic proportionality. Just do the experiment and you will {*see what to hear*}. Just listen to **Figures 3** and then go back and listen to **Figure 2.** Then, compare the two and you will see their musical differences in your mind!

5. {*RETARDED POTENTIAL*} IN THE LIVING FORCE OF LIGHT

Although Leonardo was forced to introduce into the London version some elements of symbolism from popular culture in order to appease the upset Brotherhood, such as halos and a small cross over the shoulder of John the Baptist, he nonetheless obliged his mind to supercede such forms of intellectual degradation, and forced his mind to maintain the focus on the higher purpose of his work; that is, {*agape*}. The most important thing about the painting was the truth, and the education of the spectator to this scientific truth; that is, on how he provoked the observer into becoming engaged into making a discovery of principle in the drama that was unfolding during the Renaissance. So, with that purpose in mind, Leonardo made an incredible joke: he cut off the pointing hand of the Angel, made it disappear, and highlighted the pair of wings, instead. What a delightful irony!

Not only is the right hand of the Angel hidden, but also his left hand is practically non-existent. The delicate left hand of the Angel, which held Baby Jesus tenderly, in the Paris version, has almost disappeared in the London version. Like the red and green dress of the Angel in the Paris version, his left hand has faded in some kind of brownish blur blending with the darker background of the Grotto; as if it were to reply to the objection of the Brothers who reportedly insisted: "{*Angels should not be noticeable for their hands, but for their wings.*}"

So, this being the case, the Angel has also been transformed and his facial expression has taken the same coat of sadness as the Virgin's soul. His eyes are no longer an open window from the creative soul of Leonardo to the soul of the spectator, but have been closed in the retreat of the humbling silence of meditation. His powers of pointing to the creative process are no longer there, and he has been reduced to sharing the Virgin's suffering. So, the question is: what did Leonardo replace the metaphoric function of the Angel with? What device did he choose to awaken the attention of the spectator without the Angel pointing his finger, and without his looking at him? Look for what is not there. Ask yourself: what was missing in the Paris version? The answer should not be very surprising, but it is actually quite shocking. What was missing was direct sunlight! Let the sun shine directly into this dark church of the Immaculate Conception of Milan, where the "acceptable and politically correct" version of the {*Virgin of the Rocks*} was originally located and where it was made to elevate the observer to the light of truth.

As much as the introduction of firelight enhanced and amplified the ambiguities and the contradictory impressions of the figures in the Paris version, causing them to reflect the unity of effect of the sublime in their inner life, similarly, a projection of direct sunlight on the entire scene of the London version will enhance, and bring to life all of the dormant grayish tragic figures. Thus, Leonardo turned a bad contractual situation into an opportunity to develop an exciting new scientific experiment. By placing his painting as the altarpiece of the Church of Immaculate Conception in Milan, Leonardo might have

entertained the thought that, on any sunny day, a ray of sunlight, projected inside of the dark church, might passed over the figures of the {*Virgin of the Rocks*}, touched them, and sparked each of them back into life, causing a {*retarded potential*} of the living force of light to be reawaken in them from a sort of suspended animation, and thus, causing them to become illuminated and come alive in quite an extraordinary way. The historical accounts are silent on whether this experiment was actually performed or not. The effect, however, would have been devastatingly beautiful.

Nevertheless, to confirm that this {*retarded potential*} really does exist in the crafting of this painting, and actually produces that intended effect, do the following experiment yourself. Take a good clear copy of the London version of the {*Virgin of the Rocks*}, and move it slowly out of the shadow of a dimly lit room, toward a window opening where direct matines sunlight is projected onto it. Observe how each figure will come to life, one by one, as you are lighting up the faces of each of the figures, one after the other. Their sad, grayish, and unanimated-like faces, which appeared such when viewed in the shadow of the church, or in the dim light of a room, will suddenly acquire an unbelievable brilliance of life, when put in the direct projection of morning sunlight. The result is such that the direct sunlight, reflected from them, will be almost blinding. This experiment will be most astonishing as you will clearly see that everything is becoming alive inside of the grotto, including some very beautiful and immaculate white Impatient flowers growing at the feet of John the Baptist, and at the feet of the Virgin. Then, you might even be tempted to say to yourself: "Leonardo has accomplished another miracle!"

CONCLUSION

From the standpoint of this experiment of field-perspective dynamics in light propagation, the {*Virgin of the Rocks*} is a perfect illustration of the intention that Lazare Carnot had established at the opening moment of his class on industrial drawing at the Ecole Polytechnique. The {*Virgin of the Rocks*} truly reflects "{*the art of generating ideas by means of the senses, of acting on the soul by the organ of vision.*}" However, other artists of the Renaissance period have also reflected that purpose, though in a limited manner and by using the artifice of central perspective, such as Piero della Francesca in his {*Resurrection*}, Raphael de Sanzio in his {*School of Athens*} and {*The dispute of the Holy Sacrament*}, and Hans Holbein in the {*Ambassadors*}. In each of those three cases, it was linear-central-point-perspective itself that acted in elevating the soul by means of a visual anomaly. It was a geometrical trick, an illusion. In each of those three cases, linear-central-point-perspective was brought to a paradoxical limit, but without superceding the artificial nature of the system of projection itself. Leonardo was the only one who broke the rule of central perspective formalism and superceded its system by discovering the truth of field-perspective. By the same token, Leonardo had found the solution to the Gauss problem: he broke with the attractiveness of the formula in the same way that students, today, must break with the attractiveness of mathematical formulas.

And in breaking with the formula, Leonardo revolutionized the whole idea of painting with a higher idea of truthfulness. Central perspective gave the illusion of truth; field-perspective gave access to the truth itself. And it was from the vantage point of the same Leonardo method of change that one of the greatest painters of all times, Rembrandt van Rijn later created the most exquisite masterpieces of classical artistic composition. Just study closely the series of more than fifty self-portraits of Rembrandt from the vantage point of Leonardo's method of field-perspective and you will see the most playful and ironic variations of human emotions ever put on canvas.

So, one more time, Lyn was absolutely right about the dual purpose of classical artistic composition. Leonardo gave the world a proof of his commitment to the dual purpose of all classic art; that is, the submission of his art to the rigor of scientific truth, but also a willingness to elevate such truth to the explicit required ironical principle of metaphor. For that very reason, therefore, this crucial field-perspective experiment shows that it cannot be reserved exclusively to the domain of art. Leonardo's legacy goes beyond any apparent limitation of the artistic domain. His method of polyphonic composition is truly universal and calls for universal application in the domain of physical science as well. (4)

Thus, with such an axiomatic breakthrough, Leonardo opened both the domain of artistic composition and the domain of science to the living dynamics of non-linear-field-perspective, a revolutionary method of artistic composition that was to be later developed further, and consciously so, by Kepler and Leibniz in the domain of astrophysics. This is the higher manifold of Greek {*Sphaerics*} composition that Lyn has been addressing and which is an essential prerequisite for understanding astrophysics and economics today, especially with respect to the field of isotope transformations inside of our solar system. Therefore, it should be from the epistemological wellspring of Leonardo's {*non-linear-field-perspective-principle*} that our work in science should now project its source of light throughout the scientific community of today.

NOTES

(1) Leonardo developed an exquisite metaphor for the creative process of his field-perspective with the well-known and very elementary optical experiment of the Camera Obscura. Think of the setting of the {*Virgin of the Rocks*} as being a complex Camera Obscura experiment. Leonardo wrote:

> "{*All bodies together, and each by itself, give off to the surrounding air an infinite number of images which are all in all, and all in each part, each conveying the nature, color, and form of the bodies which produces it. It can clearly be shown that all bodies pervade all the surrounding atmosphere with their images all in each part as to substance, form, and color; this is shown by the*

images of many and various bodies which are reproduced by transmittance through one single perforation, where the lines are made to intersect, causing the reversal of the pyramids emanating from the objects, so that their images are reflected upside down on the dark plane (opposite the perforation).

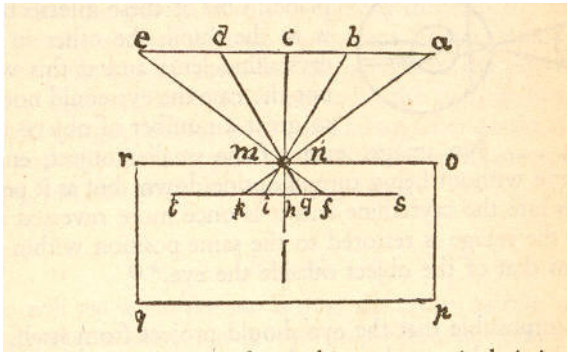

Figure 4. Leonardo's experiment of the Camera Obscura.

"{An experiment, showing how objects transmit their images or pictures, intersecting within the eye in the crystalline humor.

"{This is shown when the images of illuminated objects penetrate into a very dark chamber by some small round hole. Then you will receive these images on a white paper placed within this dark room rather near to the hole; and you will see all the objects on the paper, in their proper forms and colors, but much smaller; and they will be upside down by reason of that very intersection. These images, being transmitted from a place illuminated by the sun, will seem as if actually painted on this paper, which must be extremely thin, and looked at from behind. And let the little perforation be made in a very thin plate of iron.

"{Let abcde be the objects illuminated by the sun, and ro the front of the dark chamber in which is the hole nm. Let st be the sheet of paper intercepting the rays of the images of these objects, and turning them upside down because since the rays are straight, a on the right becomes k on the left, and e on the left becomes f on the right; and the same takes place inside the pupil.}" (Leonardo, {*The Notebooks*}, p.115-116.)

It is useful to see how Leibniz has developed a similar pedagogy for his calculus in {*Acta Eruditorum*}. For example, compare the following least action light propagation experiment of Leibniz as an extension of the optical experiment of Leonardo.

"{*But I expect the most brilliant discoveries from this last work of Newton, and if I may judge by the summary of the Acta, I have to admit that if, on the one hand, he communicates many new results of great importance, on the other hand, he also tackles a certain number of problems that I have occupied myself with; aside from the question of causality relative to celestial movements, he has also*

worked on the explanation of catoptric (reflection) and dioptric (refraction) curves, as well as on the resistance of different media. Descartes has known about such {Optical Curves} but, he has not whispered a word about them to anyone, and his commentators have not found any traces of them. The whole matter, in point of fact, has nothing to do with ordinary analysis. I know that, later on, Huygens has also made their discovery (but he has not yet communicated his results either), and now, it is the turn of Newton. As for myself, I have also discovered them, but by a different route. Even though I was familiar with general methods of approach, it is the remarkable discovery of our dear M. Tschirnhaus, which was published in the Acta, and where he treated entire curves as foci, which gave me the idea of discovering the proper and very elegant methods required. I shall explain this process by an example, which should clarify everything else.

"{Given a point A and a curve BB, on which are reflected rays AB, find the curve CC which will reflect, a second time, the rays ABC which will converge on a common point D.

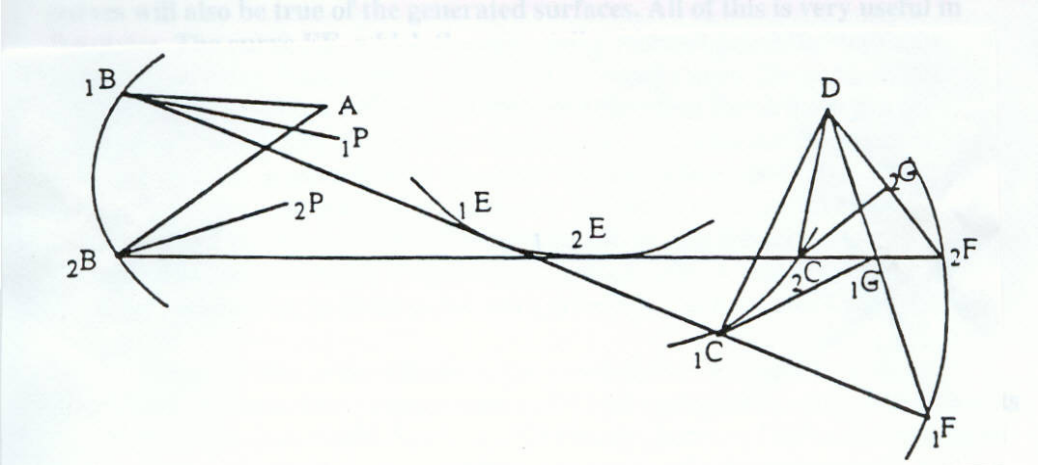

Figure 5. Leibniz's least action principle of light propagation.

"{Here is the solution I have found on my first attempt. The curve BB being given, it is clear that the focus-curve EE is also given from point A, and by means of that curve; thus, two conjugated foci being given, curve EE on the one hand, and point D on the other hand, it is clear that curve CC can be found whose two foci are EE and D; this curve CC is the curve we are seeking. But, there exist better ways of constructing this. In fact, A1B + 1B1E + arc 1E2E = A2B + 2B2E and D2C + 2C2E + arc 2E1E = D1C + 1C1E, consequently the sum AB + BC + CD is always equal to a constant straight-line segment. (1) If, at the same time, a thread is enrolled around curve EE, and is connected to point D, and if we generate the curve of evolution EE (the evolute), a marker which is held at the end of the extended thread will trace curve CC (the involute). If, on the contrary, the same thread is fixed by its other extremity to point A, the marker, which is

extended from it, will draw curve BB. But, if curve EE were to disappear, the simplest construction would be the following: take away from a constant segment (equal to AB + BC + CD) the given segment AB, then take the segment BF equal to the difference, and trace it in a manner such that it makes an angle FBP equal to ABP, with the normal PB to the curve (or to the tangent of the curve) BB. Trace the normal GC to point G through the middle of the straight line DF, such that it cuts BF at point C that is the sought for curve; you can see that GC is tangent to the curve CC.

"{If you rotate that figure around its axis AD, what I have said about the curves will also be true of the generated surfaces. All of this is very useful in Dioptrics. The curve EE, which the rays strike without going through any reflection or refraction, is what I call the {Acampe} curve. There also exist {Alcaste} curves, which reflect rays without refracting them. Such are the generative processes of curves described by way of simple development of the caustic curve EE, a process that Huygens was the first to study, but with another purpose in mind. We get curve FF by locating CF (as an extension of BC) equal to CD. We would get the same result, taking into account the specificity of each problem, if we were to replace point A and D, or only one of them, by foci-curves, or if the point were at infinity, in the case of parallel rays}. (G. A. Leibniz, {*ON OPTICAL CURVES AND OTHER QUESTIONS*}, Acta Eruditorum, Leipzig, Jan 1689.)

Imagine that the caustic evolute {*Acampe*} curve, EE, is a sort of extension of the small round hole mn of Leonardo's Camera Obscura, but without the camera. You can generate a stereographic mental image of the {*general wave function*} that Leonardo is using in his science of painting by rotating the whole experiment of Leibniz along the axis of the two foci A and D.

(2) Leibniz discovered that the harmonic ordering of a "{*compliant deferent ether*}" generated least action surfaces [minimal surfaces] everywhere in physical space-time. This Leibnizian conception, conceived roughly 200 years before the discovery of Nuclear Physics, is an extraordinary expanded development from Cusa, Leonardo, and Kepler. The entirety of these physical processes are subjected to the Leibniz calculus, and its diverse methods of discovering a new physical principle which explains the diverse processes of inversion of tangents and osculation, which were developed during the same period in the {*Acta Eruditorum*} of Leipzig.

Leibniz was also seeking to discover the unity of effect of two universal physical principles in order to explain the behavior of the solar system as a whole; that is, the principle of gravitation of the planets with respect to the sun and the principle of the magnetic orientation of the same planets with respect to the pole star. It would be extremely useful if some members of the LYM were to translate these discussions from the Leibniz-Huygens correspondence, especially the period of 1692 to 1695.

For further reading on these questions, see the selection of unpublished English translations of the Leibniz-Huygens correspondence in [98-26-4/PB_001]:[LEIBNIZ-HUYGENS CORRESPONDENCE], and a selection of unpublished English translations of the Leibniz calculus taken from the ACTA ERUDITORUM of Leipzig, in [97-52-6/PB_001]: [LEIBNIZ TRANSLATIONS ON SCULATION] -- [97-46-4/PB_001]: [LEIBNIZ OSCULATION] -- [98-07-7/PB_001]:[LEIBNIZ CONSTRUCTION OF CATENARY] -- [98-19-7/PB_001]: [TRANSLATIONS OF LEIBNIZ ACTA ERUDITORUM- ON THE ISOCHRONE AND THE BRACHISTOCHRONE], from G.W. Leibniz, {*Mathematische Schriften*}, herausgegenben von C. I. Gerhardt, Band I, Georg Olms Verlagsbuchhandlung Hildesheim, 1962.). I also refer the reader to the English translation of G. W. Leibniz, {*Two Papers on the Catenary Curve And Logarithmic Curve*}, FIDELIO, Spring 2001.

(3) I wish to bring to the attention of the reader that I not only had the opportunity to examine closely Leonardo's original {*Virgin of the Rocks*}, when I organized in Paris, for the Jacques Cheminade campaign for President of France of 1995, but that I also very much appreciated the excellent painted reproduction of the same subject executed by our Paris member, Karel Vereycken.

(4) By locating historically this Leonardo-Kepler-Leibniz principle of a dynamical {*general wave function*} with respect to rays whose infinity of points are, themselves, radiating, we are not only witnessing the establishment of the historical foundation of gravitation, optics, and magnetism, but we are seeing, as well, the epistemological features underlying the discoveries in electrodynamics by Ampere and Fresnel at the Ecole Polytechnique. Moreover, Leonardo is providing some leading insights for investigating the continued efforts by Gauss and Weber, especially in their collaboration on the Riemannian {*retarded propagation*} of light and the longitudinal (angular) force.

For the application of the same principle to physics, I refer the reader, again, to LaRouche's paper on {*How Space Is Organized*} and to Laurence Hecht's box on {*The Controversy over Angular Force*}, EIR, September 14, 2007. Hecht wrote: "{*Experiments, carried out in collaboration with Rudolf Kohlrausch at Göttingen in 1855, established the unknown constant in the Weber force law as equal to the product of the square root of 2 into the velocity of light. In an 1858 paper, "A Contribution to Electrodynamics," Bernhard Riemann, who was present at the experiments, proposed the "retarded propagation" of the electrodynamic potential at the velocity of light.*}

Finally, this reinforces, also, the recently discovered confirmations by Maurice Allais concerning the conceptual errors of the theory of relativity with respect to the speed of light, and thus, this also contributes to bringing to an end the most despicable fraud in the history of science, on the very nature of light, and the hoax of the so-called inverse square law, which had been perpetrated by Newton, Descartes, Cauchy, and LaPlace, as well as the more recent hoaxters such as Maxwell and Heisenberg.

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