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Afterword: The Hermeneutics of Natural Science

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PATRICK A. HEELAN, S.J.

AFTERWORD

THE HERMENEUTICS OF NATURAL SCIENCE

In this volume Stephen Toulmin and Allan Janik have represented me as the person who converted Hans-Georg Gadamer to the recognition that the natural sciences and technology are hermeneutical, like history, art, the humanities, and the social sciences. That is, they are constituted by human meanings embodied in language, symbols, and cultural practices. The two cultures of the natural sciences and the human arts are thereby brought together under a common historical hermeneutical umbrella that gives shape to all science, technology, and culture – even to theology (see below). I doff my hat with respect – and deep appreciation – to Stephen and Allan. But I continue to muse: surely it took a slew (Gaelic from '*sluagh*,' a tribe) to change such a strongly entrenched tradition of which Gadamer was chief! Who were the members of this tribe? Stephen, of course, was one, a special one. Allan too, and Babette Babich – and others. I still recall with excitement my encounter with Gadamer at Boston College in April 1974 when I spoke up to challenge him about his exclusion of the natural sciences and technology from the umbrella of human hermeneutic constitution. Memories, warm memories!

The issue in question also has a certain majesty. Aristotle and Plato were the Magi from the Middle East whom the West followed consistently for two thousand years and more, in pagan, Christian, and post-Christian times. They taught that knowledge was expressible only in objective universals, and that such knowledge became science only when integrated through laws and theories that permitted inferences to be made by mathematical or logical deduction. Euclid's geometry was a model, and so was Archimedes. In such a science, however, there was no place for randomness, contingency, and human freedom, that is, for the stuff of real individuals, real history, real emergent development, and real social choices. Universals trimmed the differences among real individuals and reduced the latter to "irrationals." Biological evolution and other forms of emergent development stem from contingent opportunities that are similarly "irrational." History can do no better because it refuses to trim real events of their particularity; the stories it tells are about "irrational" events. Even technologies, because they re-shape the lives of real men and women in ways not deducible from general laws, so they too, despite their association with the sciences, are "irrational." Finally, society itself turns out to be "irrational," because it is the maker and transformer

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of the languages, representations, and cultural practices through which knowledge is handed down from generation to generation in ever new and unpre-dictable words, grammars, forms of discourse, and cultural activities.

It was to account for a local community's science of the local real life-world that the hermeneutics of *Da-sein* (Heidegger's term for the human subject) was introduced. Heideggerian ontological (or existential) hermeneutics criticizes the universality and theory-ladenness of science. The theory-laden practices of science, however, produce new real life-world phenomena that are post-theoretical and (mistakenly? metaphorically? ironically?) named by theoretical names. But are these so-named phenomena truly "theory-laden" realities, I mean, are they constituted by theory? Heidegger answers correctly, No! But we who come later need to push the question further. Since such post-theoretical phenomena (though theoretically named) are the products of practices that embody new theory-based technologies and institutions, we need to reflect further on why they are not constituted by the theory which provides their names. Only the abstract model elements named by the theory are constituted by the theory. In contrast, the phenomena named by the theory are constituted by the experi-mental practices of the laboratory or (what I have called) "readable technologies." How is it that the same terms have two different meanings and are applied to two different objects? Because science works under the hermeneutical umbrella of culture, it has a history, a community, and a freedom that is unintelligible and unexplainable by theory alone. The two meanings, one deriving from theory and the other deriving from praxis, come together contingently and freely in the local life-world of scientists and others trained in the use of appropriate readable technologies. These meanings can be connected by figures of speech, by metaphor or analogy. Usually, however, either the theoretical meaning is used mistakenly to trump – more precisely, to replace – the practical one, as when philosophers of science recite the mantra that scientific phenomena are – "univocally" and "literally" – theory-laden, or the practical (post-theoretical) meaning is mistakenly identified with the pre-theoretical meaning, as when scientists and science writers talk down to the general public using images and analogies from daily life.

How firm is the age-old belief that scientific thinking dispels ambiguity, diversity, contingency of meaning, and metaphor? This belief which stems from Plato and Aristotle was adopted by modern science and incorporated into the early scientific metaphor of the "lynx-eyed." The Roman *Accademia dei Lincei* (predecessor of the present Papal Academy of Sciences) to which Galileo belonged, was the name of one of the earliest academies of science in Europe. Early modern scientists saw themselves as 'seeing' more keenly than merely human eyes the shape, number, and quantity of things. As theoretical scientific vocabularies these terms were thought to be no more than specifications of the visual shapes, numbers, and quantities that belong to the life-world – perhaps, as ideal or limiting cases of these, as Koyré and Husserl thought. But they are not so. They turn out, instead, to be specified by mathematical models related to the life-world by measurement, and processes of measurement are not like seeing, they are more like working with tools in a black box. Eventually, the black box is opened, and I discuss below the new post-theoretical phenomena that are found there. The importance of metaphor for science, however, and for a correct understanding of the history of science has to be recognized.

What then are the post-theoretical phenomena of science? They are new furniture for an ever-changing historical life-world. The river of life, history, language, and culture runs through life-worlds and in its flow it never stops revising and reshaping life-worlds. New invariants and symmetries are created that diversify both subjects and objects. The dynamic of a community's history is driven by its culture, and its culture is driven by science and technology ever transmuting the present into a free and contingent future. The optimism of this principle tends to be muted by its pessimistic counterpart: there is no guarantee that a free and contingent future will be a progressive one. Whether the future – or, for that matter, the present – is healthy/progressive and on the road to survive or in decline and on the road to extinction is not something that the sciences can judge. This can be done only by a culture informed by historical, moral, and religious thought whose parts like the whole are sheltered under the one hermeneutical umbrella.

When the modern trajectories of philosophy and natural science crossed, they influenced one another in fateful ways. Analytical philosophy of science is the residue of such a crossing that reflects both the enormous prestige of theoretical thinking and a strong cultural preference for the *Naturwissenschaften* over the *Geisteswissenschaften*. In England and the USA, the privilege given to theory and to modern physics was carried over into the philosophy of science, and even to philosophy itself. Philosophy and the philosophy of science lost touch with the grass roots of reality, with particulars, history, freedom, society, survival. If we concede, as we should, that the sciences are of and about, not just theories and systems, but real life-worlds, then science begins and ends in the scientists' life-world where theories are eventually used to produce post-theoretical phenomena. Philosophy, being also a theory user, should also ask: how should theory function within philosophy so as to understand the grass roots of human experience? Philosophy and science should go beyond the role of theory to the phenomenology and hermeneutics of the grass roots. Up until recently, Continental Philosophy tended to dwell almost exclusively on the deformations associated with theoretical scientific thinking, while analytic philosophy dwelt almost exclusively on the beauty of its successful theoretical models. Recalling, however, that theory enters essentially into all inquiry, its positive role needs also to be researched within the traditions of Continental Philosophy. That has always been my aim.

Before taking up philosophy as a career, I studied theoretical physics and did research in theoretical geophysics. I also took courses on relativistic cosmological models by Erwin Schrödinger and John Synge at the Institute for Advanced Studies in Dublin and taught the subject to graduate students. I worked as a post-doc at Princeton with Eugene Wigner on the localization of elementary particles, using quantum field theory, and later had many conversations with Werner Heisenberg about the quantum theory. I found that this scientific material contained enough philosophical "mysteries" of the grass roots kind to last a lifetime and beyond. I also found, however, that most of them were related to one another and were generated by the single assumption that universal theory, scientific and/or philosophical, in contrast with local knowledge, constitutes the goal of human inquiry. While addressing specific questions, I found myself grappling with systemic weaknesses in both Analytic and Continental Philosophy focused on the mediations whereby scientific research passes from the recognition of a problem to the acceptance of a solution. What are these mediations? First, the initial problem presents itself as an experience in the pre-theoretical life-world of a scientific

community that does not understand it and is ready to take steps to come to an understanding of it. The first step is to transform the problem by finding a suita-ble hypothesis/theory. The hypothesis/theory is then transformed by laboratory practices into a new kind of problem which depends on new theory-laden technologies. The new technologies in turn produce new sets of experiences different from the initial experience and take place in a changed post-theoretical life-world different from the initial life-world of the unsolved problem. This outcome is then freely taken to be the solution to the original problem under the conditions set by the original search for understanding. The cycle of activities is transformative not only of the local ambient life-world of the researchers through the addition of new local technologies, but also of the members of the local scientific community, of local scientific language, representations, and media. These steps form a sequence of time-ordered human activities, many of them freely made and without guarantee of success, that can only be described in narrative form that belongs to the genre of the history of science. This kind of narrative makes sense only on the presumption of one local hermeneutical cultural umbrella.

After exchanging the practice of physics for the profession of philosophy, I addressed the following challenging philosophical topics:

A HERMENEUTIC PHILOSOPHY OF SCIENCE

- A Husserlean intentionality analysis of the early Bohr-Heisenberg view of the quantum theory; of quantum logic as a context logic of differently embodied inquirers; of the problems of causality and localization in quantum mechanics.
- Heideggerian analysis of the ontological status of measurement and laboratory data.
- The Husserlean group transformation structure of perceptual objects in general, and of theoretically denominated laboratory entities construed as perceptual objects.
- A critique of David Marr's program for machine perception.

VAN GOGH'S EYES

- A study of Vincent Van Gogh's painting, *Bedroom at Arles* (1888), of the art and aesthetics of the (negatively curved) local Riemannian pictorial space achieved by the artist and how the artist used the theory and technology of perspective to achieve his purpose.

GOD

- Using a common philosophically understood method underlying theology and natural science, scientists who are religious and theologians who respect the processes of natural science should be able to gain reliable experiential, intellectual, and rational knowledge both of Nature, the subject matter of the natural sciences, and of God, the subject matter of religion.

A HERMENEUTIC PHILOSOPHY OF SCIENCE

My introduction to philosophical research was influenced in equal parts by the writings of Edmund Husserl, Martin Heidegger, Maurice Merleau-Ponty, Hans-Georg Gadamer, and Paul Ricoeur, and the lectures of Jean Ladrière at the University of Leuven (Louvain). Leuven is the location of the Husserl Archives. I also owe much to the influence of Bernard J.F. Lonergan, S.J., especially to his *Insight* and *Method in Theology*. My phenomenological research was tempered from the start, then, by recourse to Aristotle, Aquinas, and Kant. Later I was to find among my American colleagues some who moved me further in the direction of existential hermeneutics, such as William Richardson, S.J., Joseph J. Kockelmans, Theodore Kisiel, Hugh Silverman, and Babette Babich. I discovered many of the more technical details of philosophy and the history of science in discussion with the analytic philosophers at the

Pittsburgh Center for the History and Philosophy of Science where in 1983 I was a senior fellow.

What I learned from Lonergan is the importance of the starting point in any inquiry. Insight into insight or the "phenomenology" of insight became for me the starting point for a philosophy of science. A similar but richer message came from the phenomenological tradition with its emphasis on "*die Sache selbst*," which in Husserlean language is the object constituted as known by language, community, history, technology, and the human body, and revealed through the intentionality of inquiry. One begins, not as Plato, Descartes and Hume did, by asking the epistemological question: what can we know? (for we don't know whether we are competent to answer it), but, as Aristotle, Aquinas, Husserl, Heidegger, and Lonergan did, with the ontological question: what is knowing? Which leads to the further questions: what do we do when we know, and why is this doing a knowing? For the answers to these *must be* in some sense self-evident; the Being of Knowing *must be* – in some sense to be uncovered prior to the beginning of any trustworthy inquiry – the Knowing of Being.

My first book, *Quantum Mechanics and Objectivity* (1965), studied the intentionality-structure of quantum mechanics under the original Bohr-Heisenberg account, and criticized the later, more frequently held, objectivist account of John von Neumann and Eugene Wigner that construed the quantum theory as a new universal theory of physics. In the Bohr-Heisenberg account, the quantum theory spoke about the (observed) microsystem as it was revealed to a macroscopic observer through the process of measurement. Measurement for Bohr and Heisenberg was central; it was quantitative, technological, social, historical, linguistic, teleological, and local. It was the action of one local part of the humanly inhabited cosmos on another local part that strangely (to classical epistemologists!) had the capacity to change both local observer and observed. This mysterious capacity does not lie in the non-physical or spiritual agency of the human Mind, as proposed by von Neumann and Wigner, but in the intentional character of the measurement process and its ability to shape the way an object – here a quantum mechanical object – is "dressed" to make its appearance as a cultural object within the context of a particular culture, in this case a local historical scientific community.

I was to do much further study on these and other topics, among them quantum logic, measurement, locality, and causality which are names for the set of epistemological problems associated with the quantum theory that are particularly recalcitrant to classical epistemology.

Quantum logic studies the deviance in truth-functionality that seems to characterize experimental sentences in quantum mechanics. For many logicians, quantum mechanics seems to involve either a third truth-value intermediate between T(ruth) and F(alsity), say, I(ndeterminacy) or a range of truth-values between 0 and 1. In either case, there is deep uneasiness about the objective goals of both science and logic. I found the basic paper of Birkhoff and von Neumann incoherent and claimed that in keeping with Bohr-Heisenberg's original interpretation of quantum mechanics it was sufficient to hold that any experimental sentence formulated in quantum mechanics becomes truth-functional (either T or F) only conditional to the prior implementation of a specific local measurement process. In my view, since truth-functionality in quantum mechanics is locally context-dependent, quantum logic should be addressed as a specific case of local contextuality in sentential logic. This solution, though often anthologized in quantum

logic collections, offended against several dominant perspectives: the nominalism of the logical empiricists and the objectivism inherent in the new universalist interpretation of quantum mechanics. It also offended, on the one hand, the universalist historico-political leanings of the neokantian founders of the logical empiricist school and, on the other, the postmodernist longings of those who looked to the "weirdness" of the quantum theory for disembodied spiritual inspiration. The articulation of the notion of contextuality requires sophisticated tools and techniques that stem from Continental approaches to knowledge, using, for example, such notions as intentionality, phenomenology, constitution, history, hermeneutics, and local embodiment. Such philosophic tools are simply not available to objectivist social science or analytic (rationalist or empiricist) philosophy. The use of Continental tools unlocked for me some of the "mysteries" of the quantum theory and opened up a large field of inquiry that I hope others will be able to develop and appropriate in time.

Among the topics of outstanding importance for the understanding not just of quantum mechanics but of all empirical science is *measurement*, for the measurement process is that which can bring model-defined "theoretical entities" into the domain of human culture and perception, revealing them as cultural entities of scientific laboratory culture. Among these cultural entities, some become perceptual entities under the philosophical criteria implicit in Husserl's (Hilbert inspired) analysis of the noetic-noematic invariances of any perceptual object under the group theoretic variation of its characteristic profiles. By measurement the theoretical and quantitative language of a model gets translated into a cultural and perceptual life-world language. Look! we say, that trace (one of the characteristic group theoretic profiles of) is a proton with 10 Mev energy in this local setup. Measurement is where the language of theory gets "dressed" within a social, historical, and technological context with local perceptual "clothes." Measurement is a hermeneutic performance, like the playing and replaying of a game or like a musical or theatrical performance. Bob Crease has developed this notion in a book called *The Play of Nature*. This is not the literary hermeneutics of author/text/reader (ATR) but the existential hermeneutics of coded-energy/embodied-receptor/lifeworld-interpretation (CE/ER/LI, perhaps), which is the transcendental structure of human perception in the tradition of Husserl, Merleau-Ponty, Heidegger, and Lonergan.

My approach to the problems of localization and causality in quantum mechanics was influenced by a study I began in the late sixties (and recently revisited) of the pictorial space of Vincent Van Gogh's painting, "The Bedroom at Arles." This led to a comparison between, on the one hand, the non-Euclidean spaces of visual and pictorial presentations and, on the other, the Euclidean space of science and traditional mathematical perspective. The Van Gogh study was sparked by discussions at a course (on differential geometry) given by Erwin Schrödinger at the Dublin Institute for Advanced Studies in the late 1940's and by a lecture I gave some years later at Fordham University on pictorial spaces at the invitation of my friend, the distinguished art historian, Irma B. Jaffe. The metric structures of visual and pictorial spaces fascinated me because they seemed to follow a negatively curved Riemannian metric rather than the Euclidean metric of classical physics which both culture and philosophy assume to be the one and only, "true," "real" and "actual" space of experience. This problem led to my second book.

Space-Perception and the Philosophy of Science (1983/1988) is a book about the philosophy of science, but it is often read as a book about vision. It uses vision as a starting point and helpful illustration that shows how to address the analysis of science from the standpoint of an embodied, hermeneutical and phenomenological philosophy. I show that the shapes, sizes, and distances that people actually see in the life-world and in pictures do not fit a Euclidean space but seem to belong rather to members of the two-parameter family of finite hyperbolic Riemannian spaces. (One parameter is correlated with the overall diameter of the visual space and the other with the distance from the viewer of the local quasi-Euclidean zone of vision directly in front of the viewer's eyes.) The finitude of the cosmos and the locality of places and times were accepted by Plato, Aristotle, and nearly all of the ancient philosophers and by most people till the end of the fourteenth century. However, the new technologies of perspective, mapping, navigation, and time keeping changed all that and made it possible for the cultural elite to entertain belief in a single infinite – terrestrial and heavenly – Euclidean space and a single universal time The authority of a single cosmological geometry and a single cosmological time over the multiplicity of local perceptual places and times was full blown by the times of Descartes and Newton, and has persisted right up to the present day.

The conclusion of Part I of my *Space-Perception* is that the scientific (post-theoretical) organization of space does not have to be single, universal, and theoretically Euclidean, but could be local, contextual, and theoretically Riemannian. Each form of organization is tied hermeneutically to some form of local practical appreciation of the environment. It is Euclidean if attention is paid to the "carpentering" of the environment, and Riemannian if attention is paid to the purposefulness of direct local action in the world. Local places and times do not have to be "irrational," they too can be scientific with the discovery that the presentations of self to the world and vice versa are often deployed in daily life in Riemannian metric spaces.

In Part II of *Space-Perception*, I address the following questions: What philosophical weight should be given to modern science given that it narrowed the options of spatial theory to just the Euclidean? What "reality" weights should be assigned to the diversity of modes of spatial perception when contrasted with the uniqueness of Euclidean space? Do answers to these questions throw any light on the "mysteries" of quantum mechanics?

The phenomenological principle is that the local life-world is the primary horizon of perception within which reality is given to individual humans. This principle takes issue both with rationalist criteria (the privilege of theory over practice) and the empiricist criteria (the privilege of measured data over cultural perception). One of the sources of paradoxes for scientific modernity is the tension in common usage between theory and practice, measurement and perception. This tension is resolved only when it is understood that reality (in a philosophical analysis) is never given absolutely in a unique way, but is always given locally in a local space for a local community for local purposes and, therefore, in spaces with possibly different metrical structure. If in keeping with the above principle, scientific reality is the phenomenolo-gical *"die Sache selbst*," then the local "being-in-the-world" within which it is given is a local laboratory culture. Reality, then, is always given to a human locally, and its furniture is "dressed" characteristically for that local situation according to the Husserlian-Hilbertian theoretical criteria referred to above.

One of the standard "mysteries" of quantum mechanics is that particles are not localized spatial entities before they are measured. The reason for this, I claim, is that, prior to the setup of a measurement process, there is no constituted, local life-world space in which a particle can make its appearance. Setting up a measurement process then constitutes the local life-world space (here, it is the local laboratory culture) in which a particle can display itself as a localized entity. With this analysis the "localization problem" in quantum mechanics disappears. A problem of understanding, however, remains. What quantum mechanics seems to be saying is that in a world where all real entities are of necessity localized even in science, quantum particles are exceptions. But when properly understood, quantum mechanics should be interpreted as saying that in a world where real spatiality is always of a local life-world kind, the relevant life-world space has first to be constituted before objects can be experienced as localized entities. In science, however, the local life-world space for scientific observers is constituted by an implemented measurement process, and it is in this space that the particle is "dressed" to display itself to local scientific observers.

Following the same analysis, the "causality problem" in quantum mechanics also disappears. Causality (in the Humean sense) is defined as the lawful ordering of localized events in before/after sequences. Since in quantum mechanics things are not localized prior to measurement, they cannot be said to participate in orderly before/after sequences of interactions prior to the setting up of a space-constituting measurement process.

So much for quantum mechanics. A final word on machine perception: if visual and other perceptual spaces are hermeneutically engendered and if they are Riemannian within non-carpentered life-world spaces, then the machine processing of Euclidean optical signals can go only so far before it encounters the need to be guided by top-down local cultural factors. These are the kinds of active cultural intentions that are at the core of narratives of human life and to which Riemannian vision is culturally attuned. Machine processing beyond this point is possible only if the machine is already a servant of the culture and not its master.

VAN GOGH'S EYES

Returning to pictorial vision, I was early fascinated by the realism of Van Gogh's paintings, particularly of his *Bedroom at Arles* (1888) which I had seen at the Chicago Art Institute and which gripped me with the experience of a transfixing presence that I can only describe as being in that room. As I mentioned above, I took a course on Riemannian geometry given by Erwin Schrödinger at the Dublin Institute for Advanced Studies in the late forties. During the course, he raised the question: was it possible to see – or, at least, imagine – a non-Euclidean or Riemannian world? Wasn't such an intuition of space necessary just to be able to do Riemannian geometry?

Some elliptic and hyperbolic three-dimensional (3D) Riemannian spaces are finite in size, and since they are not in themselves closed by any enclosing Riemannian 3D surface, they would, if experienced as the container of the visible cosmos, be experienced from the viewer's position at the center as spatially unlimited, though not infinite – something like the finite but unlimited character of the 2D surface of a sphere if it were to be explored by a 2D visitor. Riemannian spaces would then be model spaces for visual worlds, like Euclidean space for "carpentered" measured worlds.

Though the geometrical metric is new, the basic idea is as old as Aristotle, for Aristotle says in *De Coelo* (279a) that beyond the starry heavens, there is nothing, *not even empty space.*

In Chicago I seemed to recognize in the local pictorial space of the painting the features of such a finite but nevertheless unenclosed space which is the local space of his bedroom as experienced by almost any viewer. The noisy, everyday world was not represented, but was it excluded merely by omission or in a still more definitive way? Try to imagine what you, the viewer, would see if, when looking at the painting, the closed shutters were opened. You would find, I think, one of two possible alternatives. Either the finite yet unenclosed space of the room would have to change to accommodate the new presence of an intrusive busy everyday world, or else one's vision had to be blocked by a solid object such as, maybe, a solid sky like the skies in many of Van Gogh paintings. For beyond the bedroom, beyond its closed shutters and walls, there is nothing, *not even empty space*. Then I asked myself, could it be that Vincent had discovered the art and aesthetics of suggesting a local (for empirical reasons, a negatively curved) Riemannian world space? Here was a scientific problem wrapped in an aesthetic problem and an aesthetic problem wrapped in a scientific problem. Was it true that the viewer's perception was captured by the unlimited finitude of (a negatively curved) Riemannian space? If so, how was this achieved? What technique did Vincent use?

In Auvers-sur-Oise where he died, there is a statue by Zadkin of Vincent Van Gogh as a remote figure bent under the burden of the easel on his shoulder. As we know from a letter to his brother Theo written from Arles, Vincent also carried about with him a clumsy and costly perspective frame (*"cadre perspectif*") which he used to make his compositions. Why? Because, as he wrote to Theo and his friend Emile Bernard, *form* is very important for a painter, and on that account he does exercises in perspective to perfect his ability to capture true form on a canvas. Perspective is a technique based on a mathematical theory for projecting 3D objects onto a flat picture plane from a fixed sight point. Its basic assumptions are that objective physical space is Euclidean (and, of course, infinite), and rays of light follow straight lines and obey the laws of geometrical optics in this space. Perspective is the proto-science that was historically one of the paradigms for modern science. In his letters, Vincent claimed that his search for true forms led him to discover a new, a "modern" (*"moderne*") use of perspective different from its "former" (*"ancien*") use, by which he meant the way German, Italian, and even Flemish artists used it. This, he believed, would necessitate a new art of color and representation ("*dessin"*) and of how artists work (*"la vie artistique*"). So Vincent had a technique, and one based on mathematical perspective. But what was it? He did not say.

Even to ask such a question today would be taken by some critics and cultural anthropologists to be artistically insensitive or worse, to be a kind of wickedness, for, according to Natalie Heinich, a cultural anthropologist of heros and hero worship, and author of *The Glory of Vincent Van Gogh: An Anthropology of Admiration* (1996), Van Gogh is worshiped by posterity as a redemptive figure who, by his rejection in his own lifetime and death, inspired artists with the courage to liberate themselves from objective rules, to free perception from perspective, creativity from rationality, and culture from theory and especially from the alien authority of scientific theories. For this

reason, she writes, he "marks a turning point, an aesthetic, historical, and ethical rereading of art." He is the first postmodernist.

It is fair to say that the suffering Vincent was innocent of wanting to be a martyr for postmodernism. He treated the science and practice of perspective as necessary for an artist, but he discovered that its formal inflexibility quâ mere tool was complemented by the eye's flexibility in using it for different tasks. He respected it then as a generalized tool for the artist to use in expressing visual form, and for the viewer as a kind of "text" for the locally situated eye to "read" in "context." For him perspective was as necessary for vision as for artistic creativity, but in isolation from a specific visual task perspectival depiction was incomplete, it was a "text" without a practical life-world "context." It accounted just for a part of what underlay the meaningful task-filled meeting of subject and object, viewer and painting.

Vincent's artistic problem was to depict his bedroom so that a viewer sees it as a local finite yet unenclosed universe of peace, quiet, trust, and intimate companionship. He accepted the tradition that mathematical perspective and the technology of the perspective frame were the scientific tools a painter should use to depict a scene and he used them because they were part of a tradition that linked painting to an artist's experience of what counted as "the true and the possible ... and the really existing" and this "really existing" was for him in a real sense sacred. In so doing Vincent, however, made two discoveries: *firstly*, that the eyes, searching in a picture for a visual "language" that "speaks" of a meaningful local place, do not find the "language" just in the universal "grammar" of perspective alone but only as complemented by ways of looking that convey the experience of a local place with a local meaning and feeling; *secondly*, that he could adapt the technology of the perspective frame in keeping with mathematical theory (using, for example, diagonal lines in his grid rather than horizontal-vertical lines) to make it serve his artistic goal of opening, within a viewer's local life-world space, the gates of *feeling* to reveal the *beauty, peace, and intimacy of that particular place, his bedroom*. This constituted, I think, an essential part of his "new" and "modern" use of perspective.

Vincent found a way of making it possible for a viewer to experience a particular local motif by using a scientifically designed universal technology in a particular way to shape the forms and colors on the canvas so that the artistic "utterance" as a whole would evoke in the viewer the particularity of the local experience he intended to convey. The product of this interpretive viewing is what phenomenology calls the presentation of "the things themselves" (*die Sachen selbst*). Is this not what Van Gogh meant by "the true and the possible as to form... and the really existing"? The task-filled meaning of the *Bedroom* painting is not the architecture of the room or its furniture as mere physical set-up, but its implied entry into the artist's Bedroom-as-Total-World in a mood of peace, totality, intimacy, trust, and possibly, hoped-for companionship, a gift only a prepared viewer, (Heidegger's) *Dasein* as *Ek-sistenz,* would be able to receive.

GOD

Since the recurring question in my *Afterword* reflections is about local (post-theoretical) practical knowledge as the goal of science in contrast with universal theoretical knowledge, I will end with some speculative reflections on the turning point of seeking

in local practical knowledge an understanding of theological as well as scientific knowledge.

I refer back to a paper I read at a meeting of scientists, philosophers, and theologians at Notre-Dame University in 1993, entitled "Lonergan and the Measures of God." It asks whether people's religious and spiritual lives are based on purely theoretical, say, philosophical or theological arguments, or on local practical lifeworld experiences. The term "God" in the paper's title refers mostly to the God of Christian theology but can be taken *mutatis mutandis* for the unique object of any monotheistic theological thinking. The "measures of God" refer to the kind of local (post-theoretical) practical knowledge that individual persons may have of the God described by their theological belief.

"Lonergan" in the paper's title is Bernard B.F. Lonergan, S.J. (1904-1984), a Canadian philosopher and theologian who deeply influenced my thinking at the crucial point in time when I turned my attention from physics to the philosophy of science. His principal works are, *Insight: A Study of Human Understanding* (1957), focused mostly on mathematics and the natural sciences, and *Method in Theology* (1972) focused on theology. Both works are concerned with the development and assessment of scientific understanding in the theoretical Aristotelian tradition of modern science. However, unlike the former which is content to dwell in the construction and testing of natural science theoretical models, the latter is forced by its subject matter to dwell also on the transformation of propositional and theoretical belief into practical faith. Lonergan's word for this transformation is "conversion." "By *conversion*," he writes, "is understood a transformation of the subject and his world ... it is as if one's eyes were opened and one's former world faded or fell away" (*Method*, p. 130). This is replaced by a new local (post-theoretical) life-world within which the subject comes to live. Conversion is the outcome of free choice, love, and commitment and, while intensely personal, it is also communal and can be handed on within a historical community. Conversion, Lonergan says, is the foundation for theology.

But, is it not also the case that conversion is the foundation for science? That was a moment of conversion, for example, in Galileo's life when in the winter of 1609 he made his telescopic discovery of the gibbous phases of Venus. It was then, as astronomer Owen Gingrich once told me, that Galileo came to have complete faith in the Copernican system. On that same day, he went to his desk and wrote his protocol notes, not in Italian as he was accustomed to do, but in Latin, the universal language of science. Speaking thereafter to all the world, Galileo stated that Nature is a Book written in the language of geometry and the horizons of nature are structured by the geometry of the Copernican system. Other natural philosophers continued to follow Aristotle and Ptolemy, but for Galileo, astronomy, mechanics, and all of natural science was a divine revelation about Nature expressed in God's own language of mathematics. For Galileo, mathematics was geometry and geometry was an idealization of measurable shape, size, and motion. This conversion experience changed the direction of Galileo's scientific inquiry in fundamental ways; what formerly was experienced as relative to place in a local geocentric system organized by a hierarchy of sensible qualities came to be experienced as relative to an abstract heliocentric model organized on the basis of measurable shape, size, and motion. What formerly, for example, was experienced as a stone in local downward fall toward its natural place at the center of the Earth until stopped by the ground came to be re-described, after his conversion, as a stone

following a parabolic trajectory above the surface of a turning Earth in a Sun-centered cosmology as imagined by a disinterested viewer in outer space. The old facts dissolved with the old perspective, and gave way to new facts generated by the new perspective.

There was much yet to be researched and, perhaps, revised, but all began with a human decision. The grounds for this decision would be debated by many even today in historical retrospect. Galileo, however, made his fateful act of faith and committed himself and his colleagues to a model, a set of experimental practices, and an interpretation of them that would profoundly mark the next few centuries of Western culture and religion. His new scientific faith did not change an iota of the theory but, like Van Gogh, it changed his life-world. Ultimately it changed ours too in fundamental ways. In changing that life-world, which was more important? The theory? The practices? The *virtuosi* in all parts of Europe that also committed their faith to the new scientific process? Nor must we forget the emerging new economic, military, political, bureaucratic, and other orders that would find it in their interest to join the movement of modern science. All of these collaborated in a commitment of faith to support and develop a community of empirico-mathematical natural philosophers.

For what end? Basically, though much to the surprise of many of our contemporaries, it was for a theological end: to possess, as far as possible, a divine guarantee of unity and simplicity in Nature. The fall of the old cosmology had created a theological rift that for cultural reasons had to be filled, for the old geocentric life-world of antiquity that the Christian community inherited contained a host of traditional images and symbols that worked for both nature and the Christian faith, while the new heliocentric life-world was at first embarrassingly empty of useful theological images. Galileo. being a devout Christian, tried, not too successfully, to supply such images in his debates with theologians, but it was not until Newton published his *System of the World* that Nature was once again filled – but only for a time – with theological meaning. Absolute Space and gravitation became the symbolic venue where Nature and Divine Providence worked together to maintain the stability of the World System. It will probably always be so that theology will be linked with the science of the natural order (though whether the natural order includes, as I would hold, the cultural order is a decision about which many would disagree), because as long as the science of the natural order seeks an intrinsic unity in some Final Account, such an account must surely be in some sense theological.

Scientists are thought to *know*, while theologians are thought just to *believe*. It should be clear from what has been said that the intellectual environment of science, like the intellectual environment of theology, is full of local historical background, some of which masquerades as universal knowledge. More precisely, much of what is called scientific knowledge is not universal, trans-cultural, and trans-temporal, as it (usually) purports to be – but is the product of the faith researchers have in experts belonging to their local historical scientific community.

Finally, just as a good philosophy of natural science needs Lonergan's *Method in Theology*, so a good theology needs to reflect more on the scientific structures studied in *Insight*. I shall try to make plausible the claim that the foundation of theology in conversion, history, and transformations of life-world horizons must have its own analogue, a quasi-laboratory to complement the consecrated words and practices of a religious tradition. By a quasi-laboratory I mean a domain for empirical investigation

so set off by common background and context that relevant data can be harvested with security in terms of some antecedent theoretical – here, theological – model. New theological insight is not limited to pure theoretical speculation or the study of the literary works of dead theologians, institutional councils, and leadership, but comes also from the study of current religious witness, a quasi-laboratory where theological insights and theories are used, successfully or unsuccessfully, by expert religious and spiritual guides and witnesses.

Such a claim may be unsettling in the Catholic theological context because, among other reasons, it raises the specter of enthusiasm, old and new, from the Shakers and Quietists of the seventeenth century to the present-day Pentecostalists, and the threat enthusiasm always poses to academic theologians and hierarchical institutions. Theologians and institutions have enormous reluctance to use their theological theories or theory-laden canons to "measure" and pass judgment on local events of a religious character. I stress the context of "measurement," for measurements are done individually, case by individual case, each constrained by place, community, and history. In "Belief: Today's Issue," a paper he read to *Pax Romana* in 1968, Lonergan gave among his own reasons for this reluctance: God is not an entity within this world and so cannot become known by experience; no one knows God face-to-face in this life and so no one can look for confirmation of theological theories in human religious experience. In 1968 Lonergan took the position that there was no quasi-laboratory that could provide, as it were, public ecclesial "measures" of religious experience, or, at least speaking to *Pax Romana*, he was unwilling to defend such a position. Whatever one might say in defense of the influence of Dionysos on the Platonic tradition, at least within the context of Apollonian classical thinking in theology, Dionysos has no part to play.

Four years later, however, in *Method*, and to a different audience, he makes a stunningly different claim: theology in relation to religious experience is like economics in relation to business. Religious life can flourish without theology, just as business can flourish without economics, but just as economics results from intellectual inquiry into business, so theology results – or should result, he says – from intellectual inquiry into religious life. Lonergan gives the old word *faith* a new meaning: "Faith," he says, "is the knowledge born of religious love" (p. 115), it is the *cognitive intentional counterpart* of that transformation of the life-world wrought by *sanctifying grace*; faith makes possible a *conversion* that opens *horizons* of *religious experience*. He distinguishes, as I do, *faith* from *religious belief.* The latter is the readiness to accept the historically sedimented pattern of communal understanding that people living within a religious tradition have, based on the totality of their religious culture, comprising sacred books, rituals, accepted teachings, and other cultural traditions of use in daily life. In contrast with religious belief, faith, being the knowledge born of love, expresses its *interiority* in four stages: religious experience; insight or theory-making; judgment or theory-accepting or -rejecting; and responsible *decision* which is the self-transcendent outcome of the loving part of faith's interior intention.

By the time *Method* appeared in 1972, Lonergan was ready to accept the fact and necessity of a quasi-laboratory of faith, a community practice able to provide the experts with, as it were, public "measures" of the life of faith.

I turn now specifically to Christianity. For the purpose of this paper I take it to be a community defined by faith in a God, Creator of the Cosmos, but not a part of it, who

has made a historic covenant with a free human community offering individual, social, and, perhaps, even cosmic redemption through the incarnation, death, and resurrection of his Son, Jesus Christ, in the Church that was founded by the Holy Spirit. The Christian question would be, whether faith in such a God, articulated by theologians and administered by the institutional Church, can be referred to a particular historical quasi-laboratory of religious experience, in which theological statements about living "in the spirit of faith" can be "measured" or "tested" by experiential signs interpreted as marked with a divine approval.

Such a question may sound strange, perhaps very strange indeed, coming from a practicing Catholic. Beyond the Catholic community, however, there is no such reluctance; one finds today a plethora of religious theologies stemming, for example, from interpretations of contemporary evolutionary and cosmological science. One of the reasons for the widespread appeal of Stephen Hawking's *A Brief History of Time* is his argument that astrophysical theories can lead the religious inquirer to the "Mind of God." Since all scientific theories aim at prediction and control, this kind of argument deeply undercuts our image of human life, for it presupposes a metaphysics where human freedom is absent and human decisions are pre-ordained by neurological circuits. Existence in this story is determined by cosmological "crunches" and "rebirths" which, though bearing some reminiscence of the mythic cosmological cycles of the Great Year of Stoic or Hindu cosmology with their "eternal return of the Same," are nevertheless of an entirely different genre; they are secular, not sacred, predictions. By contrast, what is characteristic at least of Christianity is the drama of the biblical narratives that underline *human freedom* in making history in the life-world in which we live. Instead of looking to cosmological models, should we not, following Lonergan, look for a quasi-laboratory of religious experience where human freedom is respected and history retains its edge of uncertainty? Such is more likely to be a faith community of people productive, as Lonergan has said, of "works of self-transcendent love animated by faith," – among whom some are expert in interpreting theologically the horizons of critical religious experience.

In such a quasi-laboratory community, what would be the "measures"? One suggestion is criteria afforded, for instance, by techniques of "spiritual discernment." By "spiritual discernment" I mean prayerful techniques equipped with practical theological language and responsive, say, to what the Christian tradition calls the "spiritual senses" which serve to "measure" divine presence and action in a community. Such historical practices of spiritual discernment were taught throughout the history of the Church and have been an essential part of good or "perfect" Christian living for two thousand years. Borrowed from the Stoics and other pre-Christian sources, they were adapted for Christianity by the desert fathers and monks and they are still taught and practiced and monitored by spiritual directors today. Such Christian spiritual exercises introduce the better prepared and motivated to a religious path where everyday decisions within the life-world context are examined in the light of spiritual criteria traditional to the path being followed.

One such set of practices of spiritual discernment, for example, is taught by St. Ignatius Loyola, the founder of the Jesuit Order, in his *Spiritual Exercises*. Such spiritual exercises, as Pierre Hadot has shown in his *Philosophy as a Way of Life* (1995), have their roots in ancient philosophy, in Socrates, the Stoics, and Epicurus, for whom wisdom was a form of practical reason focused on the divine. The exercises of

Ignatius lead participants in silent prayer to play the role of actors in Gospel narratives, representing themselves as disciples eager to share the life of the faith community of Jesus. Ignatius and other spiritual writers speak of the experience of "spiritual senses." These bear an analogy to the physical senses: of the "eyes" of faith, the "bitterness" of remorse, the "sweetness" of charity, the "tears" of divine love and sorrow or, more generally, of "spiritual touches," "consolation," and "desolation." All such information is structured a priori by theological language in some way analogous to the way laboratory information is structured by scientific theory, but stressing the individuality of each participant. With the scientific analogy in mind, can we then speak of such spiritual exercises as constituting a quasi-laboratory of religious experience?

Laboratory experimentation and its protocols are properly described in narrative form, because every experiment is particular, involving actions of particular people at a definite place and time, motivated by a common purpose, equipped with an explanatory theory, and brought to the bar of experience as subject to a jury of peer experts. So, too, would religious experience in the quasi-laboratory of spiritual exercises be presented in narrative form under explanatory theological categories.

I have argued that both science and theology should exhibit the range of structures that Lonergan describes in *Method* and *Insight*. Such a conclusion does not guarantee that the natural sciences reveal the God of the Bible. What it shows is merely that there is a common philosophically understood method underlying theology and natural science, and that using that method within the established traditions of Christian life and practice, scientists who are Christian and theologians who respect the processes of natural science should be able to gain reliable experiential, intellectual, and rational knowledge both of Nature, the subject matter of the natural sciences, and of the Christian Trinitarian God, the subject matter of the Christian religion.

Finally, I want to address the editor of this handsome volume, Dr. Babette Babich, and the authors who contributed to this wonderful collection to speak my delight, wonder, and thanks! The collection, though dedicated to my honor, really celebrates no one individual unless it is the *δαιμον* (great spirit), Eros, of whom the wise woman Diotima in Plato's *Symposium* says, that he is neither wise nor ignorant for "he is the interpreter between the gods and men."