Insight & Beyond

Class 4, Part 1: September 30th 2009

Why does Lonergan Begin with Science?

Math & Science Compared

Summary of Material on Chapter 2 §1

Why does *Insight* begin with technical scientific matters?

How can sections on such unfamiliar topics be in aid of self-appropriation?

Lonergan gives several different explanations for beginning with natural science:

Clarity and precision of these insights

Natural science illustrates the methodical dynamism of inquiry.

The experience of formulating definitions and concepts is more evident.

Yet Lonergan himself raises the question of biases – of alien interests, or disruptions to the dynamic process of pure inquiry.

Natural science can be distorted by political interests, racial biases, profit motives, etc.

Lonergan's reasons for starting with science are thus somewhat more complex.

A key to a different reason for beginning with natural science:

One finds a 'Crossing of the Rubicon' in Ch. 2, Sect. 3: "Concrete Inferences from Classical Laws."

Sect. 3 makes the transition from one heuristic method to another (i.e., from classical to statistical methods).

It highlights the limitations of the 'classical scientific method' typical of Enlightenment thinking.

"Why Begin with Science?" is a question that Lonergan himself poses in Ch. 2, Sect. 2.

Analyzing scientific procedures in terms of insight is a novel approach.

Does this new approach conflict with earlier assumptions of science? Or merely with earlier "extra-scientific opinions" on science?

Lonergan aims to test his account of science by paying attention to how scientists actually operate, leaving aside extra-scientific opinions about science.

This aim leads him to situate the chapters on science at the beginning of *Insight*.

Lonergan claims that the modern world has been shaped by extra-scientific opinions, and that these have gone unchallenged due to the oversight of insights that occur in science.

Some Extra-Scientific Opinions that developed along with science:

Science's purpose assumed to be the "betterment of man's estate" – Leon Kass.

This assumption dates back to the early days of modern science, and was first articulated by Francis Bacon.

It was developed by Descartes, who saw in science a means to become "masters and possessors of nature."

Note the difference between doing science, on one hand, and interpreting the meaning/purpose of science, on the other.

Example: A scientist being asked to justify a new method for exploring the surface of Mars in terms of its practical and social benefits.

Extra-scientific opinions in the 20th century all emphasized determinism, necessity, indifference of the universe to human aims.

Max Weber's fact and value distinction.

All forces in play are now subject to calculation, and lead to the disenchantment of the world.

Human existence as contingent and haphazard, in an "unfeeling universe" seen from a biochemical point of view (Jacques Monod).

Richard Dawkins – modern science reveals nature as mere brute force, "red in tooth and claw."

Questions asked by Lonergan in *Method in Theology*:

Is moral enterprise consonant with this world?

Are we merely gamblers and fools, hoping for progress against the odds, in a declining world (a universe of increasing chaos)?

Is there a transcendent, intelligible ground of the universe?

Is that ground the primary instance of moral consciousness, or are we?

Stuart Kauffman's *At Home in the Universe* presents arguments against these extra-scientific opinions of the 20th century, drawn from sophisticated bio-informatic models.

Humans did not come about in a merely 'ad hoc' manner.

The natural emergent order of the world was inevitable, given the universe that we have. Humans are not out of harmony with the natural emergent order but an intrinsic part of it.

Lonergan argues a point very close to that of Kauffman.

Lonergan's Position (given in Chapter 19 of *Insight*).

Reality is completely intelligible.

The immanent order of the universe is one of emergent probability.

Our striving for good is part of the directedness of the natural universe.

The universe is our home, as meaning-seeking and morally striving beings; not fundamentally alien to us and our fundamental aspirations and needing to be subdued.

Lonergan argues that this view of the universe, as hospitable to the highest human strivings, follows from the actual practices of the natural sciences as truly self-appropriated.

Student question about the meaning of intelligibility and Lonergan's use of explanatory definitions.

– Discussion of how insights always initially occur in a fusion with the sensible and imaginative *noematic* contents (*phantasms*) from which they emerge.

– Especially in explanatory definitions, Lonergan highlights the differences of sensible and imaginative *noematic* contents from the distinctive content of insights (intelligibility), forcing us to relinquish our laziness in letting images do our thinking for us.

– And to take possession of ourselves as also intelligent (self-appropriation).

Question as to whether Lonergan is reaching out to scientists through these examples.

Question about the post-World War disillusionment about the meaning of life, and whether these extra-scientific opinions were the result of that, or resulted independently and inevitably from scientific progress itself.

– Lonergan was deeply concerned with the sources of that disillusionment.

– The problem is not science but the extra-scientific opinions that led to a post-Enlightenment revision of the very idea of *reason*.

Question on whether the intelligibility of the real implies that we have the potential to know being completely.

– The full treatment of the intelligibility of the real not completed until Chapter 19.

– Lonergan approaches being in terms of an analysis of the *notion* of being, the human anticipation of being.

– Lonergan's first step is to show that the world known by science is intelligible, thanks to insight.

Question about Lonergan's views versus those of Bacon and Descartes.

– Lonergan as a philosopher is interpreting science in a way more true to the real practices of science.

– The *telos* or objective of science does not put human beings at the center of the universe.

– Science is not merely to serve human interests but rather, aims at a perfection transcending human purposes.

Comparison of Lonergan's argument to Kauffman's.

Instead of biochemical processes, Lonergan references the structures of human cognitional activity, specifically how they are structured by heuristic methods.

Four fundamental kinds of scientific, heuristic methods structuring knowledge:

Classical: Functional correlations among data.

Statistical: Ideal frequencies among data.

Genetic: Embryology and the discovery of intelligible sequences of transformation to systems. (Extended discussion).

Dialectical: Discovering the roots of conflicts in human affairs. Only humans can act unintelligibly, unreasonably, and irresponsibly. (Extended discussion).

What is science?

Human intelligence is essentially dynamic; that is, it is permeated with the dynamism of inquiry and self-correcting understanding.

Science is *methodologically* dynamic.

An explication of methodical dynamism allows for a general explanation about a world towards which that methodical dynamism is oriented.

Student question about transferring scientific methodological dynamism to ordinary, moral and common sense intelligibility.

Further student question about the nature and role of human science.

What is science? Explanation *vs.* Description.

Chapter 2 §1. Math & Science: Comparison of these in terms of insight.

Mathematics: Lonergan characterizes math not as primarily logical, but as primarily heuristic. Not a static structure but a dynamic way of searching for the unknown.

Insight & Beyond:

Lecture 4, Part 1:

"*Insight*, Chapter 2.
"Heuristic Structures of Empirical Method"
30th September 2009

Okay. Welcome to the class again. Today we are going to begin talking about chapter two, which Lonergan entitles: "**Heuristic Structures of Empirical Method**" (*CWL* 3, pp. 57-92).

Why does *Insight* begin with technical scientific matters?
How can sections on such unfamiliar topics be in aid of self-appropriation?
Lonergan gives several different explanations for beginning with natural science:
Clarity and precision of these insights
Natural science illustrates the methodical dynamism of inquiry.
The experience of formulating definitions and concepts is more evident.

And the first thing that I wanted to do is *talk about why is Lonergan beginning with this discussion of science. He gives some answers of his own as to why he is beginning with science. He says, for example, that in the area of mathematics and science, you get the clear and distinct and exact types of insights, and since he said that this is the key to clear and distinct insights/science* [word unclear], *we're going to start there*!

And later on in the book he says that: "**in the previous five chapters, precision was our primary objective, and so our examples were taken from the fields of mathematics and physics."** (*CWL* 3, p. 196). And that may make some sense, unless you sort of step back

and ask the question, "Well, what did he say he was writing the book about?" … Anybody? … So the book was an invitation to what?

Student: Self-appropriation?

Pat: *Self-appropriation!* Yes. *And so you would think that he was going to start with some examples that were proximate and near to people, so that they would find it easy to appropriate their insights*.

Why Begin with Science?

"If one's apprehension of [insights] **is to be clear and distinct, then one must prefer the fields of intellectual endeavour in which the greatest care is devoted to exactitude and in fact the greatest exactitude is attained. For this reason, then, I have felt obliged to begin my account of insight and its expansion with mathematical and scientific illustrations**." (*CWL* 3, p. 14).

"In the previous five chapters, precision was our primary objective, and so our examples were taken from the fields of mathematics and physics." (*CWL* 3, p. 196).

And yet he starts arguing with some very, very difficult things! Within a few pages of the beginning of chapter two, he is talking about General Relativity, not exactly the most familiar thing to the average person picking up the book!

[Some subdued laughter]

So why is he doing this? What he says in one place is that mathematical and scientific insights are the clearest and the most distinct, but *if you haven't had those kinds of*

insights they don't seem all that clear and distinct! And then later on he will tell us, well, precision was our objective! Well, he never said precision — this is nearly 200 pages into the book — *he never said precision was his objective*!

So there is something different going on here, I think!

> **Why Begin with Science?**
>
> **In the previous chapter insight was examined in a static fashion. … But if a set of fundamental notions has been introduced, no effort has been made to capture the essential dynamism of human intelligence. Now a first move must be made in this direction …** (*CWL* 3, p. 57).

So another take on this: *he actually gives several accounts of why he puts the scientific chapters at the very beginning of the book*. So a little later on, he says, **"in the previous chapter insight was examined in a static fashion …** [but] **no effort** [was] **made to capture the essential dynamism of human intelligence**" (*CWL* 3, p. 57). And so he's going to make a first move in that direction. *Now the difficulty is, as we saw last week, there is an essential dynamism to human intelligence*. It's the dynamism of what?

Student: Inquiry?

Pat: *Inquiry! And that is in the first chapter, and he did talk about that, and he gives an example from Archimedes, and he gives some other examples. And then we get the further essential dynamism of the way in which the mind moves from experience through inquiry to insight to formulating those insights*. And we spent some time last week in the middle of *that* dynamism.

So there's something a little misleading, or at least confusing, about ***the fact*** *that he's going to introduce science as the model of the dynamism of human knowing*. Now, we'll see next week, when we get into chapter three, we'll get a little bit more clarification about that. *He says that science is conspicuously, methodically, dynamic*! *And so he's getting at*

something a little bit more than dynamism. He's getting at how it can be that inquiry cannot just be sort of hit and miss, which has merit [sound unclear], *but also methodical*! *And that's really much more, it seems to me, what he's getting at here, is how inquiry can be methodical, and some of the implications of that.*

Why Begin with Science?

"In the previous chapter insight was examined in a static fashion. … But if a set of fundamental notions has been introduced, no effort has been made to capture the essential dynamism of human intelligence. Now a first move must be made in this direction …" (*CWL* 3, p. 57).

"The precise nature of the act of understanding is to be seen most clearly in mathematical examples; the dynamic context in which understanding occurs can be studied to best advantage in an investigation of scientific methods; the disturbance of that dynamic context by alien concerns is thrust upon one's attention by the manner in which various measures of common nonsense blend with common sense." (*CWL* 3, p. 4).

But we get a little bit of a sense, perhaps, of why he is interested in the kind of dynamism that is to be found in natural science, with the following remark that he makes. This is all the way back in the "Preface", where he says — He seems to be laying out how he is going to write the book here, with this remark from the "Preface": ***"The precise nature of the act of understanding is to be seen most clearly in mathematical examples."*** (*CWL* 3, p. 4, emphases added). As I tried to suggest last week, *I think it's the nature of formulae, of*

expressing things in definitions and concepts, that is most clear in mathematics. But be that as it may: "**the dynamic context in which understanding occurs can be studied to best advantage in an investigation of scientific methods."** (*CWL* 3, p. 4).

Yet Lonergan himself raises the question of biases – of alien interests, or disruptions to the dynamic process of pure inquiry.
Natural science can be distorted by political interests, racial biases, profit motives, etc.
Lonergan's reasons for starting with science are thus somewhat more complex.

But then Lonergan says this: "**the disturbance of that dynamic context by alien concerns is thrust upon one's attention by the manner in which various measures of common nonsense blend with common sense."** (*CWL* 3, p. 4).

Now that's looking ahead to chapters six and seven. And *a central feature of his discussion of common sense, or what you might say, ordinary human living — a central feature of that is his discussion of bias*. And he *is* going to talk about biases — in relationship to the dynamism of inquiry and understanding and judgment — as disruptions and interferences. So it makes a certain amount of sense to have spent some amount of time looking at inquiry and its normativity before he talks about the disruptions.

Now the difficulty with that, of course, is that it's not quite that simple. *Any number of studies, historical studies, philosophical studies — especially in the late twentieth century — have drawn attention to the various kinds of things that you might say interfere with a kind of a pure reason, a pure inquiry, that he seems to be saying is characteristic of natural science*. For example, we all know the horrors of the medical experiments done on not only Jewish people, but gipsies and others during the Second World War in the Nazi regimes. Perhaps less well known, but certainly much closer to home, is the infamous Tuskegee Experiments[1], where a large number of African-American males were allowed to suffer from

[1] The Tuskegee syphilis experiment (also known as the Tuskegee syphilis study or Public Health Service syphilis study) was an infamous clinical study conducted between 1932 and 1972 in Tuskegee,

syphilis — so that the doctors could see how it worked, how syphilis worked — without being informed of their condition, or without being informed of the fact that, after the nineteen-forties, a readily effective treatment of penicillin was available to them. *And increasingly in the late twentieth and early twenty-first centuries, numbers of issues have been raised about the interference of scientific research by, for example, corporate interests, profit interests, profit motives! Questions have been raised about the fact that to a large extent grants for scientific research are driven by not only what corporations think may be profitable, but by what certain kinds of funding agencies think are interesting, and so on*.

> *So this whole idea that it is in science that we have, so to speak, freedom from all bias, and only once we get out of the realm of science do we have the interfering influences of biases, is a little bit problematic and questionable*! And in fact Lonergan knows that, and actually talks about it in several places in the book! You will notice this if you're paying attention for it when he talks about it.

So all of a sudden, all the things that he says that seem to be the most significant reasons for starting with science in this invitation to self-appropriation seem to have some difficulties with them!

And I don't mean to say that there isn't some partial correctness in each of those features. It is true that in science, methods do in fact exclude a lot of interfering concerns, if not all, compared to the hurly burly crazy twentieth and twenty-first century demands of our modern society! And it is true that there is a certain kind of clarity about those insights in

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Alabama by the U.S. Public Health Service to study the natural progression of untreated syphilis in poor, rural black men who thought they were receiving free health care from the U.S. government.

The Public Health Service, working with the Tuskegee Institute, began the study in 1932. Investigators enrolled in the study a total of 399 impoverished, African-American sharecroppers from Macon County, Alabama who had previously contracted syphilis before the study began. For participating in the study, the men were given free medical care, meals, and free burial insurance. They were never told they had syphilis, nor were they ever treated for it. According to the Centers for Disease Control, the men were told they were being treated for "bad blood," a local term used to describe several illnesses, including syphilis, anemia and fatigue.

The 40-year study was controversial for reasons related to ethical standards; primarily because researchers knowingly failed to treat patients appropriately after the 1940s validation of penicillin as an effective cure for the disease they were studying. Revelation of study failures by a whistle-blower led to major changes in U.S. law and regulation on the protection of participants in clinical studies.

maths and science. It is also true, I think, that in science and in mathematics, the tension of inquiry is much more evident, because when you don't know, you know that you don't know, whereas in common sense there is an awful lot of sophisticated fooling yourself and fooling others! So the things he does say certainly have some credence to them, but somehow or other, they don't seem to quite make sense of all the kinds of things that Lonergan is investing, the great amount of detail and complexity that he is investing in these first chapters.

A key to a different reason for beginning with natural science:
One finds a 'Crossing of the Rubicon' in Ch. 2, Sect. 3: "**Concrete Inferences from Classical Laws**."
Sect. 3 makes the transition from one heuristic method to another, i.e., from classical to statistical methods.
It highlights the limitations of the 'classical scientific method' typical of Enlightenment thinking.

So let me propose something a little bit different! If we look at the structure of chapter two, what would you say just looking at the Table of Contents there, what would you say is the most significant feature of that chapter? What is the thing that draws attention to itself?

[The Table of Contents of chapter two is displayed]

You've read through it. There is, so to speak, a "Crossing of the Rubicon" that takes place in this chapter! Where does it take place? There's something that's highlighted here. …

*Well, Professor Byrne thinks that the Crossing of the Rubicon takes place in section three, "***Concrete Inferences from Classical Laws***" (CWL* 3, pp. 70-76). *Because it is at that point, that Lonergan makes the transition from talking about one kind of heuristic method to another! But it's also significant that he is drawing attention to the serious limitations of what he calls classical scientific method, the scientific method that arguably is the method of Western European Modern Enlightenment.*

"Why Begin with Science?" is a question that
Lonergan himself poses in Ch. 2, Sect. 2.
Analyzing scientific procedures in terms of insight is a
novel approach.
Does this new approach conflict with earlier
assumptions of science? Or merely with earlier "extra-
scientific opinions" on science?
Lonergan aims to test his account of science by paying
attention to how scientists actually operate, leaving
aside extra-scientific opinions about science.
This aim leads him to situate the chapters on science at
the beginning of *Insight*

So there is something significant going on right in the middle of that chapter! There is a general hermeneutic principle: read the first sentence, and then look at what's in the middle of a chapter or a book! It's usually fairly important. And so, there it is! There's this section entitled "**Concrete Inferences from Classical Laws**." And I think that points to something, because it's — *If you're talking about concrete inferences, you're talking about inferences from thought to the natural world, among other things*. And I think there is something going on there. So why begin with science?

Why Begin with Science?

"Our account of classical heuristic structure is essentially free from any opinion about corpuscles, waves, causality, mechanism, determinism, the uniformity of nature, truth, objectivity, appearance, reality." (*CWL* 3, p. 69).

So this is a remark from towards the end of the second section of chapter two: "**Our account of classical heuristic structure is essentially free from any opinion about corpuscles, waves, causality, mechanism, determinism, the uniformity of nature, truth, objectivity, appearance, reality."** (*CWL* 3, p. 69) And so on!

Why Begin with Science?

"**It has become a matter of some obscurity whether the new approach conflicts with the assumptions of earlier science or merely with the extrascientific opinions of earlier scientists."** (*CWL* 3, pp. 69-70).

"**It has become a matter of some obscurity whether the new approach**" — and *here he is referring to the approach of statistical methods*, and this is right at that juncture just before he goes into section three — "**It has become a matter of some obscurity whether the new approach conflicts with the assumptions of earlier science or merely with the extrascientific opinions of earlier scientists."** (*CWL* 3, pp. 69-70).

Why Begin with Science?

"**Finally … an analysis of scientific procedures in terms of insight is also new, and that the value of such analysis cannot be tested except by working out its implications and confronting them, not with opinions on science based on other analyses, but solely with strictly scientific anticipations, procedures, and results**" (*CWL* 3, p. 70).

So that word 'opinions' is there. And it comes up again. "**Finally … an analysis of scientific procedures in terms of insight is also new"** (*CWL* 3, p. 70). *Not only is statistical method new, but analysing or doing the philosophy of science in terms of insight is something*

that hasn't been done before. It hasn't been done before because, as he says, the history of philosophy, and the history of western thought generally, has suffered from an oversight of insight.

"And that the value of such analysis" — later on he will call this an "**intentionality analysis**," and so link it to a certain kind of phenomenological analysis.

> *So approaching the question of what makes science to be science from the self-appropriation of insight, and asking how and where does insight play a role in modern science, and what is that role and what is its significance, that's what he is talking about with this analysis*. It "**cannot be tested except by working out its implications and confronting them, not with opinions on science based on other analyses, but solely with strictly scientific anticipations, procedures, and results**." (*CWL* 3, pp. 69-70).

So what do you think he is getting at there? You've read the chapter, puzzling though it may have been, and in many parts of it! But what do you think he is getting at there? What is he saying he's going to do, in this way of approaching science? What is he calling into question? … Byron?

Byron: Is he calling the method into question, in any way?

Pat: He's going to give an account of method! He doesn't say he's calling the method into question.

> *He says that he is going to call his account of method into question by looking at* "**strictly scientific anticipations, procedures, and results**." **(***CWL* 3, p. 70).

So in other words, what he is saying he is going to do is *test his account of science*, *his account of science as seen through the lens of self-appropriation of experiencing, inquiring, insight* … So he's going to call his own account of science into question by paying attention to what scientists actually do! As opposed to what? … As opposed to opinions that people have about what science is all about!

Now, I think, in some very, very important ways, this arguably is the major reason why the chapters on science come first!

Lonergan claims that the modern world has been shaped by extra-scientific opinions, and that these have gone unchallenged due to the oversight of insights that occur in science.

Some Extra-Scientific Opinions that developed along with science:

Science's purpose assumed to be the "betterment of man's estate" – Leon Kass.

This assumption dates back to the early days of modern science, and was first articulated by Francis Bacon.

It was developed by Descartes, who saw in science a means to become "masters and possessors of nature."

Note the difference between doing science, on one hand, and interpreting the meaning/purpose of science, on the other.

So I want to give you a little bit of an overview of what I think might be going on here.

> So in other words, *what Lonergan wants to argue is that the world, the modern world, is very profoundly impacted by the interpretations or the opinions that have come as the fellow-travellers of modern scientific practices*! *And Lonergan's claim is that the oversight of insight has allowed those extrascientific interpretations, those extrascientific opinions, to go unchallenged, and in fact, to parade under the mantle of being really true because of the power and validity of modern science*!

So what would be some of those extrascientific opinions? Well, here's one, by a person who in fact has serious questions about precisely this characterization of science. But Leon Kass, Professor in the Committee on Social Thought at the University of Chicago, former member of the President's Council on Bioethics, a very prolific author, and a person who likened the practice of medicine to the pursuit of philosophical reflection, says this:

Some Extra-Scientific Opinions

"By 'science' I will mean modern Western science, the globally successful effort to understand how things work — of which mathematical physics is the jewel and foundation — based on a method of discovery uniquely invented for this purpose, and ultimately imbued with a philanthropic aspiration to use that knowledge for *the relief of man's estate and the betterment of human life.*"

Leon Kass, "Science, Religion and the Human Future."

> "By 'science' I will mean modern Western science, the globally successful effort to understand how things work — of which mathematical physics is the jewel and foundation —"

Now those of you who have read chapter two of *Insight* know that Lonergan has a lot to say about precisely mathematical physics.

> "— based on a method of discovery uniquely invented for this purpose, and ultimately imbued with a philanthropic aspiration to use that knowledge for *the relief of man's estate and the betterment of human life*."

Okay. And I've highlighted that last phrase, because that is *a statement about what the purpose of modern science is*! And *Kass is making a claim that this guiding purpose, "the relief of man's estate and the betterment of human life," is structuring the way in which modern scientific investigation is proceeding, including modern mathematical physics*!

Now does anybody recognize that highlighted phrase as coming from anywhere besides Leon Kass? …. It comes right out of Francis Bacon.[2] You could say arguably that the three most important original thinkers about modern science — original because they were thinking and articulating their philosophical views precisely at the time that modern mathematical science was emerging — were:

- Galileo himself, who has some interesting things to say about what modern science is about. He's the one that introduces the very important and very famous and very influential distinction between *primary and secondary qualities*. That's something Lonergan raises some questions about in chapter three.
- René Descartes, who we'll see in a minute, and
- Francis Bacon.

So a very, very influential contemporary figure, Leon Kass, is taking the characterization of what modern science, and particularly modern mathematical physics, is all about *from Francis Bacon*, one of the people who *influences how modern science is going to be received, and what opinion or interpretation there is about what science is*.

So there's

- the doing of science,
- and then there's
- the interpretation of science.

Lonergan is a philosopher who is giving an interpretation, a philosophical interpretation of science,

[2] Francis Bacon (1561–1626) was one of the leading figures in natural philosophy and in the field of scientific methodology in the period of transition from the Renaissance to the early modern era. As a lawyer, member of Parliament, and Queen's Counsel, Bacon wrote on questions of law, state and religion, as well as on contemporary politics; but he also published texts in which he speculated on possible conceptions of society, and he pondered questions of ethics (*Essays*) even in his works on natural philosophy (*The Advancement of Learning*). Although his efforts to start a political career were not crowned with success during the era of Queen Elizabeth, under James I he rose to the highest political office, Lord Chancellor. Bacon's international fame and influence spread during his last years, when he was able to focus his energies exclusively on his philosophical work, and even more so after his death, when English scientists of the Boyle circle (*Invisible College*) took up his idea of a cooperative research institution in their plans and preparations for establishing the Royal Society.

To the present day Bacon is well known for his treatises on empiricist natural philosophy (*The Advancement of Learning*, *Novum Organum Scientiarum*) and for his doctrine of the idols, which he put forward in his early writings, as well as for the idea of a modern research institute, which he described in *Nova Atlantis*.

> *and he wants to test it against the doing of science. The key that he thinks is original is the importance that he is attaching to the act of insight, and as I tried to show earlier, that also means the importance that he attaches to human inquiry.*

It's not inquiry or insight that's of primary interest to Bacon. It's the use of reason for the benefit of humankind, in that phrase, for "the relief of man's estate," that Kass picks up on. Kass is deliberately and specifically quoting Bacon. He knows his Bacon, among other things.

Some Extra-Scientific Opinions

"But the greatest error of all the rest is the mistaking or misplacing of the last or farthest end of knowledge: for men have entered into a desire of learning and knowledge … seldom *sincerely to give a true account of their gift of reason, to the benefit and use of men:* as if there were sought in knowledge … not a rich storehouse, for the glory of the Creator and *the relief of man's estate*. But *this is that which will indeed dignify and exalt knowledge, if contemplation and action may be more nearly and straitly conjoined and united together than they have been*."

Frances Bacon, *The Advancement of Learning*.

And at almost the same time as Bacon was writing *The Advancement of Learning*, René Descartes is writing — it's just a little bit later, virtually at the same date — Descartes is writing his *Discourse on Method*.

Some Extra-Scientific Opinions

"It is possible to reach *knowledge that will be of much utility in this life*; and instead of the speculative philosophy which is now taught in the schools *we can find a practical one*, by which, knowing the nature and behaviour of fire, water, air, stars, the heavens, and all the other bodies which surround us *we can employ these entities for all the purposes for which they are suited, and so make ourselves masters and possessors of nature*."

René Descartes, *Discourse on Method*.

And he says that, what is the point to his method? Now remember, Descartes's *Discourse on Method* is in six parts. Part five is dedicated to a sketch of his — what he thinks his method is going to lead to in terms of a transformation of biology. He has an account there, for example, of how the body is heated. And he thinks that heating takes place in the heart and in the body, and that the heart serves to pump blood into the lungs, where it is cooled down. For him the fundamental function of the lungs is to cool the blood, so it doesn't overheat. And he has lots of discussions of this. And then when he gets to part six, we find this passage [Pat gestures to the overhead display]. And then it is immediately followed by his three scientific works, the *Geometry*, the *Optics* and the *Dioptrics* [Should this be the *Geometry*, the *Optics*, and the *Meteorology*?], where he, in the latter two works, applies the things that he does with his methodical geometry to very specific phenomena of light, meteorology, and so on.

So Descartes, in this transition to his new method, is very deliberately, as is Bacon, opposing himself to the methods of Aristotelianism that had proceeded their work. He is going to say that: what is this method about, and just before he introduces some of the most important innovations in mathematics in the seventeenth century, he says:

> "It is possible to reach *knowledge that will be of much utility in this life*; and instead of the speculative philosophy which is now taught in the schools *we can find a practical one*, by which, knowing the nature and behaviour of fire, water, air, stars, the heavens, and all the other bodies which surround us we can employ these entities for all the purposes for which they are suited, and *so make ourselves masters and possessors of nature*." (René Descartes, *Discourse on Method*, emphases added).

That's a stronger statement than simply a science dedicated to the relief of humankind — "the relief of man's estate"! But if you stop and think for a minute of what sorts of things would Bacon want to relieve humankind from? These turn out to be very much the same kinds of things as Descartes wants to relieve humankind from, namely, disease, pestilence, famine, earthquakes, tornadoes, storms, fires, and so on. *So, if we make ourselves the masters and possessors of nature, then we have control over nature; and having knowledge of how to control nature will be for the benefit of humankind. Or so it seems, unless you start to peek a little bit over the verbiage of all this, and start to ask some other kinds of questions*.

> *So these are part of the extrascientific opinions*, or, if you like, *the interpretations*. So if somebody says, "What's science all about?" *this is part of what is coming forward at exactly the same time as the profound — almost accelerating in an exponential way — the profound discoveries and innovations in mathematical and scientific techniques and methods. So when Lonergan is talking about extrascientific opinions, opinions about science and particularly opinions about the world that science makes open to us, this is the sort of thing that he is talking about*.

Example: A scientist being asked to justify a new method for exploring the surface of Mars in terms of its practical and social benefits.

Let me pause for a moment, because I have an anecdote that I have to share with you. Some of you have heard it before, so I hope you'll forgive me. But a number of years ago, maybe three or four years ago, I was listening to a report on Public Radio. And I found it quite fascinating, but that's because I'm a sort of a Geek. But this scientist had come up with an idea about how to improve the exploration of Mars. And his idea was that you could send a rocket to Mars, land on Mars, and then have this huge bubble, this huge balloon being inflated. It was something like maybe thirty feet in diameter. And in the middle you'd have an instrument package. So it could be a clear nylon balloon, with some instruments. And the reason he thought this would be good is because they knew at this point that there are winds on Mars, and the wind would just sort of blow the balloon and it could send messages back.

Now any of you who have seen the Mars land-buggies — you know, it's basically a little golf cart, like they use to take injured players off a football field when injuries occur. Or the people use them to go from one hole to another hole, or one tee to another, when they're playing golf. It doesn't cover a lot of territory. But a thirty-foot balloon with wind blowing, it could blow all over the place, in a kind of random — It would give you a lot of information about a lot of parts of Mars that you could probably never drive to before the batteries on these little go-carts stop. So he thought this was pretty cool!

So the interviewer said: "Well, why would you want to do that?" And now he caught on real quick — because he was a smart guy, and he did his history — he caught on real quick that if he said, "Because I'd love to know more about Mars!", that that wasn't going to fly with this interviewer or his colleagues. So he said, "Well, we could find out if there was already water on Mars!" As you know, they'd found out some interesting things about water on Mars. So the interviewer, like young children, said: "Well, why would you want to know that?" "Well, if there was water there, you might be able to find out if there was life on Mars!" "Well, why would you want to know that?" At that point it dawns on him that this pure scientific interest is not on the horizon of this interviewer! "Well, it might, if we discover something about life on Mars, we might find a clue to curing cancer!" And that was the end of discussion!! There were no more questions after that!

[Laughter]

You see, Descartes and Bacon were employing that line of inquiry. *What is science for? It's for the relief of human kind. It's for the mastery and possession of nature*.

Extra-scientific opinions in the 20th century all emphasized determinism, necessity, indifference of the universe to human aims.

Max Weber's fact and value distinction.

All forces in play are now subject to calculation, and lead to the disenchantment of the world.

Human existence as contingent and haphazard, in an "unfeeling universe" seen from a biochemical point of view (Jacques Monod).

Richard Dawkins – modern science reveals nature as mere brute force, "red in tooth and claw."

Well, that strain or that tradition of interpretations or extrascientific opinions doesn't just stay there! At the beginning of the twentieth century, there appeared a very important and very influential essay by Max Weber (1864-1920), *his famous, very subtle and very profound essay*, "Science as a Vocation."[3] This is the one that *established almost as a dogma in universities the fact/value distinction. Weber talks about what he sees science to be, and how*

[3] ***Science as a Vocation*** (*Wissenschaft als Beruf*) is the text of a lecture given in 1918 at Munich University. The original version was published in German. In *Science as a Vocation* Weber discusses the benefits and detriments of choosing a graduate career in the sciences. He probes the question "what is the value of science", noting that ethics themselves are not subject to scientific examination. Science, to Weber, gives methods of explanation and means of justifying a position, but it cannot explain why that position is worth holding in the first place; this is the task of philosophy. No science is free from suppositions, and the value of a science is lost when its suppositions are rejected. He reasons that science can never answer the fundamental questions of life, such as directing people on how to live their lives and what to value. Value he contends can only be derived from personal beliefs such as religion.

it is connected with what he calls the ongoing process of rationalization and intellectualization that has been going on for hundreds of years.[4]

Some Extra-Scientific Opinions

"Let us first clarify what this [increasing intellectualization and rationalization], created by science and by scientifically oriented technology, means … It means that principally there are no mysterious incalculable forces that come into play, but rather that one can, in principle, master all things by calculation. This means that the world is disenchanted."

Max Weber, "Science as a Vocation"

And he says: that the ongoing process of rationalization and intellectualization was:

> created by science and by scientifically oriented technology … [and] it means that principally there are no mysterious incalculable forces that come into play, but rather that one can, in principle, *master all things* by calculation.

[4] Max Weber (1864-1920): Arguably the foremost social theorist of the twentieth century, Weber is also known as a principal architect of modern social science along with Karl Marx and Emil Durkheim. His wide-ranging contributions gave critical impetus to the birth of new academic disciplines such as sociology and public administration as well as to the significant reorientation in law, economics, political science, and religious studies. His methodological writings were instrumental in establishing the self-identity of modern social science as a distinct field of inquiry; he is still claimed as the source of inspiration by empirical positivists and their hermeneutic detractors alike. More substantively, Weber's two most celebrated contributions were the "rationalization thesis," a grand meta-historical analysis of the dominance of the west in modern times, and the "Protestant Ethic thesis," a non-Marxist genealogy of modern capitalism. Together, these two theses helped launch his reputation as one of the founding theorists of modernity. In addition, his avid interest and participation in politics led to a unique strand of political realism comparable to that of Machiavelli and Hobbes. As such, Max Weber's influence was far-reaching across the vast array of disciplinary, methodological, ideological and philosophical reflections that are still our own and increasingly more so. Among his publications were *Religions of China: Confucionism and Taoism* (1916), NewYork: Free Press, 1964; *The Religions of India: The Sociology of Hinduism and Buddhism* (1916), New York: Free Press, 1958; *Ancient Judaism* (1917), Gencoe, IL; Free Press,1952; and most famously, *The Protestant Ethic and the Spirit of Capitalism,* New York: Scribner's, 1958.

And so you can see that that is coming right out of Bacon and Descartes into the twentieth century, and influencing, in really fundamental ways, the manner in which the universities in the twentieth and now in our twenty-first century are structured.

But he takes it the next step! "*The world is disenchanted*." And this is something that deeply troubled Weber himself, but it nevertheless was something that he saw as an inescapable conclusion. Weber did an enormous amount of work on sociology of religion. He wrote a whole volume on the religions of China and a volume on the religions of India and a volume on Judaism. He has a very famous monograph on *The Protestant Ethic and the Spirit of Capitalism*. *He was very, very concerned with the fact that religion among the educated peoples of the twentieth century had died, and yet he saw that that was inevitable*. He saw that that was the outcome of this process of scientific progress. And he said that "it means that *the world is disenchanted*." The world is just a bunch of material bodies pushed around by forces.

And a little bit later in the twentieth century a Nobel prize winner, Jacques Monod, wrote a very famous essay, one in which he took some very unorthodox views about certain things. His scientific work was in the analysis of the biochemistry of organic proteins, of how they are synthesized, and what roles they play in cells. Where most of the world at the time were very interested in chromosomes and DNA, Monod was interested in questions having to do with the biochemistry of proteins. He got the Nobel Prize for that work. He wrote this very influential book entitled *Chance and Necessity*. And some of the sound-bites that people remember from this book are the ones that I have up there. [See next page].

> We would like to think of ourselves as necessary, inevitable, ordained from all eternity. All religions, nearly all philosophies, and even a part of science testify to the unwearying, heroic effort of humankind desperately denying its own contingency.

We arrived here by accident! So clearly the heritage of both Jews and Christians at the very beginning reflects this heroic effort in his view. In both of the Genesis accounts of creation, human beings have a very special elevated place in the order of creation. The *Koran* reflects this as well! So he's basically saying: "Those poor religions, how misguided they were to

think that human beings were anything special. We're just a bunch of chemicals floating around in a chemical bag!"

Some Extra-Scientific Opinions

"We would like to think ourselves necessary, inevitable, ordained from all eternity. All religions, nearly all philosophies, and even a part of science testify to the unwearying, heroic effort of mankind desperately denying its own contingency."

"The ancient covenant is in pieces; man knows at last that he is alone in the universe's unfeeling immensity, out of which he emerged only by chance. His destiny is nowhere spelled out, nor is his duty. The kingdom above or the darkness below; it is for him to choose."

Jacques Monod, *Chance and Necessity*.

Monod also writes: "The ancient covenant is in pieces." In this remark, he doesn't really mean the covenant as it's understood by Christians and Jews; what he means is that the kind of elevated sense of self-worth that comes with religion is in pieces!

> Humans know at last that they're alone in the universe in its unfeeling immensity, out of which they emerged only by chance. Their destiny is nowhere spelled out, nor is their duty. The kingdom above or the darkness below; it is for them to choose.

So perhaps you're beginning to see what some of the implications of these extra-scientific opinions are — that *science is about something, and what it's about does not offer a very hospitable place for human life and human meaningfulness*!

Some Extra-Scientific Opinions

"I think 'nature red in tooth and claw' sums up our modern understanding of natural selection admirably."

Richard Dawkins, *The Selfish Gene*.

And then of course even more recently, Richard Dawkins in his best-selling book, *The Selfish Gene*, writes as follows: "*I think 'nature red in tooth and claw' sums up our modern understanding of natural selection admirably*." You know, Dawkins thinks that natural selection is the cat's whiskers! He believes it is the fundamental force.

Questions asked by Lonergan in *Method in Theology*:

Is moral enterprise consonant with this world?

Are we merely gamblers and fools, hoping for progress against the odds, in a declining world (universe of increasing chaos)?

Is there a transcendent, intelligible ground of the universe?

Is that ground the primary instance of moral consciousness, or are we?

So what I want to suggest is that Lonergan is very, very aware of these implications. Because remember those things that he said!! They refer to some of those extra-scientific opinions: determinism, necessity, uniformity of nature! *The* "uniformity of nature" here means *everything is just chemicals. There's nothing specifically different about animals, or human*

beings, or plants, or — It's all just a bunch of chemicals all on the same level. So those are the things that Lonergan is saying are part and parcel of the accompanying extra-scientific interpretations of the meaning of science!

Lonergan's Questions

"**Is moral enterprise consonant with this world? … Is the universe on our side, or are we just gamblers and, if we are gamblers, are we not perhaps fools, individually struggling for authenticity and collectively endeavouring to snatch progress from the ever mounting welter of decline?" The questions arise and, clearly, our attitudes and our resoluteness may be profoundly affected by the answers. Does there or does there not necessarily exist a transcendent, intelligent ground of the universe? Is that ground or are we the primary instance of moral consciousness? Are cosmogenesis, biological evolution, historical process basically cognate to us as moral beings or are they indifferent and so alien to us?** (*MiT*, pp. 102-103).

And these issues are not to be found explicitly in Lonergan's *Insight*, but they are to be found in *Method in Theology*, which we will have a look at in the second semester, or some parts of it at least. In a very crucial chapter, namely, chapter four on "Religion" in

Method in Theology, *Lonergan raises a series of questions, which show that these concerns were on his mind, and that he thought that his work had something important to say to this*.

Lonergan asks: "**Is moral enterprise consonant with this world?**" … (*MiT*, p. 102). Now, given what we have just seen, why would that be a question for him? … Matt?

Matt: Because the progression from Bacon to Dawkins is more and more an impersonal, sort of random world!

Pat: Right! And so is the effort to try to make meaningful, to make good, is it just a grand illusion? And he — This is all from the same paragraph:

> "**Is the universe on our side, or are we just gamblers and, if we are gamblers, are we not perhaps fools, individually struggling for authenticity and collectively endeavouring to snatch progress from the ever mounting welter of decline?** (*MiT*, p. 102).

One of the big statistical laws of the nineteenth century is the Second Law of Thermodynamics![5] When I was studying physics, we were told that there were four laws of thermodynamics. The first law was about the conservation of matter/energy, and we were

[5] The Second Law of Thermodynamics is one of three Laws of Thermodynamics. The term "thermodynamics" comes from two root words: "thermo," meaning heat, and "dynamic," meaning power. Thus, the Laws of Thermodynamics are the Laws of "heat power." As far as we can tell, these Laws are absolute. All things in the observable universe are affected by and obey the Laws of Thermodynamics.

The First Law of Thermodynamics, commonly known as the Law of Conservation of Matter, states that matter/energy cannot be created nor can it be destroyed. The quantity of matter/energy remains the same. It can change from solid to liquid to gas to plasma and back again, but the total amount of matter/energy in the universe remains constant.

The Second Law of Thermodynamics is commonly known as the Law of Increased Entropy. While quantity remains the same (First Law), the quality of matter/energy deteriorates gradually over time. How so? Usable energy is inevitably used for productivity, growth and repair. In the process, usable energy is converted into unusable energy. Thus, usable energy is irretrievably lost in the form of unusable energy.

"Entropy" is defined as a measure of unusable energy within a closed or isolated system (the universe for example). As usable energy decreases and unusable energy increases, "entropy" increases. Entropy is also a gauge of randomness or chaos within a closed system. As usable energy is irretrievably lost, disorganization, randomness and chaos increase.

told that the laws of thermodynamics could be summarized as: "You can't win, you can't even break even, things are going to get worse before they get better, and who says they're going to get better?"

[laughter]

So when he's talking about a "**welter of decline**," he's talking not only about the human world in which we've seen ever escalating amounts of human carnage. As science progresses the numbers of ways in which we can kill each other also accelerate. He's also talking about a universe in which an increasing chaos and randomness is thought to be part and parcel.

> "**The questions arise and, clearly, our attitudes and our resoluteness may be profoundly affected by the answers**. (*MiT*, p. 102).

So in other words, *if the universe is not on our side, and we're just fools and gamblers by trying to live decent and moral and ethical lives, then the question arises as to What's the point to doing that? And you may come to the conclusion that there's no point to doing that! Well, it's a lot easier to go with the flow than it is to try to live an ethical life*!! So …

The answers to the questions about whether or not the universe is on our side are very important! And it's in this context that Lonergan is saying that this is one way of raising the question about transcendent reality, about divine being!

> "**Does there or does there not necessarily exist a transcendent, intelligent ground of the universe? Is that ground or are we the primary instance of moral consciousness? Are cosmogenesis, biological evolution, historical process basically cognate to us as moral beings or are they indifferent and so alien to us?** (*MiT*, pp. 102-103).

So this gets a very powerful articulation when he comes to write *Method in Theology*. *But I've come to believe that this is also very much behind the way in which he chose to structure the book* Insight.

Stuart Kauffman's *At Home in the Universe* presents arguments against these extra-scientific opinions of the 20th century, drawn from sophisticated bio-informatic models.

Humans did not come about in a merely 'ad hoc' manner.

The natural emergent order of the world was inevitable; given the universe that we have. Humans are not out of harmony with the natural emergent order but an intrinsic part of it.

A similar kind of question was raised by an independent researcher at the Sante Fe Institute in New Mexico by the name of Stuart Kauffman. Stuart Kauffman is in the field of what might be called bio-informatics. He has done some remarkably sophisticated modelling of biological systems in very, very advanced high-speed computers. And he published a somewhat popular version of his work in a book called *At Home in the Universe*.[6]

And I just want to read to you some passages from Kauffman's book:

> "Random variation, selection sifting. Here is the core, the root. Here lies the brooding sense of accident, of historical contingency, of design by elimination. At least physics, cold in its calculus, implied a deep order, an inevitability. Biology has come to seem a science of the accidental, the ad hoc, and we just one of the fruits of this ad hocery. Were the tape played over, we like to say, the forms of organisms would surely differ dramatically. We humans, a trumped-up, tricked-out, horn-blowing, self-important presence on the globe, need never have occurred. So much … for paradise. …

[6] Stuart Kauffman, *At Home in the Universe* (New York: Oxford University Press, 1995).

"I shall argue in this book that this idea is wrong. For, as we shall see, the emerging sciences of complexity begin to suggest that the order is not all accidental, that vast veins of spontaneous order lie at hand. Laws of complexity spontaneously generate much of the order of the natural world." (Kauffman, *At Home in the Universe*, pp. 7-8).

Stuart Kauffman

"Biology has come to seem a science of the accidental, the ad hoc, and we just one of the fruits of this.… We humans …. need never have occurred.

"I shall argue in this book that this idea is wrong. For, as we shall see, the emerging sciences of complexity begin to suggest that the order is not all accidental, that vast veins of order lie at hand….

"If all this is true, what a revision of the Darwinian worldview will lie before us! Not we the accidental, but we the expected."

Kauffman, *At Home in the Universe*, pp. 7-8.

And so on. And then he says: "If all this is true, what a revision of the Darwinian worldview will lie before us! Not we the accidental, but we the expected." (Kauffman, *At Home in the Universe*, p. 8). The Darwinian worldview is that which we saw reflected in both Jacques Monod and in Richard Dawkins. Now this is a guy who's got some very sophisticated mathematical techniques and arguments to back up what he's saying. And so what he's saying is that this tradition of extra-scientific opinions that ends with Weber and Monod and Dawkins, that that's not right!

Now he's making his argument by — It's a very sophisticated multi-layered argument which involves an awful lot of research and an awful lot of modelling. *And his argument basically is that, under a fairly limited set of assumptions, you can say that order of the kind that we find on our planet is inevitable given the universe that we have. And that therefore, the universe that we live in, particularly the planet that we live on, is inevitable and that our emergence from it is inevitable. And that therefore we are not out of harmony with the natural emerging world. But that rather we are part and parcel of that natural emerging world*!

Lonergan argues a point very close to that of Kauffman.

Lonergan's Position (given in Chapter 19 of *Insight*):

Reality is completely intelligible.

The immanent order of the universe is one of emergent probability.

Our striving for good is part of the directedness of the natural universe.

The universe is our home, as meaning-seeking and morally striving beings; not fundamentally alien to us and our fundamental aspirations and needing to be subdued.

Lonergan argues that this view of the universe, as hospitable to the highest human strivings, follows from the actual practices of the natural sciences as truly self-appropriated.

So Kaufmann argues then that we are not out of harmony with the natural emerging world that surround us. Rather we are part and parcel of that natural emerging world! Now that's

exactly what Lonergan is going to argue. *His argument is going to cover most of the book Insight in one way or another. With various kinds of — Sometimes it's more prominent, and sometimes it's less prominent. So Lonergan's position — that comes rather late in the book* Insight, *in fact the two passages below are both from chapter nineteen — is that being, reality, is completely intelligible. That means it makes sense. It's not a reality of absurdity, but rather a reality that's intrinsically and completely intelligible.*

Lonergan's Position

"**But the real is completely intelligible**." (*CWL* 3, p. 695).

"**It has been seen that the immanent order of this universe [is emergent probability] …. So it is that every tendency and force, every movement and change, every desire and striving is designed to bring about the order of the universe in the manner in which in fact they contribute to it; and since the order of the universe itself has been shown to be because of the perfection and excellence of the primary being and good, so all that is for the order of the universe is headed ultimately to the perfection and excellence that is its primary source and ground.**" (*CWL* 3, p. 688).

And then he recalls that "**the immanent order of this universe [is emergent probability]",** which is where these first four chapters are headed, to give an account of what he means by "emergent probability."

Emergent probability is:

> "**the immanent order of this universe …. So it is that every tendency and force, every movement and change, every desire and striving is designed to bring about the order of the universe in the manner in which in fact they contribute to it; and since the order of the universe itself has been shown to be because of the perfection and excellence of the primary being and good, so all that is for the order of the universe is headed ultimately to the perfection and excellence that is its primary source and ground.**" (*CWL* 3, p. 688).

Now, in other words, what he's saying is we are not gamblers and fools to be striving for the good, to live ethical lives, to be striving for authenticity. But rather that is part and parcel of what the direction and directedness of what the natural universe is all about!

Now in order to make that argument, you have to do something rather radical! You have to go back and take another look at the methods and the procedures and the operations and the workings of natural scientists! That is what he's doing in these first four or five chapters in *Insight*.

And it is only after he has, I would say, shown that there is an intrinsic intelligibility to the natural world process that he will then introduce the things that are specifically and properly human. *He has done something like what Stuart Kauffman is doing, namely, make an argument that the universe is our home, and not an alien nature that has to be subdued and dominated because it's fundamentally alien, it's fundamentally hostile to us. So I think that's why he has set the book up the way he has*!

Student question about the meaning of intelligibility and Lonergan's use of explanatory definitions.

– Discussion of how insights always initially occur in a fusion with the sensible and imaginative *noematic* contents (*phantasms*) from which they emerge.

– Especially in explanatory definitions, Lonergan highlights the differences of sensible and imaginative *noematic* contents from the distinctive content of insights (intelligibility), forcing us to relinquish our laziness in letting images do our thinking for us.

– And to take possession of ourselves as also intelligent (self-appropriation).

Question as to whether Lonergan is reaching out to scientists through these examples.

Pat: Matt?

Matt: Regarding this notion of intelligibility, I keep having to go back to my previous notes to try and keep reminding myself what does intelligibility mean? And in the midst of it, I kept coming back and finding that, you know, thinking of this as the 'Self-appropriation Essay', or the '*Understanding and Being* Essay', where he talks a lot of this shifting ideal of knowledge. And so the question that kept coming up to me — I'm wondering if it helps in this dialogue — is: Does the understanding of the explanatory definition and the relations of things among themselves, like the Einstein relativity piece, is all of that stuff, is Lonergan using those points as an olive branch to the prevailing

understanding of knowledge among scientists, and is he using that definition, those explanatory definitions and scientific accounts sort of to articulate this point in a clear way so that when you go with human elements, that scientific thought process applies to us as human beings?

Pat: Ah, there were a couple of questions there. I think the answer is 'Yes' to all of them.

Matt: Okay!

Pat: Let me see if I can go back to the first one: What is he doing in this business about explanatory definitions and his references to some very, very sophisticated contemporary — twentieth century mathematical physics? Is he trying to clarify the notion of intelligibility? I think the answer to that is 'Yes'!

Matt: Okay.

Pat: Something I didn't have the opportunity to say in one of the previous lectures — I may have said it in kind of passing — is: Because for Lonergan our insights are into phantasms — we had that experience, and you are having such experiences as you are thinking about composing your "Description of an Insight" papers — *because they're into phantasms, initially there's a kind of fusion*! *So first we have experiences, and then we have experiences slightly changed. They're not just experiences, they're puzzles*! We see things, we hear things, we smell things, we touch things, and then suddenly we go: What is that? Why does it feel like that? Why does it sound like that? Where's that sound coming from? *So there's been something added to the sensation to make it a little bit different. It's no longer just a pure sensation, it's now an "empuzzled" situation*!

And something very similar happens when you get an insight, because *the reason why you have a period of a tension of inquiry is because the presenting experience is not the image or the phantasm that you need to give yourself the insight*. You need to fiddle around, and we're going to see that that's actually something that happens in scientific method. What we've got in science is a methodical fiddling around with images that helps scientists get the kind of insights that they need to have.

So we fiddle around with images, as you all did, as I was getting you to talk about what you were doing in your imaginations when we had that puzzle in the first class.

And then we have the insight, and the insight fuses with the images that you've got, because it's the image that gives rise to the insight. The image is with the insight. It's the mutation, it's the spark, it's the clue, it's the stimulus, it's the condition for the arising, the emergence, of the insight. But they're both there together in your consciousness, and they're intimately connected because the insight has grasped intelligibility that's relevant to that image!

Now what happens in science of course is that you have to go back and see, well, it's a perfectly good understanding of that image, but that image is not how I started. That's not the data! Does this insight work with the data? And so you have to do things like set up experiments and equipment, and so on, to test it. But initially, the insight and the image are fused in one. *And what we tend to do is to get lazy and let the image do our thinking for us*!

And what happens in explanatory definitions is we are forced to let go of our — what he calls — umbilical dependence on our imagination, and take possession of ourselves just as the insight does [last word unclear]! That doesn't mean that we can or should live without imagination. *What it does mean it that we can let — especially in philosophy — we can let imagination stand for — take the place of — intelligibility. And the examples that he is using are where the distance between the imaginable and the intelligible becomes quite exaggerated*. And he says that one of the things about Einsteinian physics is that we are forced into a world of intelligible relations of a four-dimensional continuum. Well, we don't experience and we can't imagine a four-dimensional continuum, but we can have insights into it. … So that was part of what you were asking.

And a second thing is: Is it an olive branch to the scientific world? Well, sure! And he does say some things in there about how — where he's taking a certain kind of pride in what he's done, where he says "Look, I've been able to give an account of the use of differential equations, I've been comparing [last word unclear] principles of special and general relativity — that I'm showing you what the power of saying that insight has an important role in modern science, what are the sorts of things that it can bring together!

So yeah, he's proving his mettle, so that when he gets to talking about things having to do with human meaningfulness and human ethical living and religion, that he's got some credibility. So yeah, that is part of what he's doing, sure! Okay?

Matt: Thank you!

Question about the post-World War disillusionment about the meaning of life, and whether these extra-scientific opinions were the result of that, or resulted independently and inevitably from scientific progress itself.

- Lonergan was deeply concerned with the sources of that disillusionment.
- The problem is not science but the extra-scientific opinions that led to a post-Enlightenment revision of the very idea of *reason*.

Pat: Someone else had a question there? … Stephanie?

Stephanie: I was just thinking about whether Dawkins and Monod in the kind of period and the time frame when they were working, and one thing that kind of comes to mind is the fact that it was maybe happening around World War One or World War Two; and some of these ideas which seem to coincide with the disillusionment of mankind. And a lot of literature that came out during that time seemed to echo that, you know, meaninglessness of life! And I'm just wondering how conscious Lonergan is of that? And if he thinks that science is progressing to this final conclusion independently of the human condition, or if he feels like, you know, the state of the world and the state of the world mentality is impacting science at all?

Pat: Ah, *he was very acutely aware of the condition of the twentieth century*! It comes out most poignantly in some things he wrote in his young development, when he was in his thirties. And we'll see a couple of those passages, both in chapter three of his *Topics in Education* and in chapter seven of *Insight*. *You can see in what he has written that he has a sense of the disillusionment that has moved through several centuries of human*

history. And he does think of his philosophy as having something to say to that, to redress that problem.

What he's going to argue is that the problem is not science. The problem is the misinterpretation, the extra-scientific opinions about science. And that that has had a lot to do with the distortion of human culture and human history that you could trace to the period of the Enlightenment. So reason came to mean something very different after the Enlightenment than it did before! Which isn't to say that reason has ever had the upper hand in much of human history. But just the very idea of what reason is changed! It changed not because of the emergence of modern science, but because of what he calls the extra-scientific interpretation of modern science. And that became a cultural force. Is that okay?

Stephanie: Yes, thank you!

Question on whether the intelligibility of the real implies that we have the potential to know being completely.

– The full treatment of the intelligibility of the real not completed until Chapter 19.

– Lonergan approaches being in terms of an analysis of the *notion* of being, the human anticipation of being.

– Lonergan's first step is to show that the world known by science is intelligible, thanks to insight.

Any other questions at this point? … Tim?

Tim: Yeah. I was just really struck by that first quote that you have up there in the "Lonergan's Position" display on page thirty-seven above. That the real is completely intelligible. I'm wondering if Lonergan understands that the human mind has *the potential* — and in most cases it's not actualized, or I don't know if in many cases it is actualized, but — *the potential to know the real, to know being completely*? Because it seems that that must be a possibility or a potential in order to say that "the real is completely intelligible". In other

words, how can he make that statement about being being completely intelligible without at the same time kind of assuming the knowledge of knowing being completely?

Pat: Okay. Well, that's a really big question. And all I can say is, first of all, this comes in chapter nineteen!!

[Laughter]

So *there's a number of series of steps along the way*. But let me say just a couple of things very briefly.

The first step in the argument is to show that the world that is mediated to us by modern science is an intelligible world. That's one reason why he wants to say that *insight is so important a feature in modern science, and so woefully neglected. If insight is a central and fundamental and irreplaceable feature of modern science, then that means that what modern science is about is discovering the intelligibility of the world*. Now that doesn't solve all the questions that are going to arise with regard to that, but it certainly answers some of the extra-scientific opinions that we've seen.

The second thing is that we're already getting a hint about how he could say such a thing, how could he know that being is completely intelligible without completely understanding being, which he's going to insist we do not! And *the key to that is this business about '**heuristic**' and '**notion**'. There are things you can know about your anticipation without knowing the answer to your anticipation. By paying attention to how the mind anticipates, we can say some things about the sort of thing that will be known when you know it*! *And when he gets to the chapter on being, it is very important that he uses the word 'notion.' He does not say 'idea of being', he does not say 'concept of being', he does not say 'theory of being'! What he is talking about is a notion of being. So anything he's going to say about being is going to be said in terms of the way in which the human, the soul, the spirit, anticipates being. And he's going to make the argument based on an analysis of how we anticipate being! And that a conclusion to be drawn from that is that being is completely intelligible.*

But *for the moment, he just wants to get the first move on the board, which is that the world known by science is intelligible*. Because that seems overwhelmingly to a lot of people to be one of the big objections!

Question about Lonergan's views versus those of Bacon and Descartes.

– Lonergan as a philosopher is interpreting science in a way more true to the real practices of science.

– The *telos* or objective of science does not put human beings at the center of the universe.

– Science is not merely to serve human interests but rather, aims at a perfection transcending human purposes.

And somebody else had a question? … Matt?

Matt: I just got a question. I like the distinction between the extrascientific claims and the scientific claims, but I just have trouble with the wording, because it seems like it still kind of goes back to the view of Bacon and Descartes. That everything that is to be known can be known, and I can't reconcile that with the disenchantment!

Pat: Okay. Let me just say a couple of things. First of all, Lonergan is a philosopher. He's also a theologian, okay! But in this book he is working as a philosopher. He is not working with theological presuppositions. But *as a philosopher, he too is giving an interpretation of science. What he is arguing is that his interpretation of science is truer to the real practices of science than are the other ones*. Okay. So it's not as though he is different from everybody else because he is *not giving an interpretation of science. He is giving an interpretation of science! He is giving a philosophy of science, one that is depending on the importance of insight as a constitutive element in scientific practice*. What's different about where this statement [the statement of "Lonergan's Position" in the box on page thirty-seven above] comes — it's in the famous statement about what he calls "**general transcendent knowledge**." It's knowledge about reality that transcends what you might call ordinary human knowing. It's what he calls "analogical knowing." So he's

talking about — and this has to do with the question that Tim asked about the heuristic. *So he's talking about what you can know about the transcendent without actually knowing the transcendent directly*.

But there's a significant difference about what he says about the universe here, and what Bacon and Descartes and Weber said about that, and what Leon Kass had to say about it. Did anybody notice the difference? What is the objective of science according to Kass, who's borrowing it from Bacon and Descartes and Weber? … Donau?

Donau: Mastery of the world and improvement of the human situation?

Pat: Right. Or to put it more specifically, what's the focus —?

Donau: Control of the world?

Pat: By?

Donau: Man!

Pat: Humans. *So human beings were at the centre of the universe, right?*

> *That the world understood through scientific method is a world understood as in the service of human beings*. That's not what this [the long second paragraph in 'Lonergan's Position' on page thirty-seven above] says!! *What this says is that the operation of the universe is striving for a perfection that transcends human beings, that transcends human purposes! And that's going to be part of his argument*! And you don't have to buy this right now, and you don't have to buy it twenty-six weeks from now!

[Laughter]

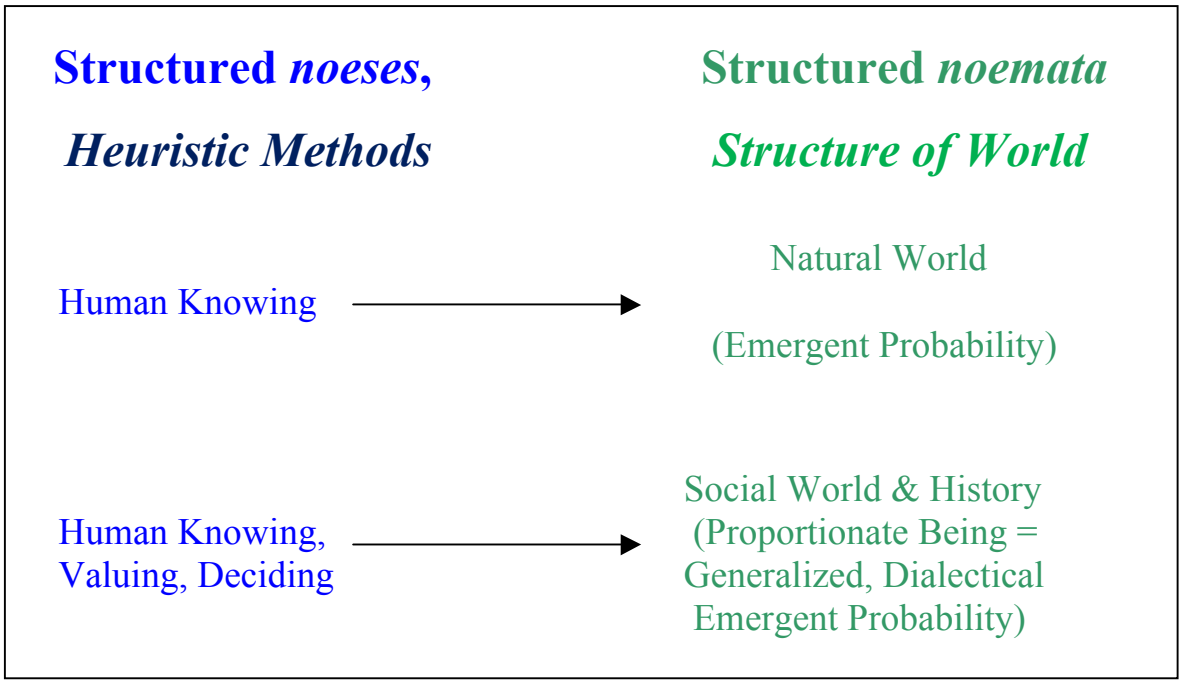
But that is what the argument is. And so that's the significant difference between Lonergan and the Baconian-Cartesian tradition, which assumes that the end of the world as known by science is *human* desire and *human* interest and *human* concern. *The end of science as Lonergan is going to determine it is transcendent, radically transcendent*! What exactly that means …? He's obviously talking about God, because he's a Roman Catholic Jesuit priest theologian: God as that's understood in the Roman Catholic tradition, which means not-understood!! All right?

[Some subdued laugher]

But that's what's making him offer a totally different characterization of science and of the world that it gives us! Okay?

Donau: Yes, thank you!

Okay! Right! Let's move forward!



Comparison of Lonergan's argument to Kauffman's. Instead of biochemical processes, Lonergan references the structures of human cognitional activity, specifically how they are structured by heuristic methods.

Now, I've read to you from Stuart Kauffman. I recommend that book to you! *It's not an easy read, but it is an utterly fascinating read*. He uses a lot of fairly simple metaphors to explain to you some of the very sophisticated computer modelling that he's done. He shows how chemicals [inaudible] interact with one another and give rise to orders and systems and so on, very much parallel to what Lonergan does! But Kauffman is working out of a certain elemental basic knowledge of how biochemicals function and interact, and he makes a strong

argument based on that to the effect that we have an emergent order which is hospitable to human life and human existence! And it is not an alien world, but rather a hospitable world!

Lonergan makes his argument — a very similar kind of argument — but he makes it on a different basis! He's going to make the argument in a manner not based on specific reference to chemical laws and biochemical processes. *He's going to make it on the basis of the structures of human cognitional activity*!

Four fundamental kinds of scientific, heuristic methods structuring knowledge:

Classical: Functional correlations among data.

Statistical: Ideal frequencies among data.

Genetic: Embryology and the discovery of intelligible sequences of transformation to systems. (Extended discussion).

Dialectical: Discovering the roots of conflicts in human affairs. Only humans can act unintelligibly, unreasonably, and irresponsibly.

Now, you saw the overhead display on the next page before, a couple of classes ago, but now *I want to bring out specifically how our enquiries are structured by heuristic methods. And how the structuring of human knowing by scientific heuristic methods implies a natural world that he characterizes as* ***emergent probability****. And that characterization, as we'll see, is a characterization that it has a certain kind of intelligibility to it — not utter random chaos, but a certain intelligibility to it*. Now that's something that will take us a couple of weeks to work our way up to.

Okay. So *Lonergan is going to say that there are four fundamental kinds of heuristic structuring, four fundamental kinds of the scientific heuristic structuring of knowledge*. He

writes of what he calls classical, statistical, genetic, and dialectical heuristic structures. Now so far you were only exposed to the first two.

Four Basic Kinds of
Scientific Heuristic Methods

Classical:

Discovering functional correlations among data

Statistical:

Discovering ideal frequencies (probabilities) among data

Genetic:

Discovering intelligible sequences of developmental transformations of systems

Dialectical:

Discovering roots of conflicts in human affairs

The first discussion of genetic method is delayed until rather late in the book, in fact until chapter fifteen. Genetic method arose in the nineteenth century when biologists became quite preoccupied with the problem of explaining embryology. And it's a fundamental reason for the emergence of the developmental sciences. And we'll talk about that in more detail when we get there.

Interestingly, the initial upper hand in the nineteenth century was held by the *vitalists* who were dealing with the vast array of data about embryological development — all kinds of different species, both animals and plants and sub-plant species, and so on — trying to deal with how do you explain certain kinds of things that happen in embryological development, especially when it gets interrupted in its early stages. It was becoming clear that mechanistic attempts to explain these failed at that time. Vitalistic explanations were better at that time

than mechanistic ones. Now, later on, mechanistic explanations came back in, and that's why people like Jacques Monod and Richard Dawkins were able to make the kind of claims they did. But the beginning of the nineteenth century was when the field of developmental science really comes into its own! And it gets taken up in areas such as developmental psychology and so on.

And then there is one more kind of method, the dialectical method. That has to do — You only use dialectical method from Lonergan's point of view — unlike Hegel's — He's influenced by Hegel, but he makes a big point of his departure from Hegel —

> *You only need a dialectical method to deal with the fact that human beings, and human beings alone, can act unintelligibly. Human being alone can act in ways that are unintelligent, and irresponsible and unreasonable. No other beings in the universe can do that. So if you want to deal with the human phenomenon, you need to add a fourth kind of method that takes into account that radical unintelligibility of human waywardness and the distortion of human living.*

Michael?

Michael: Are you, or is he, talking now about, not ignorance, but rather wilfully choosing to do something that is unintelligent?

Pat: Ah, that's a really good question. *It is not just ignorance*! But the wilfulness is a little bit — how do I want to say this? — it's making too great a demand, or it's narrowing the field too much. *So for example, in chapter six, he's going to talk about the — He's going to give his theory of psychological disturbance, and he's going to argue that it's pre-volitional! That there's a pre-volitional dialectical component to human living that has to do with mental illness, emotional disturbance, and so on*. So it's not wilfulness! But it turns out it's not exactly just ignorance, in the sense that I haven't thought of it yet! It's the — It fundamentally has to do with the disturbance and the interference with the natural self-correcting phenomenon of inquiry and insight and judgment.

So when you get something that's disturbing the genetic process of the growth of understanding and the growth of knowledge and the growth of value, then you have to have

another kind of method that he calls the dialectical method. So we'll see each of these as we go along. But this is just to give you sort of the overview. And he's going to makes an argument about why there are only four kinds of method! Whether he holds to that or not afterwards is just sort of an interesting question for us to look at in the light of some of his work in the nineteen-sixties and seventies!

What is science?

Human intelligence is essentially dynamic; that is, it is permeated with the dynamism of inquiry and self-correcting understanding.

Science is *methodologically* dynamic.

An explication of methodical dynamism allows for a general explanation about a world towards which that methodical dynamism is oriented.

What is Science?

Methodically Dynamic

"**In the previous chapter insight was examined in a static fashion …**"

"**But no effort was made to capture the <u>essential</u> dynamism of human intelligence …**"

"**Empirical science is conspicuously and <u>methodically</u> dynamic.**" (*CWL* 3, P. 57).

Okay! So what is science? Remember we saw this overhead display a while ago. He says that *in the first chapter he looked at insight statically*, which I think is not exactly the whole story. He is interested in the dynamism of human intelligence, in its *essential* dynamism. *So human intelligence is essentially dynamic*! There's a sort of a way in which you could say that in conceptualism, human knowledge is essentially static. The concepts are all there, and they're all there forever where they are meant to be.

But what I think is more to the point here is this remark that in science it's not just dynamic [cognition in science is not the only cognition that is dynamic], because as we'll see when we get to the chapters on common sense, *he can make an overwhelming argument that ordinary human living is just permeated with the dynamism of self-correcting human understanding*. So it's not just that science is dynamic, and ordinary living is not. It's rather that science is *methodically* dynamic! *What's important for him, it seems to me, is that by saying something about what that methodical dynamism is, he's in a position to say something about what the general overview of the intelligibility of the world is that is oriented by that kind of methodical dynamism*.

Student question about transferring scientific methodological dynamism to ordinary, moral and common sense intelligibility.
Further student question about the nature and role of human science.

Greg?

Greg: So will he kind of transfer, let's say the scientific model of methodical dynamism, to moral and common sense everyday intelligibility? Is he arguing that there's a methodical link between them?

Pat: *Not the same kind of methodicalness*! How do I want to say this? — *He's going to make the argument that the difference between common sense knowing and scientific knowing is that common sense knowing is concerned to comprehend the concrete realities in all their concreteness; whereas scientific knowing's methodical dynamism is to leave no stone unturned! Scientific methodicalness seeks to explore things in all their generalities*. So no, he is *not* going to say that knowing the methods of classical or statistical

heuristics are going to be simply and automatically applicable to human affairs. But what he *is* hoping is that *by having cleared the path of some of the extrascientific opinions, people will be able to be more attentive to the functioning of their intelligences in their everyday living*. Okay?

Another student: What would you do with what may be called 'intervening' sciences like theology, ethics, philosophy, political science and anthropology, that kind of — where there is a need to apprehend common sense and the way people live, and yet pertain to or claim to be somehow scientifically grounded?

Pat: Well, he's going to give an account of what he thinks a human science is, and how it is related to human living, in chapter seven. And then it's going to be revisited on a couple of occasions later on in the book. So we'll defer that question to that point. But he will implicitly introduce dialectical method by the time he gets to that discussion, and then he goes back and he does it in a more — in a fuller and more rich sense later on in the book. Okay?

Student: Right!

What is science? Explanation *vs.* Description. Chapter 2 §1. Math & Science: Comparison of these in terms of insight.

Mathematics: Lonergan characterizes math not as primarily logical, but as primarily heuristic. Not a static structure but a dynamic way of searching for the unknown.

And then another way of answering the question What is Science? is one we have seen before. I'm not going to dwell on it, because we talked about it a lot last week. What is the difference between science and ordinary understanding? Firstly, it's *methodically* dynamic as opposed to being merely dynamic! And secondly, it's concerned with things in their relationships to one another rather than the relationship to our concerns, our interests and our sensations.

What is Science?

Explanation vs. Description

Similarities are of two kinds:

"**There are the similarities of things in their relations to us ….**"

"**There also are the similarities of things in their relations to one another**." (*CWL* 3, p. 61).

Display of full contents of chapter two on the overhead

Okay. So we've already looked a little bit at the table of contents of this chapter. After these introductory reflections on why he wrote the book this way, let's dive into it and take a look at what he actually did in this chapter.

So the first thing he does is he gives a contrast, or he does a similarity and a dissimilarity between insight in mathematics and insight in natural science, throughout the modern period of science. And he doesn't say a great deal there compared to the complexity of what comes in the next several sections.

So I only want to draw attention to one thing, and if people have questions about that first section and we can talk about those.

§1 Comparison of Math & Science

"**The procedure consists in**

(1) giving the unknown a name or symbol [x],

(2) inferring the properties and relations of the unknown,

(3) grasping the possibility of combining these properties and relations to form an equation, and

(4) solving the equation.[7] (*CWL* 3, p. 60).

I only want to draw attention to one thing: A little bit later — it's actually not in section one — It's where he talks about the illustration from algebra. He's again drawing a similarity between the two, between maths and science, and he says this: that in mathematics, in algebra, the procedure consists in, *number one*, **"giving the unknown a name or symbol [x];"** *number two*, "**inferring the properties and relations of the unknown**;" *number three*, "**grasping the possibility of combining these properties and relations to form an equation**;" and then *number four*, "**solving the equation."** (*CWL* 3, p. 60).

Now, what I wanted to stress here is something that I think often escapes people. This is a way in which you look back at what he did in chapter one with those mathematical examples, and see in a new light something that was going on there, namely, that:

[7] Lonergan adds in a wonderful footnote: "Because insight is into the presentations of sense or the representations of imagination, the third step in the solution of such problems is facilitated by drawing a diagram and marking all relevant quantities. In the present instance the equation becomes evident on inspection when one has marked the three distances, x, x/12, and 15."

> *Mathematics for Lonergan is not being characterized fundamentally as a matter of a logical structure. Mathematics is being characterized as fundamentally dynamic intelligence! He is suggesting that mathematics is about being a learner, about inquiry! Mathematics gets its heart and soul, so to speak, from the fact that mathematicians are trying to figure out stuff they don't know*! And that that is profoundly similar of course to what scientists do. Now, for a variety of reasons, in much of western philosophy, in much of western civilization, both mathematics and science have been characterized as logical and deductive. *Part of the reason for that is that logic and deduction are fairly controlled phenomena, in which you've got your premises, and you've got your rules of inference, and there is a tight set of operations that you can make, and you can't step outside of that*! *Discovery, what people sometimes call induction, is very uncontrollable! There's something unpredictable and creative about inquiry, about going from what you know towards the unknown, towards something new, but not using logic to do it*!

And so Lonergan is going to suggest that in place of logic is heuristics! Heuristics is anticipations, and *methodical anticipation is how you structure what you do know about, so as to make the occurrence of an insight more likely! But you never guarantee it*!

So what scientific methods are about really are dealing with the unknown, just as math is. So it's an interesting characterization of mathematics, not as logical but as heuristic, as being about the search for the unknown. … And that's about all I intend to say about that.

§2. Classical Heuristic Structures

A radical retrieval of origins:

"**In every empirical inquiry there are knowns and unknowns. But the knowns are apprehended whether or not one understands: they are the data of sense. The unknowns, on the other hand, are what one will grasp by insight and formulate in conceptions and suppositions.**" (CWL 3, pp. 60-61).

So are there any questions that people have on section one? … … Okay. I think we'll take a break here. And after the break come back and look at what he's doing in section two on the classical heuristic method!

Insight & Beyond: Lecture 4, Part 2:

"Classical Heuristic Structure"

"Inferences from Classical Laws"

Ch 2 §§2&3

Summary of Material

§2. Classical Heuristic Structures.

Lonergan returns to origins of modern science to examine it through lens of self-appropriating insight.

Knowns and unknowns in math and science.

Seeking the unknown insight that links the data.

A Radical Retrieval of Origins. Galileo.

Various re-interpretations of Galileo; "Martyr for Reason," etc.

Lonergan's inquiry into the kind of insights Galileo sought.

Prior to discovering laws of free fall, Galileo anticipated the fact that they have a definite nature.

Law *versus* Correlation.

Class discussion of what a 'law of nature' implies.

Juridical connotations of human law: restriction, universality, imposition, violable.

A law of nature seems to control and dominate behaviour of entities in world.

Something primary (e.g., force), everything else secondary.

For Lonergan, laws are insights that grasp correlations, or reciprocal relations.

Correlation: how things are reciprocally related to one another.

Removes distinction between primary/secondary (independent/dependent) variables.

Galileo's search for correlations, namely, the undetermined function 'f', to be determined.

'f' as a function which relates other variables.

'f' as standing for any function, analogous to the 'x' in algebra.

The continual expansion of kinds of functions, i.e., ways that variables can be correlated. Progression from conic sections to polynomial functions to transcendental functions.

Examples of correlations taken from physics: e.g.,

$F - ma = 0$, $E - mc^2 = 0$, etc.

Lonergan rewrote laws so as to eliminate privileging any variable, stressing their interrelationships instead.

Galileo's complaints about lack of intellectual curiosity about projectile motion:

He shows that the projectile's curve is actually a parabola,

emphasizes the difference between descriptive and explanatory definitions,

intends the method for a new science.

Film of the trajectory of a basketball.

How do the different positions and different moments of the ball's path co-relate?

What single relation, or intelligibility, holds across all the points of data?

What whole, what function, co-relates all the parts of the ball's path of motion?

Neither the parabola, nor its formula, are visible in the moving ball.

Scientific understanding has to add the insight to the visible.

The Significance of Measurement.

Difficulties in measuring free-fall and parabolic motions.

Numbers alone do not make things objective; they are used to assist in expressing relationships.

Measurements correlate different events to each other by relating them all to a single, common standard.

How the anticipated correlation (or indeterminate function) made determinate.

(By measuring and tabulating, then arriving at the insight and expressing it in a general correlation or function.)

Scissors Metaphor for the Scientific Method/Classical Heuristic Method:

Lower blade moving from sense-data upward toward insights

Upper blade moving downward from general anticipations toward insights

§3. Concrete Inferences from Classical Laws [Correlations]

Early expectations that Newtonian physics could explain *everything*.

Lonergan claims there are not *two*, but *three* conditions of a concrete scientific inference:

Information on a concrete situation

Knowledge of laws

Insight into the situation.

Laplace acknowledged only two suppositions.

Laplace's very influential articulation of modern scientific determinism: given the locations of all the particles in the universe and their motions, one could express in one single formula the movements of every body in the universe.

Laplace leaves out the factor of insight into the given situation.

Expecting "a single formula" is unwarranted. One cannot assume a systematic process instead of a non-systematic process.

The consequences of the oversight of insights.

Actual application of general correlations to concrete cases has "tremendous implications for what the world is like."

Insight & Beyond:

Lecture 4, Part 2:

Insight Chapter 2.
"Heuristic Structures of Empirical Method"
30 September 2009

§2. Classical Heuristic Structures.
Lonergan returns to origins of modern science to
examine it through lens of self-appropriating insight.
Knowns and unknowns in math and science.
Seeking the unknown insight that links the data.

So let's start up again. Classical heuristic structure, I think, shows signs that Lonergan is going back to the origins of modern science with this lens of looking at it through the self-appropriation of insight. I think he is looking at it and saying,

"Where are insights happening? What kind of insights
are they? And what are the implications of this?"

And just as we saw a moment ago, in his emphasis on mathematics as having to do with inquiry and discovery and the search for the unknown, he's going to make the argument that that's also fundamental to modern science.

Now, what he is going to suggest — what he's going to propose here — is that in modern science, just as in algebra, there are knowns and unknowns. And the knowns in maths are, so to speak, the divisions of the problem that are set down, usually in the back of the book in the problem section. But in natural science, the unknowns are given to you by your senses. So you just find yourself in a world of a lot of sensations, what William James called a booming, buzzing confusion. And as really, really, little infants, there's a lot of just impressions that are disconnected.

When we talk about chapter five, about space and time, we'll talk a bit about the work that Jean Piaget did on discovering how children put together that diverse set of impressions to form really basic, really elementary notions about spatial objects, spatial relations, continuity, discontinuity, numbers, identities, and so on. But initially, the unknowns are the data [Pat seems to embrace totality by stretching his arms as wide as possible].

Now it's not all unknown to you, because you wouldn't have gotten into Boston College if you knew nothing about anything. We expect you to have some foundation to your education!!

[Subdued laughter]

But a scientist is always concerned with what data don't we understand yet! So there's always some knowns, and there are some unknowns. And what's known is the data, and what's unknown is what's it's all about actually! *So the unknowns are what we're looking for to have insights into*.

§2. Classical Heuristic Structures.

A radical retrieval of origins:

"**In every empirical inquiry there are knowns and unknowns. But the knowns are apprehended whether or not one understands: they are the data of sense. The unknowns, on the other hand, are what one will grasp by insight and formulate in conceptions and suppositions.**" (*CWL* 3, pp. 60-61).

A Radical Retrieval of Origins. Galileo.
Various re-interpretations of Galileo;
Martyr for Reason, etc.
Lonergan's inquiry into the kind of insights Galileo sought.
Prior to discovering laws of free fall, Galileo anticipated the fact that they have a definite nature.

Now I said that Lonergan went back to the origins of science. He goes back to Galileo. Arguably, he could have gone back a little bit earlier than this, but Galileo is certainly one of the two or three seminal sources of modern scientific thought. But what exactly did Galileo do?

A wonderful book that I recommend to you is a book entitled *Galileo's Daughter* by Dava Sobel.[8] Galileo had actually three illegitimate children, two daughters and a son, and because of the culture of the times, the two daughters were unmarriageable, and he managed to get them into a convent. And he corresponded with one of them. I forget her original name; Marie Celeste is her religious name. And the letters that she wrote to her father are preserved. The ones that he wrote to her are not preserved. But Dava Sobel is a very, very good historian of science, and she has woven this really wonderful account of Galileo, his life and his times, and where his relationship with his daughter is situated. So that she [Sobel] takes each one of these letters and then spins the context out of it. It's really a wonderful thing, and there's an awful lot of excellent history, and insights into Galileo and his achievements, and so on.

But shortly after Galileo's death, the magnitude of Galileo, the greatness of Galileo, was interpreted and reinterpreted and reinterpreted! And there's a wonderful essay by a man named Michael Segre, called "The Image of Galileo,"[9] in which he recounts several of the

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[8] Dava Sobel, *Galileo's Daughter: A Drama of Science, Faith and Love* (London: Fourth Estate, 1999).

[9] I have only been able to find Michael Segre, *In the Wake of Galileo* (New Brunswick, N.J.: Rutgers University Press, 1993). This book contains a chapter entitled "Galileo's Image through the Ages", which may or may not be what Pat is recalling here.

reinterpretations of Galileo. The first interpretation was that he was the reincarnation of Michelangelo, because he was born in the same year that Michelangelo died, and the great Italian figure, the great spirit, passed from Michelangelo into Galileo! And then interpretation took on other versions, including the one that comes down to us, the "Martyr of Reason." And reason in this case means being logical, and paying attention to the data of experience. This interpretation is that really what Galileo did was that he was the founder of *empirical* science, and not metaphysical speculation. Segre does a really wonderful job of showing how ideological that particular interpretation is, especially given the historical research that has been done on Galileo in the last fifty years!

But nevertheless, that's the image that we have of Galileo: that what he did was that he discovered things by looking through a telescope, and people would not look through the telescope and pay attention to the empirical data, that they preferred their speculative ideas. This has almost nothing to do with history! It's good *story*, but it's not *history*!

And so what Lonergan was doing, like many other very good philosophers, especially say Edmund Husserl, is to go back to: *What was Galileo doing*? But what's unique — what's distinctive between Husserl and Lonergan is that Lonergan is coming back and asking: *What were the kinds of insights that Galileo was concerned with*?

§2. Classical Heuristic Structures.

A radical retrieval of origins:

"**For what is to be known by understanding these data is called their *nature*. … Once Galileo discovered his law, he knew that the nature of a free fall was a constant acceleration. But before he discovered the law, from the mere fact that he inquired, he knew that a free fall possessed a nature, though he did not know what that nature was.** (*CWL* 3, p. 61).

And — So as Lonergan begins, the very beginning of section two of chapter two, he starts this reflection about how Galileo anticipated something! He had a certain kind of anticipation! He was doing a seeking! He had data on free fall, but he was seeking an unknown. And I've underscored the word 'law' in the above passage. "**Once Galileo discovered his law, he knew that the nature of a free fall was a constant acceleration. But before he discovered the law**," he inquired! "**He knew that a free fall possessed a nature, though he did not know what that nature was."** (*CWL* 3, p. 61). *So the kind of knowing that he had about free fall having a nature was the kind of knowing that comes from inquiring and anticipating*!

And this is something I asked you to think about in terms of the reflection questions that I circulated at the end of last week!

§2. Classical Heuristic Structures.

A radical retrieval of origins:

"**Galileo's determination of the law of falling bodies not only is a model of scientific procedure … Galileo supposed that some correlation was to be found between the measurable aspects of falling bodies.**" (*CWL* 3, pp. 57-58).

"Galileo's determination of the law of falling bodies not only is a model of scientific procedure …" (*CWL* 3, p. 57). *So notice what he's doing! He's looking back to the great beginner of modern science, and asking: How did he proceed? How did he operate*? And he again draws attention to the fact that Galileo's scientific procedure was permeated and directed by anticipation! **"Galileo supposed that some correlation was to be found between the measurable aspects of falling bodies.** (*CWL* 3, p. 58).

Law *versus* Correlation.

Class discussion of what a 'law of nature' implies.

Juridical connotations of human law: restriction, universality, imposition, violable.

A law of nature seems to control and dominate behaviour of entities in world.

Something primary (e.g., force), everything else secondary.

For Lonergan, laws are insights that grasp correlations, or reciprocal relations.

Now, as I indicated in the questions that I circulated for your reflection, and by my underscoring here, I have drawn your attention to two words, *law* and *correlation*. We speak overwhelmingly of the "Laws of science" and the "Laws of nature!" And Lonergan does too. But *notice that he's done something significant here: he's equated law and correlation*.

Now we need to think about what exactly is the significance of this, of Lonergan doing that, in a moment. But let's stay with that image of law that comes to us with such a long heritage. What comes to your minds — this was in the reflection questions — what comes to your minds, what are the associations that you have when you hear of a law of science or a law of nature? What does that imply? … Stephanie?

Stephanie: Consistency and permanence.

Pat: Consistency and permanence. Okay. Anything else? What else? ... Sean?

Sean: Universality.

Pat: Universality. Okay. … Akim?

Akim: Verifiability.

Pat: Verifiability. Okay. Mary?

Mary: I was thinking of verifiability and I think I was going to say infallibility! ...

Pat: Infallibility?

Mary: Yeah. Like you can't disagree with it.

Pat: Okay. Anything else? … Okay.

Okay! *It's a juridical metaphor*! I mentioned that in the reflection questions, including everything people have said! That's part and parcel of the connotations that come to us with the word 'law'.

What are the juridical connotations of the word 'law'? *Law is not always universal in the juridical sense*! We make a big deal of it in the United States. *We talk about no person being above the law. And so we have a certain notion of universality that's implicit in that: the equality of all human beings*! But certainly in pre-democratic times that wasn't part and parcel of law. *There were different laws for different states of life, for different states and different classes of the civilization. Laws applied differently for different people! So universality has not always been part of the notion of law as juridical. It was a matter of human jurisprudence*!

So what are some of the connotations that come with that juridical sense, with rules? … Greg?

Greg: It's something imposed on something!

Pat: Okay. Good. *So it's something imposed on something. Right*! Very good! What else? Anything else … Mike?

Mike: Some kind of restriction. Maybe that means the same.

Pat: *Restricting. Yes*. We have laws because if you don't have laws, people will do all kinds of wicked things. *So we have to restrict people's behaviours*. Anything else? *Imposed. Restriction*. … Geoff?

Geoff: It's breakable. So you can break it!

Pat: Good! Very good! *So human laws are breakable! And by way of contrast, natural laws are not! So that's a significant difference: that in human reality, we have laws, they're imposed, they're restrictive, but we know human beings can break them.*

And then there are sanctions for the breaking of the laws! And Galileo actually uses this metaphor in one of his writings, about the way in which *the laws are perfectly followed by nature. That there aren't any violations*! … Natalie?

Natalie: It's usually a response to a sort of inadequacy, or a fear of —

Pat: — Okay, good! *So it's created, it brings something as a response to something inadequate*. Ah, I'm putting words in Natalie's mouth now, but *it brings something under control that has gotten out of hand*. Is that a fair characterization?

Natalie: Yes.

Pat: Okay.

Correlation: how things are reciprocally related to one another.

Removes distinction between primary/secondary (independent/dependent) variables.

Galileo's search for correlations, namely, the undetermined function '***f***', to be determined.

'***f***' as a function which relates other variables.

'***f***' as standing for any function, analogous to the '***x***' in algebra.

The continual expansion of kinds of functions, i.e., ways that variables can be correlated. Progression from conic sections to polynomial functions to transcendental functions.

Pat: Okay. Those are also associations that come along with law. *So to speak of a law of nature is to speak of the things that control and dominate the behaviour of entities in the world*.

Now something that's significant about that juridical sense of law is that there is something that is primary and other things that are secondary. The law — or what happens with Newton in particular, force — is primary and everything else is determined by the law or the force.

> *And so we've got universality, we've got necessity, we've got permanence, we've got that it is imposed, that it is restrictive, that it comes as a corrective, that in the human order people violate it and then they are punished, and in the natural world there is perfect conformity with law and behaviour, and so on.*

Anything else? Anything else to add to that? …

Okay! Perhaps that's enough for the moment, but I want to bring those things to the fore, to say that *Lonergan — even though he still uses the word 'law', and I wish that he had shifted almost exclusively over to correlation — is saying that we're not talking about laws, we're talking about insights. We're talking about insights that grasp correlations! Etymologically, correlation is co-relation. It's how things are reciprocally related to one another. It removes the priority of one thing over another! Strictly speaking in a correlation, there are no independent variables versus dependent variables*. That is another big thing that comes along with modern science and with modern mathematics, the difference between independent and dependent variables. *But strictly speaking, all the variables are just related to one another by means of the co-relatedness that they have*.

§2. Classical Heuristic Structures.

A radical retrieval of origins:

"**Hence the empirical inquirer, to emphasize this fact, will say that his objective is not merely the 'nature of ...' but more precisely the unspecified correlation to be specified, the undetermined function to be determined**." (*CWL* 3, p. 62).

So you've got *variables* and *relations*!

And what Lonergan is saying here is that Galileo was interested in discovering co-relatedness! So empirical inquirers in the tradition coming out of Galileo are concerned to emphasize that the nature of — they can talk about 'the nature of …', but "**more precisely the unspecified correlation to be specified, the undetermined function to be determined**." (*CWL* 3, p. 62).

Okay. So first of all, that first phrase: Remember in *Insight*, Lonergan says initially we talk about 'the nature of …' by using the sense data that we're going to be seeking the nature of. So we will say, for example, the nature of fire, or the nature of heat.

And we *can* say, What's the nature of heat? The nature of heat is to heat things! What's the nature of light? The nature of light is to brighten things! What is the nature of free fall? The nature of free fall is to fall down! Does this start to sound a little bit circular?

Students: Uh, uh!

Pat: It is! Because what you're doing is: *you're saying what I will understand is what I understand when I will understand it*!

And in some ways, you can say that the attitude that the early thinkers of modern science, and the early thinkers in the Enlightenment period, they became *very annoyed with philosophers in the peripatetic Aristotelian tradition who didn't answer questions, but answered questions with another question*! Why do things fall down? It's their nature to fall down! Why does fire cook? It's its nature to cook! That would drive a curious person crazy! And we're going to see, in a moment, Galileo complaining precisely about that.

Now, what Lonergan is saying is that *what's missing, what's being sought — that's not being answered by staying within the loop of merely heuristic anticipation — is the correlation.* And that Galileo put the ball-game of *seeking and finding correlations on the tracks of modern western civilization*.

§2. Classical Heuristic Structures.

A radical retrieval of origins:

"**Hence the empirical inquirer, to emphasize this fact, will say that his objective is not merely the 'nature of ...' but more precisely the unspecified correlation to be specified, the undetermined function to be determined.**" (*CWL* 3, p. 62).

"**Where before we said, 'Let x be the required number,' now we say, 'Let the equation *f(x, y, z, t) = 0* be the required correlation.**" (*CWL* 3, p. 63).

"Where before we said, 'Let x be the required number,'" (*CWL* 3, p. 63) — So remember he's making the analogy here between an insight in mathematics, in algebra, and now he's going to be talking about what classical heuristic structure in the sciences is seeking. He says: "**Now we say, 'Let the equation *f(x, y, z, t) = 0* be the required correlation."** (*CWL* 3, p. 63). What's ***f*?**

Students: Function.

Pat: What function is it? … Taylor?

Taylor: It's a way those variables relate?

Pat: Exactly! Exactly! And what way do they relate? …

Taylor: That would depend on the function.

Pat: That's right! That's right! So what I'm trying to do — What Lonergan is drawing attention to here is that the letter ***f*** here is just like 'x'. When you start out an algebraic equation, you don't know what the x is. So x is just standing there. Some number eventually will be the number that you are seeking, but for the moment I'm just going to call it x.

This present way of proceeding actually originated with a lawyer, a French lawyer, by the name of François Viète (1540-1603), who came up with the idea of modern algebra from the idea of a class action lawsuit. And when you file a class action suit, you say that the litigant is any person who happened to be living in town x when the toxic oil spill came down in June 2001, and *all of their successors*. Now who are those people? Well, we'll have to go and find out who they are. But you've talked about them as though — in the language of algebra so to speak! And what Viète did was: *he took it from his law practice and he put it into mathematics*. So when we say, "Let x be the number," we don't know what number it is, but we know some things about it. It's like the residents of the town when the toxic waste spill took place. We know some things about them. And similarly we can start to work out some things about what falls into the x.

f *isn't like that. It could be any function at all, so long as it is something that correlates x, y, z, and t, which are variables*. Now usually those stand for the distance that something is in front of me (x), to the right of me (y) above me (z) [Pat extends his arm in appropriate gestures for each of these]; x, y, z, and then t is the time, the time it happens. So we are looking for a function that correlates, as Lonergan will say, some measurable dimensions of movements, of changes, of things that happen in the world.

But what we're looking for is ***f***!

Now, in the history of mathematics, there's a very interesting development that happens very rapidly over a period of about 150 years: there's a huge expansion of the kinds of things that could be ***f***s. When Galileo does his work, not in the book that got him into trouble, but in what's a truly lasting contribution to the history of physics, the *Two New Sciences*, *the functions that he had available to him were the conic sections. So circles, ellipses, parabolas, hyperbolas and straight lines*. That's pretty much the whole range of ***f***s that he had available to think about. He did a lot with that — made some mistakes doing it — but he did a lot with that. Within a few short years, Descartes has invented the whole realm of *polynomial functions*: so all the functions that can be expressed by y is equal to x to a power. And shortly after Descartes, his successors, and especially Newton, develop a whole field of functions that we now call *transcendental functions*: things like logarithms and exponentials and trigonometric functions. And into the nineteenth century, this whole field of possible ways in which variables can be correlated with one another keeps expanding and expanding and expanding!

But when Galileo started out, he had a very small range of ***f***s to choose from. And so he had a fairly restricted heuristic set of structures that he used. And as the field of empirical science grew, the range of structures that could be used to make correlated the sensible experiences that one encountered grew rapidly as well.

§2. Classical Heuristic Structures.

A radical retrieval of origins:

"**Where before we said, 'Let x be the required number,' now we say, 'Let the equation**

$$f(x, y, z, t) = 0$$

be the required correlation." (*CWL* 3, p. 63).

$$d - \tfrac{1}{2} g t^2 = 0$$

$$F - m a = 0$$

$$E - m c^2 = 0$$

$$p V - n k T = 0$$

Examples of correlations taken from physics: e.g.,

$$F - ma = 0,$$

$$E - mc^2 = 0, \text{ etc.}$$

Lonergan rewrote laws so as to eliminate privileging any variable, stressing their interrelationships instead.

Now these [the added equations in the box above] are some examples of correlations, and some of you will be familiar with these. Most of them are fairly simple, elementary, what are called 'laws' of physics. But I've rewritten them deliberately to follow Lonergan's emphasis here. And I want to draw your attention to it.

So the first one is simply what is known as Galileo's law of falling bodies:

$$d - \tfrac{1}{2}\, g\, t^2 = 0$$

It says that the distance fallen minus one half g multiplied by the time squared that the body has fallen, will turn out to be zero.

The second one is Newton's law of force and acceleration:

$$F - m\, a = 0$$

It says that the force minus the mass times the acceleration is equal to zero.

The third one is Einstein's law of mass and energy:

$$E - m\, c^2 = 0$$

It says that energy minus the mass times the square of the speed of light is equal to zero.

And the final one is the ideal law of gases:

$$p\, V - n\, k\, T = 0$$

It says that the pressure times the volume minus the number of molecules times a constant times the temperature is equal to zero.[10]

And you don't usually see them written that way. You usually see them with the equals sign where I've got a minus sign, and no "equals to zero" on the other end. Why would Lonergan write it this way? Any guesses, based on what we've been saying so far? …

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[10] The **ideal gas law** is the equation of state of a hypothetical ideal gas. It is a good approximation to the behavior of many gases under many conditions, although it has several limitations. It was first stated by Émile Clapeyron in 1834 as a combination of Boyle's law and Charles's law. It can also be derived from kinetic theory as was achieved (apparently independently) by August Krönig in 1856 and Rudolf Clausius in 1857.

The state of an amount of gas is determined by its pressure, volume, and temperature. The modern form of the equation is:

PV = NkT

where P is the absolute pressure of the gas; V is the volume; N is the number of particles in the gas; k is Boltzmann's constant relating temperature and energy; and T is the absolute temperature.

In SI units, P is measured in pascals; V in cubic metres; N is a dimensionless number; and T in kelvin. k has the value $1.38 \cdot 10^{-23}$ J K^{-1} in SI units.

Pat: Yes, Mary?

Mary: So you could see the variables in terms of each other!

Pat: Exactly! It doesn't give privilege to any one of them, right? Normally the — You know, the great equation of the Enlightenment, you could say, is F = ma. When you write it or think of it in that fashion, what it's saying is that the forces are determining how the bodies are moving. It privileges force, and makes the masses be the immediate subjects of the force. And you can do that with any one of these things. You can say what is the dominant thing, and what is the subordinate thing, acting according to the laws that are thus supplied by — usually by the item on the left-hand-side of the equation.

But *what Lonergan is doing here is pointing out that what Galileo put in motion is not dominance and subjection, but co-relatedness*! And if you write the equations in the way I've just done, which is a perfectly legitimate way to do it, it emphasizes that!

Galileo's complaints about lack of intellectual
curiosity about projectile motion:
He shows that the projectile's curve is actually a
parabola,
emphasizes the difference between descriptive and
explanatory definitions,
intends the method for a new science.

Now here's Galileo, in the *Two New Sciences*, at the beginning of the — I think this is the beginning of the Third Day in the dialogue, complaining about the state of the investigation of motions that he had inherited — because it goes on with some complaining that takes place before this, and some complaining that takes place after it. But I just drew your attention to this:

Galileo Galilei

Founder of Modern Science

"It has been observed that missiles or projectiles trace out a line somehow curved, *but no one has brought out that this is a parabola*. That it is, and other things neither few nor less worthy of being known will be demonstrated by me, and (what is in my opinion more worthwhile) there will be opened up a gateway and a road to a large and excellent science."

Galileo, *Dialogue Concerning Two New Sciences*.

"It has been observed that missiles or projectiles trace out a line somehow curved, *but no one has brought out that this is a parabola*. That it is, and other things neither few nor less worthy of being known will be demonstrated by me, and (what is in my opinion more worthwhile) *there will be opened up a gateway and a road to a large and excellent science*." (Galileo, *Dialogue Concerning Two New Sciences*).

So, what is he saying there, in modern terms? If we're looking at this through the eyes of Lonergan, who is saying that *science is about finding insights, and the insights are about correlations*, what is Galileo saying here? … Matt?

Matt: He's building from the concrete to the theoretical, to find through the co-relatedness of laws to the concrete situations, such as a missile or a projectile.

Pat: Okay. In fact, he does do that. That is quite right. But here he is talking about something — The emphasis here is a shift, not so much from concrete to correlations! But what? … Mike?

Mike: He brings out the difference between the descriptive and the explanatory —

Pat: *Right! Right! "Somehow curved"! It looks curved to me! What curve is it? It's a parabola! Now notice he is not saying "looks like a parabola!" He's saying "It's a parabola, and I can demonstrate that it's a parabola! So I can give more — I can give an explanatory account*!" And how he does that is something that we'll talk a little bit about.

But notice also that he says "And *the pursuit that I'm opening up opens up a gateway*" — The Greek root of the word 'method' is *methodos*, which means *a path or a way*.[11] "I've opened up a path. I've opened up a method, a path, a gateway!" *If we follow the lead of asking, not how does it appear to me, but what is it in its co-relatedness, what function is it, then we've got a whole new kind of way of doing science in which many, many wonderful things can be demonstrated*. And he goes on in just page after page after page of showing all kinds of interesting things.

Film of the trajectory of a basketball.
How do the different positions and different moments of the ball's path co-relate?
What single relation, or intelligibility, holds across all the points of data?
What whole, what function, co-relates all the parts of the ball's path of motion?
Neither the parabola, nor its formula, are visible in the moving ball.
Scientific understanding has to add the insight to the visible.

Now, I have to hope this works!

[Slide of youths playing basketball]

[11] Greek *methodos* 'pursuit of knowledge', from *meta* (expressing development) + *hodos* 'way.'

This plays funny for some reason!

[Pat displays a sequence of slides showing the trajectory of the baseball on it's way from a player's hands to the basket]

There we go! It went all right! Okay. So that was a curved path, right? And I imagine that everybody in the room has seen a basketball following a curved path! What Galileo is going to say is that that path is a parabola.

Now very quickly, arguably already with Galileo, we're getting a distinction between the true account and the apparent account. When we get further on in Insight, we'll discover that that is not Lonergan's point of view.

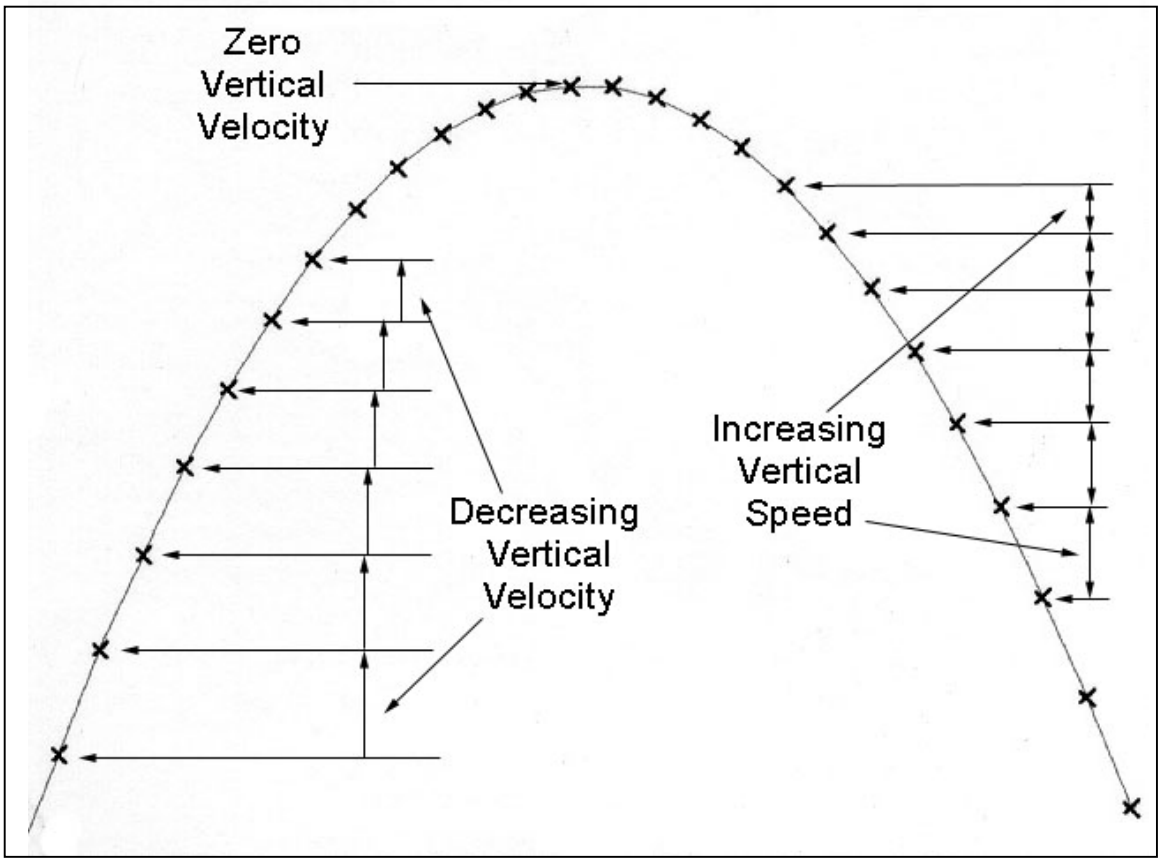
> *Lonergan is not going to draw the distinction between the true scientific account and the merely apparent, misled, ignorant, folk-psychology way of looking at things in which just ordinary people will be entrapped. He is going to say that there are different kinds of knowing, and that they have certain kinds of complementarities, so that common sense knowing is complementary to scientific knowing.*

But Galileo is asking, not what does it look like, but what do the moments in it correlate? Okay.

So what are the elements in this, the data? Notice that not all the data in this is present to you at the same time. We talked about the empirical residue the last time. You may be drawing in your imagination a single continuous line. That's actually not what you're seeing! *You're seeing different pieces of data of the ball being at different locations at different times*.

And what Galileo wants to know is: "*How are those positional locations related to the times, and to one another*?" So the ball is moving up [Pat gestures upwards]. It's moving horizontally [Pat gestures horizontally]. And it's moving through time! And *so Galileo is seeking the co-relatedness of what he calls the measurable aspects*. And so he's looking — He's observing data points, so to speak, here, here, here, here. And he is going to notice things, such as it gets slow at the top, and it gets slower as it's starting down. He's going to

want to know how much does the distance grow with time, as it moves from the top of the arc towards the bottom. *So he wants to know how are these successive distances related to the times at which those motions take place*. He's going to want to know how does this displacement relate to this displacement. [Pat is clearly picking out some of the point-dots on the display.]



Decreasing vertical velocity at start.
Zero vertical velocity at peak.
Increasing vertical speed at end

And so Galileo's going to be looking for the whole that relates all of these parts. So the line, the curve, represents for us the fact that *there is one and the same thing that they all partake of. Now the tricky thing is that they don't all partake of the line! What they partake of is the intelligibility of that correlation*. This is the image of a parabola that accompanies the intelligibility of 'parabolicness.' And the intelligibility of 'parabolicness' is that this is related to this as the square. So the square of this is related to this distance here. [Pat is using his pointer to indicate some parts of his diagram].

So

$$\mathbf{y = x^2}$$

is how we learned it in High School. It's not how Galileo understood it. Galileo didn't have algebra at his disposal. Descartes did! Galileo worked it all out in terms of the theory of proportions, which makes the relatedness much more evident. As we saw last week,

$$A : B :: C : D$$

makes the relatedness the central feature. And Galileo showed that given the data that he has investigated and a number of other considerations, that you had this co-relatedness of

$$A : B :: C^2 : D^2$$

and we now express that as

$$\mathbf{y = x^2}$$

You don't see $y = x^2$ anywhere! You don't even see $A : B :: C^2 : D^2$ anywhere! What you see is the data of the basket-ball. You see the line. You see the little lines that I've drawn alongside of it. *What you have to add to all of that is insight*!

What scientists do is what we just did. You observe things. You make some measurements. You graph the measurements. But you haven't —

The game is not over until the insight sings!

You have to add the insight to the data! And the kind of insight that's being sought is the insight of correlation, or correlatedness, or function.

The Significance of Measurement.
Difficulties in measuring free-fall and parabolic motions.
Numbers alone do not make things objective; they are used to assist in expressing relationships.
Measurements correlate different events to each other by relating them all to a single, common standard.

Now, what's the big deal about measurement? What does measurement have to do with science?

Significance of Measurement

Measurement is not just assigning a number

The way in which Galileo did his measurements is really interesting! If you didn't have a digital display like the one we just looked at [Pat's display of the trajectory of the basketball], you'd have a hard time measuring where the basketball — how high it was, what time it was that high, how far from the shooter it was, all that sort of thing! It would be a very difficult to do! It's a little bit like — I was talking about the count in Sesame Street trying to count the bats! We have to do some things to be able to perform the measurements. And one of the things that Galileo was first doing was not initially trying to measure parabolic curves that basketballs or cannonballs or anything follow. *He was just trying to measure falling bodies. It's very difficult to measure falling bodies — how fast they're moving, how long they are falling, and where they are. And Galileo figured out a really ingenious way to do this. He used ramps*! So instead of just dropping something straight down, he had these long ramps, and he put parchment on them to minimize the friction and so on, and he rolled things down them. And he could measure how far along the ramp they were, because they were moving relatively slowly. And he used a water-clock. He had a little kind of thermos, with a little spigot[12] on it, and he would open up the spigot and the water would drip out, and then he would turn it off when the ball got to the bottom of the ramp. And then he would weigh the water. And he would do it for various kinds of inclines, and so on. And that's how he came up with it! Because he knew that the water was running out the same amount whether it was going a short distance or a long distance. And so he did the equivalent graphic![13]

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[12] A device for controlling the flow of liquid in a tap.

[13] Although the story of Galileo, and the two cannonballs of different masses that he allegedly dropped from the top of the Leaning Tower of Pisa, is generally considered to be apocryphal, it seems that he did investigate the motion of falling bodies by slowing down the motion. To accomplish this, he says:

"A piece of wooden moulding or scantling, about 12 cubits long, half a cubit wide, and three finger-breadths thick, was taken; on its edge was cut a channel a little more than one finger in breadth; having made this groove very straight, smooth, and polished, and having lined it with parchment, also as smooth and polished as possible, we rolled along it a hard, smooth, and very round bronze ball."

What's the importance of measurement? The importance of measurement is not just putting numbers to it!

We live in a world — *And this is one of the most important things it seems to me about Lonergan's approach to the philosophy of science: it's going to demystify a lot of things for him — we live in a world in which it's taken for granted that if you've got numbers associated with it, it's objective! If it's got words associated with it, it's subjective! That's a lot of nonsense*! Because you can associate really bad numbers with just about anything, and there's nothing objective about it. Take — I was in a discussion when I was on the School Parents Council once, and I said: "That's not really hard data, is it? That's soft data that's masquerading as hard data!" And of course the person I said it to did not admit that that was the case!

[Laughter]

You'll be in the position to do that when you're on a School Parent Council!

[Laughter]

The fact that it's got numbers with it doesn't make it objective, because that's not what numbers are doing in modern science! *What numbers are doing in modern science it they are co-relating! They're involved in making the relationships*.

Significance of Measurement

Measurement is not just assigning a number:

Measurement is using one standard to relate numerous events to one another by means of a theoretical system.

His results: "*...in such experiments, repeated a full hundred times, we always found that* the **spaces traversed were to each other as the squares of the times**, *and this was true for all inclinations of the plane, i.e., of the channel, along which we rolled the ball."*

Technology for measuring time: "*...we employed a large vessel of water placed in an elevated position; to the bottom of this vessel was soldered a pipe of small diameter giving a thin jet of water which we collected in a small glass during the time of each descent... this with such accuracy that although the operation was repeated many, many times, there was no appreciable discrepancy in the results."* **Source**: Galileo Galilei, *Two New Sciences*, p. 178.

What do you do when you say something is twelve feet? What you're saying is: *that distance is related to the distance of a foot ruler as the number twelve is related to the number one. And once you've done that, once you've related one thing to the ruler, and another thing to the ruler, you are then in a position to correlate those two things to one another, by means of that*. There's nothing mystical or magical about numbers, but they are *the portal by means of which we learn how to relate certain things that are measurable*.

Importantly, not everything is measurable. Just as importantly, if your idea is that, if it's got a number associated with it it's objective, it seems to follow that if you can't associate a number with it, it doesn't exist, or isn't meaningful. Certainly, it's just merely subjective!

Now that's not true for Lonergan, because what he's interested in is *how our experiences are understood to be related to one another*. And *there are different kinds of ways in which things can be correlated; but not everything is correlated in any particular way*!

So that's again why that section on "**Concrete Inferences from Classical Laws**" is so important in the book *Insight*. *It's the place where the game of seeking functions, of seeking correlations, runs up against the limit,* and if there's a need to go beyond that limit.

And so, this [referring to the display copied below] is just where Lonergan talks about using a standard of measurement, and a system of correlating measurements to one another, for the sake of correlating things to one another.

> "**It would not be practical to relate things to one another by stating separately the relations of each to all the others. The procedure that is both simpler and more systematic is to select one type of thing or magnitude, to relate all others directly to it, and to leave to deductive inference the relations of the others among themselves**." (*CWL* 3, p. 189).

How the anticipated correlation (or indeterminate function) made determinate. (By measuring and tabulating, then arriving at the insight and expressing it in a general correlation or function.)

So we've already seen that what we're seeking in what he calls *classical heuristic method* is *the correlations of things to one another*. And as he goes on to say now: *how do we do that? What are the procedures? What are the structured set of recurrent operations that we use in order to come up with the insights — that give us insights into correlations*. And he mentions some of these things that we're all familiar with. But he has now put them in relationship to the insight into how things are related — seeking the insight into how things relate to one another: *measuring, tabulating measurements, reaching insight into the tabulated measurements, expressing them, graphing, and so on*.

Significance of Measurement

"**What is to be known inasmuch as data are understood is some correlation or function that states universally the relations of things not to our senses but to one another**." (*CWL* 3, p. 68).

"**Hence the** [classical] **scientific anticipation is of some unspecified correlation to be specified, some indeterminate function to be determined.**" (*CWL* 3, p. 68).

Significance of Measurement

"And now the task of specifying or determining is carried out by measuring, by tabulating measurements, by reaching an insight into the tabulated measurements, and by expressing that insight through some general correlation or function that, if verified, will define a limit on which converge the relations between all subsequent appropriate measurements." (CWL 3, p. 68).

Scissors Metaphor for the Scientific Method

Classical Heuristic Method:

Lower blade moving from sense-data upward toward insights

Upper blade moving downward from general anticipations toward insights

Now look at later — This is not in the section that you have read for today, but it will come later on in the semester.

Scissors metaphor

"**The heuristic structures of empirical method operate in a scissors-like fashion. Not only is there a lower blade that rises from data through measurements and curve-fitting to formulate, but there is also an upper blade that moves downward from differential and operator equations and from postulates of invariance and equivalence."** (*CWL* 3, p. 337).

He uses this metaphor, which is a really helpful metaphor about how he understands heuristic methods. He says that a scientific method is like a pair of scissors. There is a lower blade that begins with sensations and data, and that rises with graphing and curve-fitting, and so on. But there is also an upper blade that moves downward, from things he talks about there: differential equations, operator equations, invariance and equivalence.

So the metaphor with regard to the classical method is this: that the scissors can move both from above downward and from below upward. From below upwards, you begin with your sense experiences, the data, pure data, raw data, just as you observe it. But very quickly, it becomes clear to us — something we'll talk about next week — that *data isn't just raw, unstructured — that you are attentive and selective with regard to that data. And that you describe and classify the data! And you perform measurements with regard to the data that you selectively take in and classify. And you make tables and graphs*!

Classical Heuristic Method:

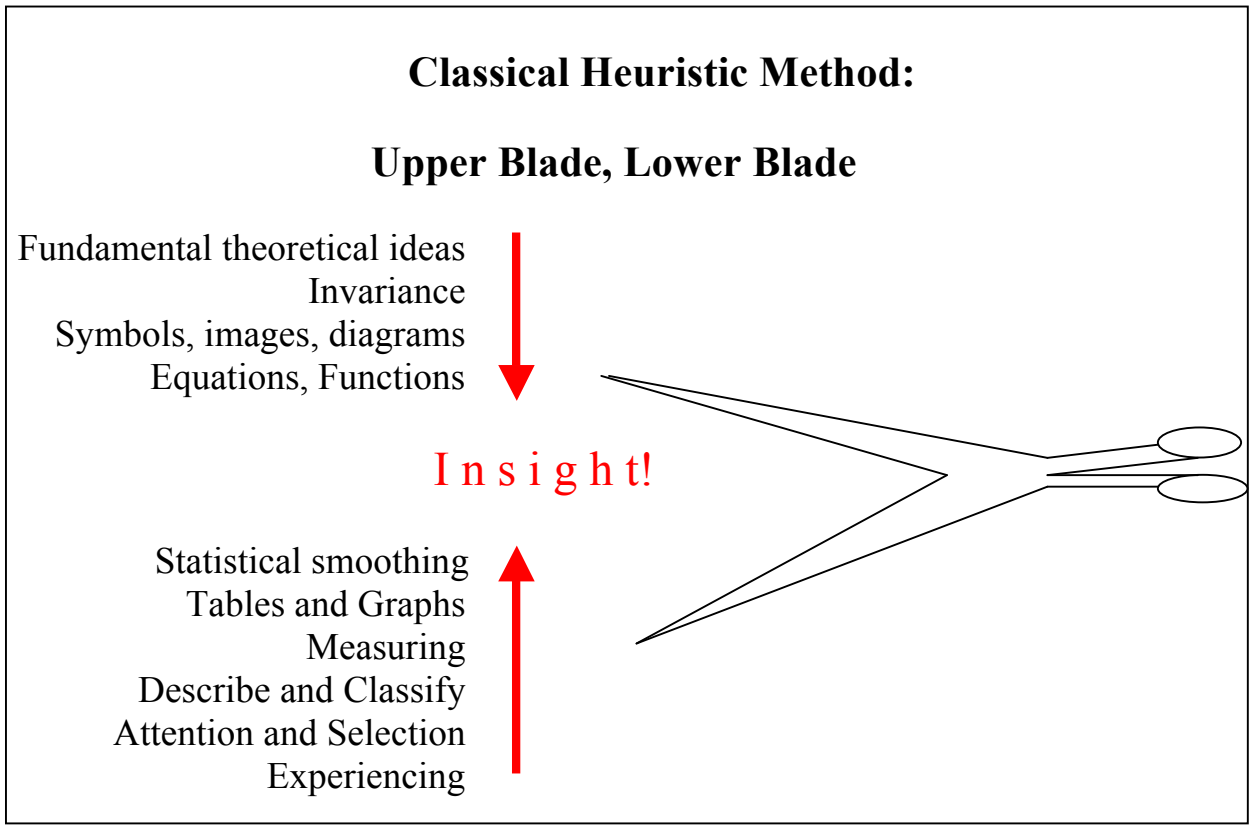
Upper Blade, Lower Blade

Statistical smoothing
Tables and Graphs
Measuring
Describe and Classify
Attention and Selection
Experiencing

So notice what's happened! You've gone from sense experiences as you experience them, and you've added a lot of imagination along with language and thought in the process! *You're fiddling with the phantasm, you're fiddling with the images and with the data. And as you do that, you might need to use some statistical methods to smooth out the data*.

And so you're moving towards an insight. You're trying to get an insight. Is it a parabola? Is it a hyperbola? Is it a part of an ellipse? Is it a cubic function? Is it a sine wave? Is it a logarithmic function?

And you begin also with very fundamental ideas about the ways in which things can be correlated. The development of mathematics in the nineteenth and twentieth centuries was overwhelmingly a development discovering all kinds of different ways in which correlations can be found. *And, as Lonergan says, you use things like principles of invariance*. We will talk about that in the context of chapter five, when we're talking about space and time.



And you use *symbols and images and diagrams* as you try to figure out what are the likely correlations that seem to fit the sorts of things that you've come across as the lower blade of the scissors is moving upward. And you form some functions and equations, *some likely functions and equations*. And finally, you get the *insight*!

> *And so classical heuristic method moves from below upwards in these ways, disposing the images, by doing things like tabulating and forming graphs. And it moves from above downwards by knowing enough about the vast world of what's known about the ways in which things can be correlated, what kinds of functions there are. And you start to sift out the vast range of the ones that are most likely to be relevant to the kinds of data that you're dealing with. And then you get the insight into the correlations*!

§3. Concrete Inferences from Classical Laws

[Correlations]

Early expectations that Newtonian physics could explain *everything*.

Lonergan claims there are not *two*, but *three* conditions of a concrete scientific inference:

Information on a concrete situation

Knowledge of laws

Insight into the situation.

Okay! We're just going to start briefly talking about "**Concrete Inferences from Classical Laws**", and then we're going to leave the discussion of Statistical Method until next week. But I will ask you to read chapter three for next week! We will do Statistical Heuristic Method, and chapter three on "**The Canons of Empirical Method**" for next week.

So Lonergan gets to the end and he gives us a sort of hint, which we saw actually at the beginning of the class today. He says that *there is something about the suppositions and the expectations and the hubris of the kind of science that began with Galileo and comes up to the middle of the nineteenth century. It has certain kinds of expectations! One of the expectations that becomes increasingly prominent is that you can explain everything*!

Everything can be explained by Newtonian physics! And then at the end of the nineteenth century and the beginning of the twentieth century, that train runs into a brick wall!

And so Lonergan's way of saying what the brick wall had to do with is what he calls "**concrete inferences from classical laws.**" And *I suspect that he uses the word 'laws' just with respect to correlations there just to remind us of the importance of the difference between our ordinary associations with regard to law, and what Lonergan is getting at in his way of characterizing what modern science is about*.

He says that a concrete scientific inference has not two but three conditions: (1) it supposes information on some concrete situation; (2) it supposes knowledge of laws; and (3) it supposes an insight into the given situation.

§3 Concrete Inferences from Classical Laws (Correlations)

"Hence a concrete scientific inference has not two but three conditions:

(1) it supposes information on some concrete situation;

(2) it supposes knowledge of laws; and

(3) it supposes an insight into the given situation." (*CWL* 3, p. 70).

Where does "not two" come from?

Where does the "not two" come from? … Lonergan says it has three, not two suppositions! Who said "inferring from"? … In other words, if Newtonian physics can explain everything that means if you infer from Newton's general laws, you can infer how *everything is going to be ordered*. Right? That's the hubris of modern Newtonian science. Who said "two"?

Laplace acknowledged only two suppositions.

Laplace's very influential articulation of modern scientific determinism: given the locations of all the particles in the universe and their motions, one could express in one single formula the movements of every body in the universe.

Laplace leaves out the factor of insight into the given situation.

Expecting "a single formula" is unwarranted. One cannot assume a systematic process instead of a non-systematic process.

Pierre-Simon Marquis de Laplace

(1749 – 1827)

"We may regard the present state of the universe as the effect of its past and the cause of its future.

"An intellect which at a certain moment would know all forces that set nature in motion, and all positions of all items of which nature is composed, if this intellect were also vast enough to submit these data to analysis,

"it would embrace in a single formula the movements of the greatest bodies of the universe and those of the tiniest atom; for such an intellect nothing would be uncertain and the future just like the past would be present before its eyes."

Who said "Two?" *Pierre-Simon Marquis de Laplace*,[14] who gives *the modern and very very powerful articulation of scientific determinism*. And this is a quote from — I've got one sentence! *It's one single passage! I just broke it up to make it that bit more readable*! And so Laplace, at the very beginning of his philosophical essay concerning probability, says this:

[14] **Pierre-Simon, marquis de Laplace** (1749 – 1827) was a French mathematician and astronomer whose work was pivotal to the development of mathematical astronomy and statistics. He summarized and extended the work of his predecessors in his five volume *Mécanique Céleste*. This work translated the geometric study of classical mechanics to one based on calculus, opening up a broader range of problems. In statistics, the so-called Bayesian interpretation of probability was mainly developed by Laplace.

> "We may regard the present state of the universe as the effect of its past and the cause of its future. An intellect which at a certain moment would know all forces that set nature in motion, and all positions of all items of which nature is composed, if this intellect were also vast enough to submit these data to analysis, it would embrace in a single formula the movements of the greatest bodies of the universe and those of the tiniest atom; for such an intellect nothing would be uncertain and the future just like the past would be present before its eyes."[15]

Now, let's pause for a moment. Let me, without fishing around for an answer, just suggest that *there is considerable resonance between this and Weber's statement*! [See box on p. 27 above]. Laplace is characterizing not just Newtonian physics but in fact the physics that he himself — the physical methods, the scientific methods that he himself has made a very, very important series of contributions to, that made it all the more powerful in terms of being able to solve problems.

And *he's making a very powerful claim here* in this passage: *that in virtue of knowing all the "forces that set nature in motion" — And so that would correspond to all the laws as Laplace and his contemporaries would think of — Knowing the laws of science means knowing all the forces — "and all positions of all items of which nature is composed" and their states of motion — If you know those* ***two things*** [(i) all the laws and (ii) all the positions and motions]*, then the whole universe is completely determined, from the largest galactic clusters down to the tiniest micro subatomic particles! Everything is determined. Everything has to happen the way it does because of the conditions of its preceding conditions. That means a disenchanted world of — That means a world in which there is nothing mysterious. Everything is laid out to anyone that has sufficient time and sufficient intellectual capacity to perform these calculations! Everything is determined! There is no novelty! There is no fun! There is no free will! Everything is all the same*!

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[15] Truscott, F. W. & Emory, F. L. (trans.) (2007) [1902]. *A Philosophical Essay on Probabilities*, translated from the French, 6th ed. (1840).

Now Laplace, of course, takes a great delight in this, partly I think because of this tradition of interpretation of modern science that we talked about before. But he himself is also a very important contributor to it, because *he really lays down the position that Newtonian physics is going to be deterministic. There is a deterministic world in which there is nothing emergent, there is nothing novel, there is nothing creative, and there is nothing free*!

§3 Concrete Inferences from Classical Laws (Correlations)

"**Hence a concrete scientific inference has not two but three conditions:**

(1) it supposes information on some concrete situation;

(2) it supposes knowledge of laws; and

(3) it supposes an insight into the given situation." (*CWL* 3, p. 70).

What is missing from Laplace?

So what were the two things in Laplace that Lonergan lists? *Information on some concrete situation*. So remember he says that you have to know the locations of the particles and you have to know their motions. Secondly, you have to have *knowledge of the laws, knowledge of the forces. What's missing in Laplace? Insight into the given situation*!

I want to draw attention to something else here! Laplace says something which is unwarranted. It's warranted insofar as sometimes they were successful in doing this. It's unwarranted in the sense that it doesn't follow from even his suppositions! Namely, that "it would embrace *in a single formula* the movements of the greatest bodies of the universe and those of the tiniest atom." *In a single formula*!

Pierre-Simon Marquis de Laplace

"We may regard the present state of the universe as the effect of its past and the cause of its future.

"An intellect which at a certain moment would know all forces that set nature in motion, and all positions of all items of which nature is composed, if this intellect were also vast enough to submit these data to analysis,

"it would embrace in a single formula the movements of the greatest bodies of the universe and those of the tiniest atom; for such an intellect nothing would be uncertain and the future just like the past would be present before its eyes."

In a single formula! That's terribly important! That is the difference — to anticipate — *That is the difference between a systematic process and a nonsystematic process*. Remember Lonergan is going to say that *you can construct a nonsystematic process based on knowledge of all the laws — all the laws, or preferably the correlations — and knowledge of all the concrete situ — knowledge of all the data and parameters about the situation*. And you can still construct a nonsystematic process. What's the difference?

The consequences of the oversight of insights. Actual application of general correlations to concrete cases has "tremendous implications for what the world is like."

In a systematic process everything falls into a nice recurrent pattern in which you have in which you have relatively few insights! Now, one of the things I loved about physics was that I didn't have to remember any details! There were just a few formulas, and I could deduce everything from them [happy smile]!

However, you can't deduce the natural world from them! *But that was the expectation*!

This is a very significant element in what Lonergan means by *the oversight of insight*. *Here the oversight of insight is the expectation that everything will fall into a single formula*! And doing this phenomenological intentionality analysis of the insights that have been overlooked — *what goes on when scientists actually do the work of applying general correlations to concrete cases — has tremendous implications for what the world is like*!

And with that we'll just sort of stop here for today, and we'll pick that up. So I would ask you to — I know people want to talk about nonsystematic and systematic and issues around that. We will talk about that next week! But I would ask you to once again to review section three and section four of chapter two, and then the new chapter three for next week. Thank you very much! Thank you!