Insight & Beyond

Class 6, Part 1: October 14th 2009

Non-Systematic Processes, Co-Incidental Manifolds and Statistical Methods; Canons of Empirical Method

Summary of Material

Introductory remarks.

- The Objective of Statistical Methods.
- Lonergan's seeming conflation of two different objects: coincidental aggregates (populations) and nonsystematic processes. What is the relation between these two?
- Members of a coincidental aggregate happen to be together in space and time while not being ordered by a single intelligible principle.
- *A kind* of unity (spatio-temporal), but not an *intelligible* unity.
- Example of a crowd in a park.
- Compare to a systematic process: ordered by a single principle.
- Compare to a *non-systematic process*: a *process*, a series of events in time that *exhibits* coincidental aggregates.

- *Both* systematic and nonsystematic processes can be constructed using only classical laws (without statistics).
- Certain additional, concrete insights are assumed in creating such models.
- Rule for Constructing a Non-Systematic Process: begin with a situation in which specified conditions of intelligibility are not fulfilled.
- Randomness for Lonergan is a *relative* term (i.e. random in relation to a certain kind of intelligible pattern or order).
- The proper meaning of [*relative*] randomness in neo-Darwinian evolution.
- Example: coincidental aggregates & nonsystematic processes: Gas Molecules.

– In the static state, the coincidental aggregate of molecules is all in one spatial region (unified by space) but lacks a corresponding intelligible unity.

Set in motion, a non-systematic process is a series of events unfolding in the same region of space and time.

– The motion of *each* molecule is in accord with the same set of classical correlations (i.e., the “laws” of conservation of momentum and energy) as every other molecule, but the spatio-temporal series of *all* the events lacks a corresponding intelligible unity.

- Student question about the apparent patterns evident in the slower and faster molecules.

– Discussion of the probability at work (Maxwell-Boltzmann distribution and temperature/speed correlation). The *kind* of pattern is the intelligibility of *probability*, not the intelligibility of a systematic process. Also of the ideal frequency versus the nonsystematic variations with respect to the curve.

- Example of nonsystematic process from biology: predator and prey model.

- Student question: Although Lonergan is arguing against a *hard* determinism, there still seems to be an element of determinism insofar as classical laws of one level set the parameters for the next level, and exclude what is impossible.

– Classical laws by themselves tell us what can happen, but not what does happen. Classical laws remarkably open to variations.

– That each individual event in a population is subject to classical correlations does not imply that the whole aggregate of events conforms to a *systematic* unity.

– Discussion of higher emergences and higher integrations, including human freedom, which arise from nonsystematic processes.

- Student question: How does Lonergan define a process? How to know when one can tell whether an observed process is systematic or not?

– Definitions of process, systematic process, and nonsystematic process, and the statistical parameters that are used to identify systematic vs. random influences.

- Example of coincidental manifold and systematic process drawn from computer animation: Battle scene from *Lord of the Rings*.

- Relevance of nonsystematic processes to Lonergan's overall metaphysics; implications of restoring the open-ended character of science. "Hope depends on probabilities, not necessities."

- Student question about whether a systematic process can coordinate several nonsystematic ones.

– Discussion of the emergence of higher integrations, and how the processes it supervenes upon must be nonsystematic.

- Mendel's Statistics of Peas.

- Intelligibility of nonsystematic processes expressed in probabilities.

- Nonsystematic Divergences: Nonsystematic deviations from the ideal frequency.

- Example from astronomy: Hubble’s Law of galactic expansion in the universe.
- Example from meteorology: variation of actual temperatures from the average.
- Classical laws powerless to predict nonsystematic variations from the ideal.
- Scissors metaphor used to describe the methods of seeking probability insights.
- Need for upper-blade theoretical knowledge of kinds of distribution patterns.
- **Introduction to Chapter 3.**
- The Six Canons of Empirical Method
- §1. The Canon of Selection – the canon of making science empirical.
- Demonstration using an optical illusion.
- We *structure* experience. Images shift.
- How insight even influences sensible data.
- Student question about verifying insights immediately, and conversely, over time.

– What confirms an insight is not empirical contact, as the positivists would claim, but the asking and answering process.

• Additional example demonstrating the effect of prior insights upon our subsequent ways of seeing.

• Student question about certain types of anticipation interfering with observation.

– Discussion of the impossibility of pure ("empty headed") observation, and the resulting need for a sophisticated and tutored (i.e., informed by insight) form of observation.

•Intellectual Patterning of Observation. *"Selective Alertness"*.

•Example of recognizing rings around Saturn.

• Student question about a hypothetical person unable to see a given pattern.

– Discussion of how various observation skills are influenced by one's context and community of inquiry.

• Lonergan complexifies what it means to do *empirical* science.

• However complicated and mediated the data, there remains empirical givenness.

• Lonergan as rigorously empirical, more so than empiricism itself.

• Data of Sensation and Data of Consciousness.

- §2. Second Canon: Canon of Operations
- What is the point to experimentation?
- Not only verification of hypotheses, but more so the objective of experimentation is the growth of understanding – insight added to insight.
- Exemplifies the self-correcting aspect of the scientific method.
- Experiments lead to transformed experience that leads to new questions.
- §§3 & 4. Canons of Parsimony & Relevance
- Stresses the immanent intelligibility of sense data, relations of things to each other.
- Science not about efficient or material causes. About formal causes in a new, sophisticated sense. Explanatory, not experiential, conjugates.
- §5. Canon of Complete Explanation:

  No exemptions for space and time,

  No primary vs. secondary qualities,

  No independent variables.

End of Part I.

Class 6, Part 1: October 14th 2009

Chapter 2, § 4 and 3 § 1-5

Non-Systematic Processes, Co-Incidental Manifolds and Statistical Methods; Canons of Empirical Method

Insight,

Chapter 3: "**Canons of Empirical Method**"

Introductory remarks.

So we're going to cover a lot of material today. I'm going to actually finish up a couple of loose ends *from chapter two on statistical method*; we ended a little bit before I got to kind of the grand finale there! And also I'm going to hit *the highlights of chapter three*. There's a lot of technical material there. I'm going to focus mainly on his discussion of *the canon of statistical residues*, which when you just look at the bulk of pages in that chapter, the overwhelming majority of pages are devoted to that! So that would be the thing that he thinks is most important. But there are *a few other highlights that I want to touch upon*. And *perhaps you have some questions* that came out of the reflection or guiding questions that I sent off. And then we'll take a break. And when we come back we'll talk about the Emergent Probability; we'll take a while on the theme of Emergent Probability.

- The Objective of Statistical Methods.
- Lonergan's seeming conflation of two different objects: coincidental aggregates (populations) and nonsystematic processes. What is the relation between these two?
    - Members of a coincidental aggregate happen to be together in space and time while not being ordered by a single intelligible principle.
    - *A kind* of unity (spatio-temporal), but not an *intelligible* unity.
    - Example of a crowd in a park.
- Compare to a systematic process: ordered by a single principle.
- Compare to a *non-systematic process*: a *process*, a series of events in time that *exhibits* coincidental aggregates.

Object of Statistical Methods?

"Statistical inquiry is concerned with coincidental aggregates of events." (*CWL* 3, p. 79).

"In other words, statistical inquiry is concerned with nonsystematic process." (*CWL* 3, p. 79).

What is the relationship between:
populations (co-incidental aggregates)
and non-systematic processes?

Okay! So what exactly is the objective of statistical scientific methods from Lonergan's point of view? I just want to point out that he says *two things that are not exactly identical*. The first thing he says is that "**statistical inquiry is concerned with coincidental aggregates of events.**" (*CWL* 3, p. 79). And then he says: "**In other words, statistical inquiry is concerned with nonsystematic process.**" (*CWL* 3, p. 79). Those are not defined in exactly the same way by Lonergan himself! So what's this business about "**In other words**"? *What is the relationship between co-incidental aggregates and non-systematic processes*?

And I tried to make the argument last time that where Lonergan introduces this very technical term '**coincidental aggregate,**" that the more common term used, particularly in the field of statistics, is populations. It's the study of populations.

Co-incidental Aggregates

"For an aggregate is coincidental if

(1) The members of the aggregate have some unity based on spatial juxtaposition or temporal succession or both, and

(2) there is no corresponding unity of the level of insight and intelligible relation." (*CWL* 3, p. 73).

And recall that Lonergan says that a coincidental aggregate consists of the members that have some unity based on spatial juxtaposition, or temporal succession, or both. So now, I'm going to give you a couple of more concrete illustrations of it in a moment that hopefully will clarify that a little bit. But

> *what that means is that a population is in some place at some time, for some period of time, and that the members of that population, the members of that aggregation, are all just coinciding — they all happen to be in the coinciding place, the coinciding time. But there is not a*

coinciding intelligibility. There is not one unified intelligibility of the sort that Laplace thought held true of our universe. There isn't one explanation for all those different things all happening to be here and now. That's what a coincidental aggregate is! Now, in *a systematic process* you have one intelligible connection among the events and their successions. In a *co-incidental aggregate, they all have a kind of unity, they are all together. But they don't have an intelligible unity. They're not all together for the same reason*.

A real simple example of a coincidental aggregate is: just go down to the Haymarket Square, or the Boston Common. There's an aggregation in the same place at the same time of a lot of people, including some pigeons, and geese, and rats, and things like that. *They're not all there for the same reason*. Some came to meet somebody, some came to go shopping, some are just out for a walk, some needed to buy a refill for their pen; and there's a million different reasons — well, as many people as there are! Or, take out couples: there are five hundred thousand —

[Subdued laughter]

— *There are many different reasons for people being there at the same time! There's not just one reason. That makes it a coincidental aggregate*!

• *Both* systematic and nonsystematic processes can be constructed using only classical laws (without statistics).

• Certain additional, concrete insights are assumed in creating such models.

• Rule for Constructing a Non-Systematic Process: begin with a situation in which specified conditions of intelligibility are not fulfilled.

• Randomness for Lonergan is a *relative* term (i.e. random in relation to a certain kind of intelligible pattern or order).

• The proper meaning of [*relative*] randomness in neo-Darwinian evolution.

But by contrast, notice what Lonergan says about a non-systematic process! *First of all, it's a process! It's not just stuff being in the same place and at the same time, but it's a process. That means that it's a series of events that moves through time. And as he says, the non-systematic process exhibits coincidental aggregates! It's not exactly the same thing*! So I want to tease out a little bit what the difference is, and *why he ends up sort of being able to say that statistics is both about a coincidental aggregate and about a nonsystematic process*.

Non-Systematic Process

(1) no single insight, or single set of unified insights, that masters at once the whole process and all its events.

(2) no single combination of selected laws that holds for the whole process.

(3) may be deducible in all its events.

(4) exhibits coincidental aggregates. (See *CWL* 3, pp. 72-73).

And this is a little remark that he makes. So remember how he got into this discussion, a discussion of — *He's going to back into what kind of a heuristic structure a statistical heuristic structure is*. But he backs into it by saying how much can you do with just classical laws. And it turns out that you can do a great deal! *Importantly, Lonergan argues, you can with sufficient ingenuity and time, you can construct out of combinations —*

intelligently combined combinations of classical laws, classical correlations, you can construct a systematic process, but you can also construct a non-systematic process! You don't need statistics to be able to conceive of a non-systematic process.

Co-incidental Aggregates

"Finally, there emerges the rule for constructing nonsystematic processes. For a situation is 'random' if it is 'any whatever provided specified conditions of intelligibility are not fulfilled.' … Therefore, the rule for constructing nonsystematic processes is to begin from any random basic situation." (*CWL* 3, p. 74).

But what you do need, he says, is to not neglect — not to have an oversight of the kinds of insights that physicists, chemists, biologists, and so on — and economists also perhaps especially as well — tend to not notice when they're working out theoretical models. People who work out theoretical models, generally speaking, bring to bear these — *application* — these concrete insights that have certain kinds of simplifications and symmetries built into them. *But there's nothing necessary that classical laws dictate that they can only be combined in a system, in unified, harmonious, simplified, systematic ways. They can also be combined in non-systematic ways*.

And he says, so how — *what's a way of thinking about a non-systematic process*? *The rule for constructing a non-systematic process is to begin with a situation where specified conditions of intelligibility are not fulfilled*. Now that's a very general — that's the sort of thing you do in a kind of a "Principles of Mathematics" course. It covers a lot of different things. But, for example, *assume that the series of points of the moving body do not fall upon an ellipse*! That violates a certain expectation of intelligibility — elliptical intelligibility, *anything but that*! Now that actually covers a lot of things. It covers a lot of things that are fairly — that have a lot of symmetry to them, *but they are just not elliptical* *intelligibility*! And you can go along and say: "Suppose it doesn't have *this* kind of intelligibility! Suppose it doesn't have *that* kind of intelligibility! That's all he means!

> *'Random' for Lonergan is a relative term! Random is always: does not follow whatever category or class or list of kinds of intelligibilities you happen to specify. Then anything else, any other process, any other collection, is going to have elements that are random relative to that ordering*!

There's a physicist called Stephen Bauer in America[1] and he makes a similar point where he says: 'random' doesn't mean "have any cause!" *Random means doesn't have a certain kind of order*!

Now you might be able to — we might be able to talk about "absolutely random," but it's difficult even to conceive what that might be! And *for the most part, physicists and mathematicians, and chemists and biologists, deal with random relative to a certain pattern of a certain kind*.

It's jumping ahead a little bit, but I'm sure most of you know the phrase, associated with the Neo-Darwinian Synthesis, of "random mutations," or that Darwinian evolution is not directed. Well, it turns out it's a relative — that's a statement about a relative non-teleology, or a relative randomness. What most Darwinians in the Darwinian research programme — what most of them have in mind is that there isn't anything either

(a) in the environment that induces mutations in such a way as to accelerate evolution; or

(b) there isn't anything in the behavior of an organism in its environment, as it interacts with its environment, that it then passes on to its progeny so as to accelerate evolution.

So those are the two things they usually mean! *That isn't a denial of* any *kind of directedness, and it's not an assertion of* every *kind of randomness*. Now, so behind those terms — you know, one of the things that Lonergan gives is it gives us some tools to think about some of these difficult questions in much more refined and subtle ways!

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[1] Pat may be referring to Stephen J. Bauer, who wrote a work entitled *The Evolutioning of Creation: An Alternative View of Modern Cosmology.* Xlibris Corp, 2004. A second volume with a similar title was published from the same publisher in 2011.

And this is one of the places where he gives it. So he says: "**Therefore, the rule for constructing nonsystematic processes is to begin from any random basic situation**" (*CWL* 3, p. 74), or if you like, to begin from a co-incidental manifold.

• Example: coincidental aggregates & nonsystematic processes: Gas Molecules.
– In the static state, the coincidental aggregate of molecules is all in one spatial region (unified by space) but lacks a corresponding intelligible unity.
Set in motion, a non-systematic process is a series of events unfolding in the same region of space and time.
– The motion of *each* molecule is in accord with the same set of classical correlations (i.e., the "laws" of conservation of momentum and energy) as every other molecule, but the spatio-temporal series of *all* the events lacks a corresponding intelligible unity.

• Student question about the apparent patterns evident in the slower and faster molecules.
– Discussion of the probability at work (Maxwell-Boltzmann distribution and temperature/speed correlation). The *kind* of pattern is the intelligibility of *probability*, not the intelligibility of a systematic process. Also of the ideal frequency versus the nonsystematic variations with respect to the curve.

All right! [Pat turns to his on-line PowerPoint computer]. Let's see if I can get this to work though! So I am going to give you an example, hopefully, that will begin to help you to get some connections between what he means by a "co-incidental manifold," what he means by a "non-systematic process," and what perhaps he might mean by constructing a nonsystematic process by beginning with a random basic situation, or if you like, a coincidental manifold.

Co-incidental Manifold &

Systematic Process:

Gas Molecules

http://www.falstad.com/gas/

Now let me see if this if this actually works! … Now, this is on! This is a simulation that I found on line for an ideal gas. And in this simulation, the different colors — the molecules, think of the molecules as all being the same kind of molecule — but their colors represent their kinetic energy, or in this case, pretty much equivalent to their velocity. And the blue ones will be slower, and the red ones will be a little bit faster, and the white ones will be the fastest, if I've got this right! This one I selected because it allows me to slow the simulation speed down to zero. All right!

What you are looking at is a co-incidental manifold! *There's a bunch of molecules. They are all in the same space*, this little container here, *at the same time*, the time you are looking at it, *and for the moment, they are all stopped. And so that's an aggregate! They have a spatio-temporal unity, but they don't have any intelligible unity*. Now you don't know that, so we're just going to assume that they are! It does say up here [Pat picks out the labeling at the top right-hand of the display with his pointer]: "Setup: 1 Gas, Random Speeds."

[Some knowing laughter]

So we'll take that at face value! It's very difficult to actually humanly make something random. There are a number of ways in which you surreptitiously introduce certain kinds of symmetry and order even by doing that!! "Well, you know, there's too many on this side; I'll put another one over there!" That's already pre-ordering in a sense. But for the moment, let's assume that they've figured out a way to get something that roughly approximates to a certain minimum of randomness here anyway! *So they are all distributed*!

So we start with a basic situation that's a co-incidental manifold, or if you like a random situation. So that's a co-incidental manifold! But we're going to do something now. And one of the things we're going to do is actually to let them move: which means each one of them is going to have a motion in a certain direction. Each one is going to have a momentum, and an energy! *And the classical correlations that matter in this case are the classical correlations that have to do with the conservation of energy, and the conservation of momentum*. When they bump into each other, they interact with each other according to those classical correlations. And they will change their directions and speeds as a result.

So now I'm just going to move them just a little bit, so as you can see a little bit of what's happening here. Now, you'll notice some of them will change colour: that means they either got faster or slower. When they have those collisions they change directions.

Now you're looking at a non-systematic process. You're looking at a series of events that are taking place, unfolding in time, all in accord with one and the same set of classical correlations! They're the events of a non-systematic process that began from the co-incidental manifold, or the basic random situation. Okay?

Any questions about that? … Deb?

Deb: So you say there is not an intelligibility to be known. But when we look at it, you can see that there are more slower molecules than there are faster molecules, and there are some —

Pat: — Very good! Very good! And what's the name of that intelligibility that *you* just identified? … Anybody? … *Probability*! *It's an ideal frequency*! And that shows up down here! [Pat points to bottom of the display]. This is really — this is jumping ahead a little bit, and we'll see another version of this in a moment. But do you see this line right here? [Pat may be pointing to the curve at the bottom right-hand side of the display]. That's called Maxwell's Gas Law — this law of gases which is called the *Maxwell-Boltzman*

Distribution Law.[2] I can't remember which gas goes in there! But Maxwell made this very important discovery about *the correlation of the probability of the distribution of how fast the molecules were moving with its temperature*. I'll show you that in a second. And notice that this doesn't change. [Pat may be pointing to the temperature level, or perhaps to the curve at the bottom of the display]. But notice there are non-systematic variations with regard to that curve.

Now last week we saw just very, very simple examples of probabilities. We saw that when Mendel leapt — had this insight that from the actual frequencies that he had, he could leap to the ideal frequency of one to three, or as we would say, twenty-five percent to seventy-five percent, or a quarter to three quarters. *That's the ideal frequency from which the actual frequencies of his pea-counts vary non-systematically*.

Here [in Pat's downloaded display] you can actually see that this is not just a single number — like twenty-five percent — that *actually* occur. *So there is a probability curve in this case around which these molecules are varying non-systematically*. The fourth scale on the right side controls the temperature.

Pat slides back and forth the temperature scale on the right of his downloaded display

So you can see how the curve is moving as I change the temperature! That means the probabilities are moving. This is actually starting to flatten out more as we get more fast molecules out here. But I guess it takes a while for it to heat up. … There you go! You can see what happens as we change the temperature. That was Maxwell's big discovery. Okay?

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[2] The **Maxwell–Boltzmann distribution** describes particle speeds in gases, where the particles do not constantly interact with each other but move freely between short collisions. It describes the probability of a particle's speed (the magnitude of its velocity vector) being near a given value as a function of the temperature of the system, the mass of the particle, and that speed value. This probability distribution is named after James Clerk Maxwell and Ludwig Boltzmann. The Maxwell–Boltzmann distribution is usually thought of as the distribution for molecular speeds, but it can also refer to the distribution for velocities, momenta, and magnitude of the momenta of the molecules, each of which will have a different probability distribution function, all of which are related.

• Example of nonsystematic process from biology: predator and prey model.

Co-incidental Manifold & Systematic Process: **Foxes & Rabbits**   http://www.youtube.com/watch?v=HoSzad12lfQ   Predator Prey Simulator

This is another one. Unfortunately, I couldn't find a simulation that I could actually stop and fool around with. So this one is actually a YouTube. *It's Predator and Prey! And the red things on here are rabbits, and the orange things back here are foxes*. And I can't stop it, to sort of say, watch this! So just keep your eyes open. You know, follow some orange things, and eventually you will see some of the red things they encounter just disappear! *So you can say something, you know, something real simple like the classical correlation that governs this pattern is that foxes eat rabbits*. Obviously that's not exactly a very sophisticated biological law!

[Murmur of amusement]

But I wanted to give you *a biological example as well*!

[Pat runs the downloaded display]

So maybe you could follow — Notice that one just disappeared! …

[Lively student reactions]

I think those are supposed to be reproductions of rabbits — those little white circles are supposed to be reproduced rabbits.

So again, this is a non-systematic process! It starts out with a random basic situation. Rabbits reproduce; they are born; they get eaten by foxes; the foxes run around — There's some barriers there that they can run behind. And so you get a kind of an —

So the population of animals in an environment is largely a non-systematic process, all governed, we might say, by the same set of classical correlations. And yet there isn't a single intelligible reason why that rabbit gets eaten and that one gets away! It all is a matter of where they started out, under what conditions did they start out, did the foxes see them, did they get distracted by another rabbit, did they manage to hide, and so on. Okay!

• Student question: Although Lonergan is arguing against a *hard* determinism, there still seems to be an element of determinism insofar as classical laws of one level set the parameters for the next level, and exclude what is impossible.

– Classical laws by themselves tell us what can happen, but not what does happen. Classical laws remarkably open to variations.

– That each individual event in a population is subject to classical correlations does not imply that the whole aggregate of events conforms to a *systematic* unity.

– Discussion of higher emergences and higher integrations, including human freedom, which arise from nonsystematic processes.

Any questions about that? … Mike?

Mike: I have a question about this, and about the molecules. I see how *Lonergan is rejecting a hard determinism*. But I still am struggling with the idea that *there is still an element of determinism insofar as physical laws still set the parameters for chemical laws, and chemical laws still set the parameters for biological laws; so that while classical laws may not tell us what might happen, they still tell us certain things about what can't happen*.

Pat: *Well, that's quite right! That's exactly what classical laws do tell us: what can or could happen! They tell us what's possible! But the laws themselves don't tell us what is*!

Mike: But they can tell us with certainty what can't be!

Pat: Aah — [Pat clearly pauses].

Mike: — Like we could never imagine a form of life that would emerge and conflict with the laws of physics!

Pat: Well, that's right!

Mike: Okay!

Pat: That's right! But the trick in saying that is we — and again this goes back to my comments earlier about the use of the juridical metaphor of law. It's true that biological entities — that the activities that take place between them and within them, within their bodies, all are in conformity with the classical correlations of physics! *But as Lonergan brings home with a special emphasis in chapter three, and again in chapter four, those classical correlations are terribly abstract and conditioned*! Now what he means by 'abstract' we'll have to go back and look at a little bit! So *yeah* ['yeah' pronounced in a manner that signals obvious reservations]: the classical correlations of physics, whatever they are — we don't understand them perfectly, but it isn't just what we understand them to be, *it's whatever they are — they are so open to variation, that to say that biological species can't evolve that would violate them, doesn't tell us very much*! *It does tell us something, that is true*! For example: that whatever ways in which the electromagnetic interactions within your nervous system — or any animal's nervous system — operate, can't be different than the way in which the laws of electromagnetism govern anything else that has negative or positive charges, *that's true*! *But that's a terribly open-ended thing*!! Just as Newton's laws of motion and gravitation open to lots and lots of different manifestations. *So it is true that you can say that, but it doesn't tell you very much*!

You did use the word 'imagine' —

Mike: Uh, uh!

Pat: My guess is that people would be thinking: "Well, you could never imagine a species that would do x!" Chances are we probably could! We probably could if we really got down and thought about some of the funny kind of conditions you could — that could be brought about!

Mike: No, I'm just thinking more in terms of: you have carbon based life, and it's possible to imagine helium based life, but that's because we know there's helium! But it's impossible to imagine certain life forms that would thrive on gases that we've not discovered, or gases that don't exist!

Pat: Well, gases that don't exist, true! But we don't know what those are!

Mike: Right! I'm just thinking: is it a heuristic to anticipate what something can't be?

Pat: Aah, yeah [concessive tone]. But it's not a very good or defined heuristic! … *And it is true that Lonergan is arguing the other point: that classical laws don't rule out non-systematic, don't rule out probabilities, don't rule out real genuine novelty of emergence. Those are all things that he is concerned with. That's true enough*!

There's another sense of 'determinism', which maybe we could come back to later on in this class or at another point. *There's a way in which to say that each and every event has very definite causes behind it, makes us think that that means that it's deterministic*! *It depends on what you mean by 'deterministic'*! *Now remember the crucial feature in Laplace is "in a single formula"*! *That's the one place that Lonergan and Laplace differ! And so Lonergan is willing to grant that the events of the universe are overwhelmingly in conformity with classical correlations*; *but that that doesn't rule out — or that that doesn't mean a single view in which one can kind of stand here and predict a hundred years down the road exactly what's going to happen. Because the complexities of the non-systematic make that impossible for human beings to — make it impossible, I would argue, make it impossible for any temporal being to know with complete accuracy what's going to happen in the future*!

The other thing that we're going to talk about a little bit later on today is emergence! *And so the notion that each and every, let's say, electron-event in our bodies, in this room, in the atmosphere, in the solar system, is in fact — can be understood in terms of some sequence of combinations of electro-magnetic correlations, does not mean that you can't have what he is going to call higher emergences, higher systems, higher integrations*! *And he's going to argue down the road that human consciousness, human intelligence, is one of those higher integrations! And it's that which makes for human freedom!* He will argue *that human* *freedom is completely compatible with electrons operating in accord with classical laws; that there is no violation of those two*. Now that's a kind of a complicated argument! It will take us — it takes a number of steps to come to it.

That's different — That's the kind of determinism he's arguing against: the determinism that says free will, human consciousness and human intelligence — that they're just illusory! That's the determinism he's arguing against, but he's going to do it in this other way! Okay!

• Student question: How does Lonergan define a process? How to know when one can tell whether an observed process is systematic or not?
– Definitions of process, systematic process, and nonsystematic process, and the statistical parameters that are used to identify systematic vs. random influences.

All right! Any other questions? … Kim?

Kim: How does Lonergan define a process? Does it have to have a set beginning and a set end? Or can we just say — Basically, does everything have to be systematic or non-systematic if randomness can be at some point in time [not very clear]?

Pat: Well, *a **process** is simply a series of events in time*! So you've got a set of events, and then at another time you've got another set of events. So that's a process! *A **systematic process*** is when all the events have some intelligible order, like some formula. You could stick in values for time: one second, five seconds, a hundred years, and using that one formula, that would give you — you would be able to see — you would be able to know with complete accuracy what it would look like at that later time. That would be a systematic process. A ***non-systematic process*** is also a series of events, just like those foxes and rabbits, or the gases! It's a series of events, but there's not one predictable — there's not one formula that enables you to predict these events as in a systematic process. Does it have to have a specific beginning and a specific end? Only in so far as — Let's say a scientist decides: "Okay, I'm going to start studying this process" — it might be the formation of the Grand Canyon — "I'm going to start studying this process going back to five hundred million years ago and then, from then to now!" So you've got a process that's five hundred million years long, and you're concerned to explore and identify and to grasp its intelligibility! Do processes have to begin at a specific time and end at a specific time? No! But investigations do! You have to sort of set a beginning point and an end point then.

Okay! Does that answer what you were asking?

Kim: Yeah, kind of! I guess what I was thinking about is if I were to observe something, how do I know when that process is systematic? When it repeats itself? Or — Like, if I were to do a science experiment, and I was observing, say gases, that's looks totally random to me! So how would I know when I could classify it as a systematic —

Pat: — Oh, I see what you mean! I see what you mean! Yes! *That's sort of a difficult question to answer! It is the sort of thing that statisticians are concerned with. They want to know, in terms of the kinds of things that you can measure, that you can observe, how do you determine whether or not it's a truly random collection, or not*! And they don't actually have to — You know, they've got some number of occasions that gives them a certain kind of reliability. They've got these things called p-formulas. And that depends on how many experiments they've done, and how many elements in the sample, how many samples they've taken, and that sort of thing! And so, the answer to that is not how long do you have to wait, but *it's actually an internal thing that has to do with what statistical methods actually do when they study events: can they figure out whether or not that collection of events is a truly random, truly non-systematic process, or if it has some systematicity to it*. Okay? So it's the kind of thing that you have to actually be a statistician to be able to answer. I don't know if that makes sense?!

I might be able — I'm going to try to come back and answer at least in part, with some of the illustrations I've got a little bit further down. Okay?!

• Example of coincidental manifold and systematic process drawn from computer animation: Battle scene from *Lord of the Rings*.

Okay. Any other questions? … All right! One more example of a non-systematic process! Some of you have seen "The Lord of the Rings"! You might have been naïve like me, and figured that they hired a bunch of extras to do some of these scenes with the Orcs. And so on!

[Some amusement in the class]

But it turns out — I have the DVD, so I watched the "Extra Features" at the end! It turns out that much of this was computer-animated, which I should have been smart enough to figure out, but anyway I didn't!

[Further amusement in class]

Co-incidental Manifold & Systematic Process: The Battle for Helms Deep

But they — what they actually did was to create these little Orc figures — little stick figures — and then they had ways of layering on different levels of enriched animation. But they gave them basic instructions, so those would correspond to classical correlations! They did more or less the same thing that the YouTube Video we just watched did with the foxes and the rabbits. So they gave the foxes and the rabbits certain instructions, and they set them going in certain directions. You know, one was, you know — I don't know if you saw it — the foxes tended to run in packs. There were usually two or three together, and then when you got close enough you ate a rabbit! And then they gave instructions to the rabbit as to how to behave! Well, they did the same thing with the Battle for Helms Deep! They gave the Orcs and the good guys — the people in the Fellowship of the Ring — they gave them instructions, and then they set the computer going! But they ran into a problem, because they discovered with the instructions they gave — you know, they sort of set them around in a ring — that when they set it going, they found that the Orcs would tend to run away!

[Much amusement in the class]

And so they had to re-programme — They had to come up with different classical correlations that govern the behavior of the Orcs so they wouldn't all run away in the battle!!

[Great amusement]

So that — I mean, that would be another example of how you do a non-systematic process by starting from a coincidental manifold, and using certain kinds of classical correlations; so that the sequence of successive events that take place is a non-systematic process!

And, you know, it's not irrelevant to Lonergan's ultimate metaphysical concerns that at any moment in that great saga of "The Lord of the Rings," things don't look so good for the Fellowship of the Ring, including at Helms Deep! They really looked like they're about to get wiped out!!

Relevance of nonsystematic processes to Lonergan's overall metaphysics; implications of restoring the open-ended character of science. "Hope depends on probabilities, not necessities."

So this kind of goes back to Mike's question a little bit: you know, *what's excluded by the laws of physics! Not much! Not much!* And the whole — You have to remember that Tolkein is writing this during the Second World War, when arguably one of the most evil forces in the history of human kind looks like it's got the upper hand! And in some very, very profound way, this is a story about hope! *And hope depends on probabilities, not on necessities*!

And Lonergan is, I think, just a genius, in saying what we have to do is to go back and re-understand what the natural sciences that came out of the modern period are about! Because *it's the extra-scientific opinions that have made them seem alien to things like, for example, hope, in a way that is really not determined by those laws themselves*. Lonergan in some very important ways is like Kant: "*What may I hope*?" But he has a different way of coming at an answer for that question than Kant does!

Student question about whether a systematic process can coordinate several nonsystematic ones. – Discussion of the emergence of higher integrations, and how the processes it supervenes upon must be nonsystematic.

Pat: Jonathan?

Jonathan: Would it — Is it conceivable that a supervening systematic process could coordinate a number of non-systematic processes?

Pat: Ahm, yes! But … When he talks about higher integrations, that's what he's talking about!

Jonathan: Okay!

Pat: But the crucial thing for Lonergan is that *higher integrations aren't built in from the beginning. They emerge on route*! And none of them is ever completely in control!

Jonathan: Wait a minute … wait please! I wanted to ask what do you mean by "they emerge on route, and none of them is completely in control"?

Pat: That's what emergent probability has to do with. But to give you a real simple example, you are the higher integration of your biological and chemical and physical entities. You are determining — not a hundred percent, but to a large extent — which muscles you're going to move! That is a higher integration. There is no violation of the biological or chemical or physical laws. But you have become a somewhat systematic in being able to organize the non-systematic processes that those are!

Crucial for Lonergan: if they weren't non-systematic, you wouldn't be able to add intelligibility to them. All the intelligibility that they could ever have would be determined from below! Right?

Jonathan: Great. Okay!

• Mendel's Statistics of Peas.

• Intelligibility of nonsystematic processes expressed in probabilities.

• Nonsystematic Divergences: Nonsystematic deviations from the ideal frequency.

• Example from astronomy: Hubble's Law of galactic expansion in the universe.

• Example from meteorology: variation of actual temperatures from the average.

• Classical laws powerless to predict nonsystematic variations from the ideal.

Statistics of Peas

All right. So we saw this last time. Mendel makes — adds the intelligibility that is different from the classical intelligibility. There's an important way in which, as Lonergan says, if you had enough time, if you had enough computer power, enough money, enough graduate students, and so on, you could trace the evolution of very complicated non-systematic processes, using only the classical laws (probably a reference to *CWL* p. 73)! If one is doing that, there's no new intelligibility, in the sense of no new kind of scientific intelligibility, no new kind of heuristic, being sought.

> *But there is a different kind of intelligibility that is proper to non-systematic processes, and that is called probabilities. And probabilities are these ideal frequencies from which non-systematic processes deviate only non-systematically*. We talked about this last week!

Statistics of Peas

Gregor Mendel, "Experiments in Plant Hybridization," 1865

Experiment	Relative Actual Frequencies
3	3.15 to 1
4	2.95 to 1
5	2.82 to 1
6	3.14 to 1
7	2.84 to 1

"If now the results of the whole of the experiments be brought together, there is found … an average ratio of 2.98 to 1, or 3 to 1."

`

Hubble's Law: Non-Systematic Divergences

This is another example, and I'm going to try to answer part of Katie's question by looking at this example. This is a graph of data points that are data points concerning Hubble's Law. Now Hubble, Edwin Hubble, was a great astrophysicist and astronomer. He's the one after whom the Hubble Telescope, that is orbiting the earth, is named after. *He made this very important discovery — He had an important insight which took him a long time and a lot of complex techniques to verify. His insight was that every stellar body in the* *universe is moving away from every other stellar body. It's a little easier to say that every galaxy in the universe is moving away from every other galaxy. Now the difficulty with that is: moving in what?*

[Slightly stunned contemplative silence!]

And it turns out that the "in-what" is what's moving! Space itself is what's moving! Space is expanding! So that everything in the universe is moving away from everything else! And to make matters worse, the farther away things are, the faster they are receding from each other.

Now that's a very strange idea. How he came up with this idea is a fascinating story! How he and Henrietta Swan figured out how to measure this idea was even more amazing! And I'll just give you part of the story. Henrietta Swan played a very important role in this.

One of the things that was a very strong argument against Galileo's advocacy of the Copernican hypothesis is that if the earth — if the Sun was really stationary and the earth really moved around the Sun, then it ought to be like — there ought to be an effect called parallax, which you can see a little right now. Close your left eye, and look at something like me, and then notice something behind me. I'm looking at Byron and I'm looking at Dirk behind him. Now open your left eye and close the right one! And you should see that there is a shift in the relative position between me and whatever you were looking at behind me. *That's called a parallax shift*! It's due to the fact that you are making the observations from two points that are separated in space! *Everybody, including Galileo, knew that that should happen with the stars! That if the earth was really rotating round the Sun, that the stars beyond — there ought to be a slight parallactic shift in the angle of observation from, let's say, the winter solstice to the summer solstice. But there was no such shift*! So that was a very — that was actually *the best* empirical evidence *against* the Copernican hypothesis! It was not until 1838 that astronomers had equipment sophisticated enough to measure the distance — the parallactic shift — to the very nearest star.

Now, so how did Hubble measure the velocities of galaxies hundreds of millions of light-years away? He just went through a whole series of: "Well, we know that this is this far, and then there is this phenomenon! We'll use that to make the next step, and we'll use that to make the next step, and so on!" And Henrietta Swan Leavitt was involved in measuring the periods of certain kinds of stars. They're called Cepheid variable stars. And she was able to figure out what kind of gases they would be composed of if they had certain periods of brightening and darkening. And then they could use something called the Doppler Effect to figure out how fast these were moving away. It's just amazing the brilliance of this!!

Well anyway, this [the graph diagram of Hubble's Law] is some of the data. These are galaxies that are very far away, and these are how fast they are moving away from the earth [Pat uses the pointer]. And these are closer, and so on! So notice that I think only two or three of the data points actually fall right on the line, dead square in the middle of the line. So that would seem to mean that Hubble was completely wrong: that Hubble's Law of the relationship between distance to the galaxies and how fast they are moving away from us is wrong! And there's hardly any data in support of that line!

What statistical investigators do is to look at the data stuff like that, and determine whether or not this is what they call "a good fit." For Lonergan that means that what they're doing is getting an insight into the probability: that this [Pat uses the pointer] *is the ideal frequency from which actual measurements vary non-systematically*. And they can vary for all kinds of reasons! They might vary because of an inaccuracy in the measurement, but they might also vary for very good physical reasons, that there are dust-clouds in the way, and there are other gravitational forces operating, and so on. And they do so in a patterning of a nonsystematic kind.

Weather 1993

Non-systematic Divergences

Here's another example. This right here [Pat uses his pointer] is the actual — I think it's the high temperature for the day. The top ones are the high temperatures for the day, in the city of Boston, day by day, in the year 1993. Why is it hotter one day and cooler the other? *Lonergan's answer to that is that our climate, our weather, is a non-systematic process*! If that little box that we saw of those molecules is a non-systematic process, multiply that by a complexity of the size of the atmosphere of the earth; that all kinds of currents and turbulences, and so on, change temperatures, change precipitations, and so on. And so you get a non-systematic process that leads from the temperature of one day to the temperature of the next day, to the temperature of the next day. But notice there's the average temperature, the probable temperature, for any given day, and that in this particular year, the actual high temperatures vary non-systematically relative to that!

And so what statisticians are doing is that they are looking for that other kind of intelligibility! Classical intelligibility, with enough knowledge of the concrete situation, the coincidental manifold, will be able to tell you, with all their computers and so on [this phrase is uncertain], what the variation in the temperatures is going to be in that year, knowing all the influences that are brought to bear, knowing all the laws that govern heat and gas and distribution and so on. *But the classical laws are not going to be able to tell you what is the mean expected temperature*! And if we had 1994, and 1995 or 2009, we would still have a random non-systematic variation of the actual values relative to the same average, the same probability!

So probabilities are not just fractions! Probabilities actually can be changing over time, in a cyclical pattern as they do, with regard to the weather pattern, or they can be —

[Pat displays again the Hubble's Law graph:]

— Probabilities can vary with distance; the further out you go, the higher the probability of recessional velocity. So they're not just numbers! We start with the counting! We start with getting the fractions! But then probabilities also can vary with place, with time, with other conditions and so on!

[Pat returns to "Weather 1993" diagram]

So just as classical laws are conditioned, probabilities are also conditioned! They're not absolutes either!

Scissors metaphor used to describe the methods of seeking probability insights.

Need for upper-blade theoretical knowledge of kinds of distribution patterns.

Method: Upper Blade, Lower Blade

Okay! And just to sort of bring our discussion of statistical method to a conclusion: just as we saw we can use that scissors metaphor to give us for classical heuristic structures the metaphor as to how do scientists guide themselves to grasp what they don't know when they start out to grasp these classical correlations, so also *statistical methods guide investigators towards an insight that's a grasp of the ideal frequency; using the actual frequencies to be guided towards an insight into the ideal frequency*.

There's a little thing in Chapter Three where Lonergan talks about verifying. *There is a difference between a method that helps you get the insight as to what the probability probably is, and then actually getting empirical evidence that that is the probability. So just the fact that you get an insight into a problem doesn't necessarily mean it's the correct answer*! *Just as using the classical method to get an insight as to what the classical correlation is, is not the end of the game. You have to still go on to do the hard work of trying to verify that*. Okay?

And so we talked about all these things [the processes on the left-hand side of the scissors diagram] last week.

Statistical investigations begin with empirical experiences, and then people start to do things to make the raw data from their experiences into a form that will help them to get the insight that's the probability insight. And likewise they'll use theoretical ideas to narrow down the indefinite range of possibilities of what kinds of probabilities they might be, and to narrow them down somewhat! And when *the scissors closes, that's where the probability insight comes! And then the hard work of determining whether or not you've got the right probability picks up*!

Lonergan refers to the fact that *among the things that start from the upper blade of the scissors are ideas having to do with types of distributions*. So what kinds of distributions, what kinds of populations, might we be dealing with?! And a lot of the mathematics of probability theory is an exploration of those possibilities. So for example, you are all familiar with the normal distribution, the so-called "Bell Curve." It's a different kind of distribution, the Laplace Distribution. Bell Curves are not the only kinds of ways in which coincidental aggregates and nonsystematic processes might be distributed.

Normal Distribution

Let me back up a little bit!

[Return to weather 1993 diagram]

If you had, say, twenty years of data here, around — I forget where this is, I think this is about January fifteen — around January the fifteenth, there would be an array of high and low temperatures, just right here, along here. *They would be distributed around that ideal frequency. But they might be distributed in a normal curve, or a cosine curve, a Laplace curve*. And you would need to have some knowledge of the different ways in which nonsystematic events can be arrayed around an ideal frequency in order to be able to close the scissors!

Okay! Let me stop there and see if people have questions. … This is just bringing Chapter Two to an end. … Now, from here Lonergan is going to go on to draw some big implications! … Okay!

Introduction to Chapter 3.

The Six Canons of Empirical Method

§1. The Canon of Selection – the canon of making science empirical.

Demonstration using an optical illusion.

We *structure* experience. Images shift.

How insight even influences sensible data.

I've briefly referred to the structure of this third Chapter, and how the bulk of the Chapter is really devoted to "**The Canon of Statistical Residues**."

Contents of Chapter Three

So I just want to touch on a couple of features here, and focus mainly, before we take our break, on the issues that he's raising with regard to the canon of statistical residues.

So the Canon of Selection. First of all, he's got six canons of empirical method. And he says that *what he's concerned with is to show the role of insight as underpinning the canons of empirical method*. 'Canon' is just another word for rule: the rules of empirical method. The only other person that I know of who speaks of "the canons of method" is Francis Bacon, and Lonergan's are not even close to the ones that Bacon uses. So Lonergan is presenting these six rules of empirical method as though everybody of course is totally familiar with them for years. But — I actually did a Google search earlier today, as I was preparing the class, wondering: does anybody else talk about the canons of empirical science, the canons of empirical method? And the only person I could find that wasn't just something that was a little bit peculiar was — There's something in one of Freud's writings, and then there is also something in Talcott Parson's writings about the canon of method for Sociology.

I've no idea why Lonergan presented this in this way. *He is, I think, faithfully paying attention to how scientists actually do their work: that they act as though they follow these rules; although I don't know of anybody who has formulated a set of canons of method, let alone his six*.

But he says that his objective here is to show the role of insight as underpinning, as explaining why these are the rules that are, let's say, implicitly followed by empirical investigators.

§1 Canon of Selection

And *the first on is the canon of selection. You could say it's the canon of making science empirical! It's that whatever insights you have, they are relevant to experience*. So what certainly is thought of as the story about modern science is that ancient science was merely speculative, but modern science is 'positive', as August Comte put it. That modern science is positive, meaning empirical! And so there ought to be — it ought to pertain to sense data. And that's the big difference — allegedly, which is not actually true — between Galileo and the advocates of the Ptolemaic System: that Galileo had empirical data that proved he was right, and his opponents were relying on the dogmatism of a scholastic philosophy. Historically that's not true, but it's part of what comes to us as the story about what makes modern science be modern, namely, that it's empirical!

And Lonergan says, "By the way, what do we mean by sensible data?" Now why is that an issue? …

What do you see?

What do you see? …. I'm sure some of you have seen this before, but perhaps some of you haven't. What do you see?

Student: A woman with a feathered hat.

Pat: A woman with a feathered hat. Yeah, there's the feather. … Does somebody see a couple of women?

[Pat uses his pointer]

Student: An old lady with a big nose!

Pat: An old lady with a big nose! ….

Deb (whispering): Ah, I see it!! [presumably seeing the old lady for the first time]

Pat (thrilled, almost shouts): *That was an insight*!!!

[Laughter]

Deb: I'd never seen that before!

Pat: I know! I know! And notice what happened! — That was — That was just — I couldn't have paid Deb enough to do that!!

[Happy laughter]

That was just — You know, as soon as somebody said something, about the big nose, and I did the pointer pointing out the big nose, the image shifted for Deb, and she had the insight of recognition — "I've recognized that as an old woman with a big nose. That's an insight! So you're all going to write about this for your insight paper!

[Laughter]

That's an insight. Whenever you hear the word 'recognition', it almost always means having an insight! It also sometimes means more than that! So it's one thing to recognize somebody, and it's another thing to recognize them as a person deserving dignity, for example, or deserving respect. But insight, plus something! So whenever there's recognition, there's insight at the very least, and probably plus something else! An insight, plus an evaluation, or something. But recognition always involves insight!

Now, the point here is this: *You all have your eyes open! You're all seeing, and yet now what you're seeing is being structured by your understanding*! Right? And that seems to be a problem! It is a problem for a certain understanding of modern empirical science! *If the guarantor of objective reality of modern empirical science is you just see what's there, and you don't imagine what's not there, then this particular phenomenon, that our understanding affects how we see things, raises a problem*!

Student question about verifying insights
immediately, and conversely, over time.
– What confirms an insight is not empirical contact,
as the positivists would claim, but the asking and
answering process.
Additional example demonstrating the effect of
prior insights upon our subsequent ways of seeing.

Jeff?

Jeff: Oh, I was going to ask one — like, if you have the insight and you're seeing it, then you can almost immediately verify it, because you like, right after you see it, you ask like, I guess, like we're talking about the question like, is it real? But it happens so fast like with this —

Pat: That's right!

Jeff: So how does that differ from like an insight when you have to work to verify it, in a sense?

Pat: Ah, you're jumping ahead a couple of chapters! But the quick answer is that the — How do I want to say this? — *What this particular example raises is: exactly what is the relationship between seeing and knowing, empirical data and scientific knowing*! *To a positivist, objectivity in knowing is seeing*! *This* [Pat gestures to the "what do you see? slide] *raises a problem, because we see differently when we understand differently! And so it seems to remove that immediate objective contact with reality, upon which a positivist evaluation of the importance of modern science rests*.

Later on we're going to see that Lonergan is going to
argue that it's not empirical contact that's the guarantor of
knowledge and objectivity. It's the asking and answering,
the self-correcting of questioning.

And he's going to say that when we make concrete judgments of fact, we always need to ask and answer at least one more question!

And most of our common sense insights, and this one you [Jeff] exactly got that just right! I mean, that really is self-appropriation that you just did! You noticed yourself having the insight, and recognizing that it was an act of insight. A lot of our judgments don't take a long time to come to verification, but some do! Ones in the scientific realm are useful because sometimes it can take people decades, of even centuries, to be able to verify insights that they've had or that their predecessors have had! Ah, the insight that there ought to be a parallax of the stars took almost two hundred years to be verified!

But not every insight requires that many further questions to be answered. So what you've noticed is that as soon as you got that insight, there weren't any further pertinent questions lining up [sound unclear] to be put. And so you knew not only that you had an insight, but that it was a correct one! But not every insight is like that! But that is something that we're going to come back to as we move on in the book. It's taken up primarily in chapter ten of *Insight*. Okay?

Any other questions? …

> All right. *So, if our insights are structuring our experiencing, then experiencing, although it plays an important role in modern science, it is not the trump card in modern science*! *It plays a role, but now it's role has been relativized. That's one of the things that Lonergan is doing here: that insight plays as much, and in fact now a more problematic role, even than does our experiencing.*

Second "What do you see? Diagram

Pat: What do you see?

Student: A saxophone player.

Pat: Okay. Does anybody not see a saxophone there?

Katie: I did.

Pat: Katie, what did you see?

Katie: A woman's face, like, in the shadows.

Pat: Okay. Okay. *Now the other thing I wanted to point out here is that you can't see both at the same time. Your visual experience will shift back and forth But notice you are now intelligently changing how you're seeing! So there's a role of insight in the way in which we actually see things.*

Student question about certain types of anticipation interfering with observation. – Discussion of the impossibility of pure ("empty headed") observation, and the resulting need for a sophisticated and tutored (i.e., informed by insight) form of observation.

Matt: This second image though, last time when I saw the old lady after you pointed it out, it was like much more startling, because this time I had like an anticipation that I would need to see more than one thing at a time! Is that what Lonergan refers to like, the anticipatory part of the intelligence? Like, this one wasn't as surprising!

Pat: Right. Right! Yeah, because you were sort of set up by the previous example, and so you were using your intelligence to anticipate what's Byrne going to pull this time! And so yeah, you brought intelligent anticipation not only of previous associations, but I wonder if there's a couple of different ways I can look at this, sure! *But again, what you're doing is you're intelligently structuring your experiencing*! … Chris?

Chris: What if you're being deceptive, and you decide instead of putting up another one of those pictures that are somewhat ambiguous, you put his other picture, and you're looking for that second form of intelligibility that you know is there. Granted there is no other insight to be had, I mean. But at the same time you think, well, how would Lonergan respond if you kind of need some sort of heuristic that we're after in a particular part of science or whatever you're investigating, and maybe there really isn't! Anyway, I'm not trying to be doubtful about it, but I'm just saying: there are often occasions where you're looking for intelligibility that really isn't there!

Pat: Ah, *if you're looking for a kind of intelligibility, and you don't find it, that's not proof that it's not there; it's only proof that you haven't found it*! But let me shift your question a little bit! I don't know if this is actually an answer to it. If it's not, let me know!

[Pat turns the attention of the class to an upper corner of the room, including the tiles of part of the ceiling.]

Pat: I wonder if I could ask everybody to look right here, into this corner! What do you see?

Student: A shadow?

Pat: How many of you saw a shadow? ….

Student: That's very interesting!!

[Laughter]

Pat: Do you see any shapes in that corner?

Student: A rectangle.

Pat: Do you see any shapes in the shadows?

Student: Well, it could be the probability of fleets forming a kind of botttom line of a shape [unclear].

Pat: Uh, uh! There's a little bit of a penumbra right there [Pat picks this out with his pointer], at least from where I'm standing. Does anybody see that? ….

Now, the point to me doing that is: you know, it's not an optical illusion that I deliberately stuck in there for pedagogical purposes!

Chris: Right.

Pat: *In almost any visual or auditory experience there's a lot to be noticed! And because there is a lot to be noticed, there's a lot to be understood*! *And being a good observer is not an empty-headed phenomenon! Being a good observer is not something that we do by taking every idea out of our head that we can! — But in fact having more ideas! Human observation — and I think it's probably true of most animals — human observation is* [meaning Pat did not use this word] *mediated. Our noticing, our attentiveness, is something that we have to learn how to do! The more we know, the better we can notice things*!

Now, there are obvious ways in which I think, Chris and perhaps others, were getting at: Don't the anticipations — Can't the anticipations interfere with what you're seeing? And the answer to that question of course is Yes. You're all familiar with that!

Intellectual Patterning of Observation.

"Selective Alertness".

Example of recognizing rings around Saturn.

But what Lonergan is getting at here is that *the idea that science is empirical raises as many questions as it answers; that there is no such thing as pure observing in which all expectations are removed. There is either untutored observing, or very sophisticated observing*! And sophisticated observing, for Lonergan, means, among other things, learning how to deal with expected and typical observances [final word unclear]. But it also involves learning how to notice other things.

Intellectual Patterning of Observing

So as Lonergan says:

> **In the trained observer, outer sense forgets its primitive biological functions to take on *a selective alertness*** [the italics are not in the text] **that keeps pace with the refinements of elaborate and subtle classifications [of insights]. In the theorist intent upon a problem, even the subconscious goes to work to yield at unexpected moments the suggestive images of clues and missing links, of patterns and perspectives, that evoke the desiderated insight and the delighted cry 'Eureka!' [until, that is, somebody gets the insight!]** (*CWL* 3, p. 209, emphases added).

So there's an active intelligent selectivity and alertness and awareness!

Rings of Saturn

Now this is actually a photo from a scientific discovery. It was the discovery of a previously undiscovered ring around Saturn. How many of you saw that ring when this display first appeared? ….

[Presumably no hands raised]

How many of you see it now? …..

[Presumably many hands raised]

The X marks the ring! … And it was a genuinely new discovery! *But notice how you actually have to learn how to pay attention to the data*! You could say — Let's say for the moment the data is really there! But the fact that the data is really there doesn't necessarily mean that without the active role of inquiry and intelligence it's going to be noticed. *So this raises the question about what is the difference between intelligently enhanced experiencing and, let's say, biased distorted occurrence of the same experiencing.*

Student question about a hypothetical person unable to see a given pattern.

– Discussion of how various observation skills are influenced by one's context and community of inquiry.

Maggie?

Maggie: Going back to the other images —

Image of saxophone player returns

— if someone were unable to come to see what is intelligible in the picture, like, say that after twenty minutes and they never see the face! What would Lonergan — how would he respond to that? Would he say that the person isn't observing properly, and isn't employing the right technique of observation to allow them to see the image? Or would it be a question of like the person is not of adequate capacity to get the image? Do you know what I mean?

Pat: Well, the first thing is: some people aren't going to notice this because they've never seen or heard of a saxophone before. Because we've seen saxophones already, at least we can see that part of the image. So there is nothing wrong with their basic mental ability, or their basic physiological ability. *There are ideas that we do bring to our observing*! And they can help us to observe things. Just as biases can get in the way of observing. So I think that the simplest answer is: the fact that somebody doesn't notice something, there might be a lot of reasons behind it.

In a community of inquirers, in a community of investigators, there is some education around how to do this. One of the things that I was actually miserable at when I was in High School, was being able to determine the different kinds of cells in a microscope. I was in a class with twenty microscopes; I don't think we did this all the time, but the only time that I ever did it, I was so bad at it! Twenty different microscopes around the room, and we had a list, and we had to look through the microscope, and write down what kinds of cell-tissue we were looking at. I got a 35% on that particular exercise!

[Loud laughter]

I can tell that made a big impression on you!

But a pathologist can make those identifications in the blink of an eye, and the same thing with a radiologist. Stuff that, you know, I would look at, and wouldn't be able to detect in an x-ray, a radiologist can identify immediately: "Oh, it's this that and the other thing!" *Well, how do you go from an ignoramus like me to somebody who can actually make those identifications? Well, it's in a community in which the insights are shared*! So what Lonergan would say is: "Probably that person needs to be in a community where those refinements can be identified and named!" Does that help?

Maggie: Yeah.

Pat: Okay, good! Okay!

Lonergan complexifies what it means to do *empirical* science.

However complicated and mediated the data, there remains empirical givenness.

Lonergan as rigorously empirical, more so than the empiricism itself.

Data of Sensation and Data of Consciousness.

Under this category of what Lonergan calls "**Canon of Selections**," almost sentence by sentence and paragraph by paragraph, Lonergan complexifies the working that you do in empirical science. *A positivist account* of science makes science seem to be very simple; so simple that everybody would have to be the most bigoted and idiotic person not to be able to know what Einstein and Galileo and Darwin, or whoever, discovered! And in fact *what Lonergan does is to pay attention to how people actually make observations, and actually use observations, in this massive human undertaking of the development of modern science*.

More Empirical than Empiricism

And then, having said that, he has this very important observation: *What makes an empirical science be empirical is that whether or not an insight is correct ultimately has to be referred to some empirical data! However complicated and mediated that data is, nevertheless it has to be empirical data*!

So I'll give you an example. I was driving along the road, and I saw a car that I thought belonged at that time to my daughter's dance-teacher, who I was very friendly with [inaudible] But it was far enough away, and my eyes were starting to go bad, so I couldn't really tell! But she had her last name on her license plate; and so I actually had to get a little bit closer to see it to see if it was really her, before I waved at her and made a fool of myself! And then when I got close enough, that wasn't what was on the license plate! Now I was doing a whole lot of mediating. I was doing the mediating of driving like a fool to get close enough to the license plate. But then there was also the mediation of knowing the letters of the English alphabet. And if that license plate had been written in Arabic, I wouldn't have been able to tell one of the set of letters from another, and recognizing them. So there was a lot of mediating going on. But nevertheless, 'Jones' was not written on that license plate. And in fact, her last name was not written on that license plate. It was just numbers*! So there was something empirically given in that experience that was, so to speak, non-negotiable, even though there had to be a lot of mediation for me to come to that judgment about what the empirical data on that license plate was*.

So Lonergan says

More Empirical than Empiricism

Issues in that cannot be settled by observation or experiment cannot be settled by empirical method, but it does not follow immediately that they cannot be settled at all. (*CWL* 3, p. 95).

Lonergan is pointing out that issues in empirical science do have to be settled by some element of empirical givenness. Otherwise you're not dealing with ideas, and so on, questions, that have to do with empirical scientific method. But that doesn't mean that they cannot be settled in some other fashion. So the fact that you can't solve certain questions by appeal to sensible data — now that we've seen that the appeal to the sensible data has a lot of complexity to it — that doesn't mean that just because a question is not "settleable" by appeal to empirical data makes it a meaningless question, or that the answers to those questions are themselves meaningless because there not solvable in that way!

And later on in the book he's going to make an argument that there are questions on which there are no empirical data, but can be solved! Analogical knowledge is going to be the big one for that. That comes in chapter nineteen!

Data of sense + Data of Consciousness
“Generalized Empirical Method

And he also says, *in addition to the data of sensation, there is what he calls the data of consciousness*. Now your insights don’t come in colours and shapes! There are no red insights, and there are no orange insights, and there are no green insights. There are no insights that are middle C in tone! There are no insights that are cold and none that are rough! *They don’t come with sense data attached to them. But they nevertheless are experiential*! *When you have insights, you have the experience of having insights! When you have questions, you have the experience of having questions. When you’re seeing or hearing, you have the experience of seeing and hearing! Those experiences are not the same as sense experiences, but they are equally experiences*!

That’s why I say: *in some very important ways Lonergan is more empirical than empiricism*! *He’s more empirical than positivism — because of the range of experiences that his approach to empirical method opens up onto*!

§2. Second Canon: Canon of Operations

What is the point to experimentation?

Not only verification of hypotheses, but more so the objective of experimentation is the growth of understanding – insight added to insight.

Exemplifies the self-correcting aspect of the scientific method.

Experiments lead to transformed experience that leads to new questions.

§2 Canon of Operations:

Self-correcting Scientific Method.

He talks about the Canon of Operations. There are some very interesting details there! The fundamental feature is: What is experimentation about? The tendency again in this positivist account of natural science is to say that experimentation is about the testing of hypotheses and the proving or disproving of hypotheses. *Lonergan sees it much more as a matter of the growth of understanding; that experiments that come out of hypotheses, that come out of insights, lead to transformed experiences which give rise to new questions, and further insights, and further hypotheses, and experiments. So in other words, what Lonergan is doing is situating the whole phenomenon of getting insights and doing experiments within a larger context of the self-correcting process of human learning*, both individually and communally.

§§3 & 4. Canons of Parsimony & Relevance

Stresses the immanent intelligibility of sense data,
relations of things to each other.

Science not about efficient or material causes.
About formal causes in a new, sophisticated sense.
Explanatory, not experiential, conjugates.

§§3 & 4. Canons of Relevance and Parsimony

The Canon of Parsimony and the Canon of Relevance — Again there are some detailed things there! But the point from that that I just wanted to emphasize for our purposes, is that *empirical science has to do with the immanent intelligibility of experience*! Now what the word 'immanent intelligibility' means is something that we get more by discovering the kinds of insights that he's talking about, in opposition to the ones he's not talking about. One of the things that is part of the story about the emergence of modern science is the irrelevance of final causality in empirical science! That it's about efficient causality rather than final causality! Lonergan says: *No, it's really not about efficient causality or final causality! What it's about is immanent intelligibility*! And 'immanent intelligibility' here means how things are intelligibly related to one another. That's what modern science is concerned to explore!

I have this reference on the display to

"of explanatory conjugates, not of
experiential (or imaginable) conjugates"

just to clarify his terminology.

§§3 & 4. Canons of Relevance and Parsimony

Empirical science is of

intelligibility immanent in the data of sense

relationships of things to one another, not to us

of explanatory, not of experiential (or imaginable) conjugates

'Conjugate' comes from the word 'conjugal' which means joined or coupled or connected. So what he's getting at here is that

> *science, modern science, is about discovering the conjugates, the X about this and the Y about that, that put them into some kind of relationship with one another; that the relationship defines what character this has and what character that has that they may be related that way! And that that, rather than the experiential qualities is what modern science is investigating*!

§5. Canon of Complete Explanation:

No exemptions for space and time,

No primary vs. secondary qualities,

No independent variables.

The Canon of Complete Explanation

No exempting or privileging
of space and time from scientific inquiry.
No "primary" vs. "secondary" qualities distinction:
No "independent variables"

The Canon of Complete Explanation we will talk about a little bit next week, because it's the reason why he feels that he has to write Chapter Five. *Now, his big target in this is the account of modern science which holds that what modern science is about is to get beneath the superficial appearances to the real substances of things*! And the real substances of things begins with the account that Galileo gives in *The Assayer* of the distinction between primary and secondary qualities. Secondary qualities are things like touch and taste and sound; the primary qualities are matter and motion, extension and duration; that those are the real things that drive everything else. And you can explain why things taste a certain way, why they have a certain colour, why they are shaped a certain way — all in terms of those little particles that bombard one another and bombard our senses!

> *Lonergan is saying that is to give an arbitrary privileging to one part of our experiential conjugates, and to exempt them from the demand to want to know about them and their intrinsic intelligibility! For Lonergan there are no "independent variables" and no "dependent variables", and no "primary qualities" and no "secondary*

qualities"! There is no privileging! Everything, all of our experiential elements are on an equal footing, and require of us that we ask and answer how is this related to other things? Why is it the way it is? — rather than giving it as the bottom line explanatory feature!

§6 Canon of Statistical Residues

The general argument:

Abstractness of classical correlations;

Imaginative Synthesis & Systematic Unification

Okay! And that brings us up to the **Canon of Statistical Residues**, but we will take a break here and come back shortly!

Insight & Beyond: Lecture 6, Part 2:

Chapter 3, § 6: "Canons of Statistical Residues"

and

Ch 4, § 2: "Complementarity of Classical and Statistical Investigations."

§ 6 Canon of Statistical Residues.

Need statistical methods *because* the universe has that kind of intelligibility (i.e., probability), not only for bureaucratic management of organizations and societies.

Distinction between Imaginative Synthesis & Systematic Unification.

Classical laws are intrinsically abstract and conditioned. Hence systematic unifications of abstract laws are also abstract, indeterminate.

But Imaginative Syntheses surreptitiously introduce additional, particular conditions, creating an illusory determinism (an extra-scientific assumption).

Example from physics: Is the evolution of the universe governed by *one law*?

If the classical laws alone or in systematic unification do not imply a deterministic universe, what sorts of alternative views of the universe are therefore possible?

Lonergan will develop emergent probability as a very likely alternative.

§6.5.2: Diverging Series of Conditions

Diagram of a random series of events in time and space.

Tracing back the causal sequences shows that their causes can be ever more divergent and nonsystematic.

Student Questions:

Is this an argument against social sciences, that they are corrupt? In the sense that social sciences want to trace everything human back to some one cause?

– Examples of oversimplification and reliance on extra-scientific opinions in certain fields.

Question about how Stephen Hawking would respond to Lonergan's argument.

– Discussion of the hypothesis of multiple universes, all with a single cause.

Question about tracing back only the relevant, proximate causes.

– Discussion about tracing back to pertinent (causative) factors; and the need to distinguish intelligibility of a single event versus the intelligibility of the aggregate of events.

– Inability of science to explain why *these*, rather than some other, classical laws (correlations) are the ones that are.

– Science's inability to explain the reasons for the conditions under which classical correlations operate, etc.

– Statistical probabilities remain constant despite non-systematic divergences; but statistical science does not explain the precise set of nonsystematic divergences from the probabilities.

Question about whether a Grand Unified Theory would be a claim that the whole is no more than the sum of its parts, whereas for Lonergan the whole is larger than the sum of its parts.

– Discussion of Lonergan raising the question about *what* the whole *is*.

Insight, Chapter 4: "The Complementarity of Classical and Statistical Investigations"

Mainly focus on §2: "Emergent Probability."

Four Basic Kinds of Scientific Heuristic Methods:

– Classical, Statistical, Genetic, Dialectical.

What happens when Classical and Statistical Methods are combined?

Classical: Discovering functional correlations among data.

Statistical: Discovering Ideal frequencies among data.

Interaction between the two practices: worldview of Emergent Probability

Non-systematic Processes as the womb of novelty.

Probabilities themselves emerge (probabilities shift in time).

Probability indicative of the directionality of the universe.

Internal vs. external directionality of the universe.

Universe is not a big box. Universe is not a big space.

The Universe is a process constituted by Emergent Probability.

Lonergan's "Worldview" = Emergent Probability.

The universe has a *kind* of intelligibility that does not eliminate contingency or nonsystematicity.

Definition of Emergent Probability: Abbreviated version & long, precise version.

Illustration: Emergence of a volcanic island.

Conditions for the emergence of biological schemes were initially absent.

Once cool enough, certain vegetation schemes emerge and set conditions for later schemes of vegetation.

What emerges? Qualities? Things? Properties? Schemes?

How many different kinds of schemes there are in the natural order.

Emergence of Schemes of Recurrence: a series of events linked by classical correlations.

Insight & Beyond: Lecture 6, Part 2:

Chapter 3, §6: "Canon of Statistical Residues" & Chapter 4, §2: "Complementary of Classical and Statistical Investigations"

§ 6 Canon of Statistical Residues.

Need statistical methods *because* the universe has that kind of intelligibility (i.e., probability), not only for bureaucratic management of organizations and societies.

Distinction between Imaginative Synthesis *&* Systematic Unification.

Classical laws are intrinsically abstract and conditioned. Hence systematic unifications of abstract laws are also abstract, indeterminate.

But Imaginative Syntheses surreptitiously introduce additional, particular conditions, creating an illusory determinism (an extra-scientific assumption).

Example from physics: Is the evolution of the universe governed by *one law*?

If the classical laws alone or in systematic unification do not imply a deterministic universe, what sorts of alternative views of the universe are therefore possible?

Lonergan will develop emergent probability as a very likely alternative.

Let's begin again! The more complicated of the sections of chapter three is the one about the "**Canon of Statistical Residues**" (*CWL* 3, pp. 109-125).

§6 Canon of Statistical Residues

The general argument:

Abstractness of classical correlations:

Imaginative Synthesis & Systematic Unification.

His general argument is to make the case for the fact that you do not only need a second method of scientific investigation, or a second kind of heuristic structure having to do with statistical investigations, but that it in and of itself is needed not just for purposes of — for managerial efficiency and things like that such as we talked about last week; but we actually need it because the universe has this kind of intelligibility to it! *It's a distinctive kind of intelligibility that is not approached or understood within the purview of the classical scientific method*! So that's ultimately where he's headed in this argument on the Canon of Statistical Residues.

And here he is doing something a little bit stronger. In the sections that we've talked about so far, he's made the argument that classical investigation — what we're used to thinking of as the paradigmatic examples of modern natural science — that they don't exclude the nonsystematic. Now what he's going to argue is that the fact that they don't exclude the nonsystematic means that you need to be open to the intelligibility of the universe that specifically has to do with probability! And he's going to make his argument on the basis of a couple of major points.

The first has to do with what he calls *the intrinsic abstractness of classical laws*! In chapter four this is going to come back in the version that *classical laws are conditioned*! So to talk about the abstractedness and the conditionedness is to talk about the head and the tail of the same coin!

So first of all their abstractedness! Now, initially that doesn't seem like a big claim, but he's going to make a point from it that is a big claim! And then the second thing is to make this distinction between an "**Imaginative Synthesis**" and a "**Systematic Unification**" (*CWL* 3, pp. 114-117). And he's going to argue that the universe is determinate only for somebody who's relying on an Imaginative Synthesis, but not a Systematic Unification.

Now, what does he mean by a Systematic Unification? A Systematic Unification is a way of putting together the laws of science with the expectation that that unification, that systematic unification of the laws of science, is going to tell you everything that happens in the universe at any given time. And his argument is that a Systematic Unification is just as abstract as each particular classical correlation is. It's just a more complicated abstractness. It lacks — It doesn't tell you under what conditions those classical correlations have to be applied! And without that knowledge, all the classical correlations in the world — all of them in any kind of combination you like — don't determine in and of itself how the universe unfolds. So that's the basis of his argument.

However, once people add in the specific determinations of those laws — the specific conditions under which those laws are operating — by throwing into the mix some Imaginative Synthesis, then you get a determinism. But it's not an empirical determinism! It violates what he calls the Canon of Parsimony! It brings more in to the mix than legitimately classical scientific method allows! Okay? So that's going to be his argument: that *because of the inherent abstractness of classical laws, individually or in any kind of systematic combination you like, they don't determine how the universe must behave, because in addition to the Systematic Unification you have to supply the particular conditions*! — Just as when we were looking at the nonsystematic illustrations before — the gases, and the rabbits and the foxes — the laws themselves didn't determine how the scenario was going to unfold. You had also to add where the rabbits and the foxes started out from, and where they were, and which direction they were headed in! Likewise with the gas molecule! *Only when you added those in did you get an account of how the process unfolds. So also the universe: you have to add something in, and if what you add in is an imaginative set of assumptions, you will think that you got that determinism from the classical laws alone, and not the classical laws combined with your imagination.*

Evolution of the universe: Governed by One Law?

So here's an example! This is a diagram of the evolution of the universe, over the fifteen billion or so years that it is thought to have existed! By the way, *nobody sees this*! You can't get a powerful enough telescope to see this diagram out there in space! And so what this is is exactly what we've been talking about! *It's an image! It's an image that's meant to convey a certain set of insights.* And among the insights that it is intended to convey is that the actual radius of space — Now how can space have a radius? This is a complicated thing! But for the moment, just bear with me! — That the radius of space actually expanded! It went from what is called the singularity of a dark massive point. And then it expanded, and then there was what is called cosmic ?? metric ?? [word unclear] inflation, and it expanded still further. And as far as we can tell, it is still expanding! But we are right at that point where we can't really tell whether the universe has expanded as far as it's going to, or whether it is going to start contracting [word unclear] or not. But anyway, so far as we know, for over fifteen billion years, the universe has been expanding!

Now Einstein in particular, and Steven Hawking, have been looking for the *GUT*, the Grand Unified Theory, the Grand Theory of Everything! Einstein called it the "Unified Field Theory," and different physicists have called it by different names. But the idea is to find a set of laws or a set of principles from which the whole universe can be deduced! Einstein really wanted the one equation, just like Laplace, that would explain why everything in the universe happened.

And when I talked about this set of issues in a previous class, one of the students said: "Well, look, if you start from here [Pat uses his pointer], maybe this is all nonsystematic, but if you go back in time, things get closer and closer together, and they all eventually become unified!" But *they only become unified spatially*! *They don't become unified intelligibly*! If we went back to that gas thing, and I put some more gas molecules in, which it allows you to do, that would be the equivalent of kind of squeezing the box down. There's no [words unclear] do that. *It doesn't get more systematic because it gets more compact. It actually gets less systematic, because there's more interfering going on because of the compactness*!

And so what Lonergan is arguing is: if you look at an image like this, or if you construct one in your mind, and you're not noticing that, you're going to think: "Oh, it's the Unified Field Theory, the Grand Theory of Everything, that explains how the whole universe works!! And how it all expanded!

And the study of this in the area of physics is really marvellously fascinating and complicated, and sometimes hard and maddening! *But it doesn't explain everything*!! It explains things *given certain conditions*, *but the equations don't give you the conditions*!

So that's what Lonergan means by this business about a Systematic Unification versus an Imaginative Synthesis! A Systematic Unification can combine the laws in all kinds of ways, but without some further exterior specification of what conditions are those classical correlations even in that combination operating, you don't have any understanding of the universe! It's only with the Imaginative Synthesis — *Imaginative Synthesis is part of what he calls the extra-scientific opinion! It's an import! It doesn't come from science itself! It comes from certain human expectations and aspirations*! And what he is doing here is to radically call those into question! If those are not dictated by modern science, what other sorts of things can we make of modern science? What other sorts of ways can we think about modern science, and of the universe that it leads us to?

§6.5.2: Diverging Series of Conditions

Diagram of a random series of events in time and space.

Tracing back the causal sequences shows that their causes can be ever more divergent and nonsystematic.

The heart of his argument — So that's kind of the overview, that what he is going to attack is the assumption about the — that once we know all the laws of science, we will know how the universe has to run! That's the nature of his attack!

And the strong point of his argument is this very complicated thing that he calls the "**Diverging Series of Conditions**" (*CWL* 3, pp. 118-119). Okay! So last week, in contrast to the regularity and the systematic process that's characteristic of the rotation of the moons around Jupiter, I just sort of put together this relatively random sequence of events — So there is a collection of events in space and time!

[Random dots added to diagram]

Now what Lonergan is getting at in his argument about the **Diverging Series of Conditions** is someone who might say:

"Well okay, I'll grant you that in that period of time, it's a nonsystematic aggregate; it's a random population. But *really*, there is *one formula underlying it*! Because if you look back to the causal series of events behind each of *those events*, you will eventually discover the grand pattern! And the grand pattern would be the Grand Unification. So see you're wrong Lonergan on this! You just didn't trace it back far enough! You gave us a bunch of events, but you didn't say what events they were connected to! *And if you did that, you would eventually go back to something like the Big Bang where everything is unified! And we can then run the tape in the other direction and see how everything was determined from the beginning anyway*! And, la di da di da!!!"

[Some laughter]

And hopefully this addresses a bit of the question that Katie had raised before, too! So this [Pat refers to the diagram] is what he means by the **Diverging Series of Conditions**. Okay, so let's look at the events that were responsible, in accordance with classical correlations, with each of those little x events that are up there! So let's say that there were three conditions —

[Pat picks out one x point on the diagram and adds three conditions y]

— all in conformity with some classical correlation that were responsible for the occurrence of x. And let's look at the next steps!

[Pat picks out the next x point on the diagram and adds further conditions y]

So it had some ys that were *its conditions*.

[Pat repeats this for the next x point on the diagram adding further conditions y; and he then repeats this for more and more x points on the diagram, adding further conditions y to each x event]

And so each of them has some conditions that were responsible for its occurrence. But note that they don't seem to have formed a systematic aggregate here; not by surprise, because Byrne put this together to show that it was possible to do this and have it not be systematic!

Well, maybe we didn't go back far enough! Let's go back one more iteration. And so y itself — it had its conditions! And this y, it had its conditions!

Diverging Series of Conditions — enriched diagram

And so Lonergan's point is: far from solving the problem of the nonsystematicity of any given point in time by tracing back the causal sequence, that in fact things become — *could* become ever more divergent, ever more nonsystematic! *So there isn't any — there isn't anything but a kind of an imaginative expectation that they ought to somehow all be traceable back to the same z, or q, or t, or some event from which everything then originated* *and gives you a simple explanation*. It's perfectly conceivable, and in fact pretty likely, that the further back you go, the more spread out is the series of events that led to any given moment of nonsystematic coincidental population events. Okay?

So that's really the basis of his argument! *And it's meant to undermine the deterministic assumption that ultimately everything is unified way back in the beginning*! This is exactly what Einstein, Steven Hawking and other such people think about what they're going to find when they get the final unification of all Physics into one set of laws.

Student Questions:

Is this an argument against social sciences, that they are corrupt? In the sense that social sciences want to trace everything human back to some one cause?

– Examples of oversimplification and reliance on extra-scientific opinions in certain fields.

Question about how Stephen Hawking would respond to Lonergan's argument.

– Discussion of the hypothesis of multiple universes, all with a single cause.

Question about tracing back only the relevant, proximate causes.

– Discussion about tracing back to pertinent (causative) factors; and the need to distinguish intelligibility of a single event versus the intelligibility of the aggregate of events.

– Inability of science to explain why *these*, rather than some other, classical laws (correlations) are the ones that are.

– Science's inability to explain the reasons for the conditions under which classical correlations operate, etc.

– Statistical probabilities remain constant despite non-systematic divergences; but statistical science does not explain the precise set of nonsystematic divergences from the probabilities.

Jeff?

Jeff: Is this a complete argument against the Social Sciences? Does this make their procedures corrupt almost?

Pat: Well, Lonergan wouldn't say that they are totally corrupt! He's going to have his own criticisms and his own suggestions about what needs to be done in the social sciences. So I'm not exactly sure what you have in mind?

Jeff: Well, you see like social sciences: they tend to want to draw everything back to some one cause [unclear set of words] people seem natural.

Pat: *Ah, in that sense, they are as much subject to extra-scientific opinions as are the natural sciences! So corrupted by extra-scientific opinions, yes*! Social Darwinism is an example of an attempt to be a social science that is highly questionable, given some of its assumptions, one of which is exactly this kind of an assumption! So to the extent to which a social science thinks — whether it's a Freudian psychoanalysis or a Hobbesian account of the state of nature, or whatever it is — thinks that it is going to explain everything; then Lonergan would say: "Well yeah, it's got a hubris about it that expects more of a real science than a real science is capable of! Okay? And it all goes in the direction of over-simplifying the complexity of reality! … Mike?

Mike: I don't know whether Hawking has read Lonergan, so —

Pat: I doubt it!

Mike: I doubt it too, but could you, just for the sake of the class, give us your suspicions as to what Hawking might say, if he was here right now, to this argument? Because this argument seems complicated; but also somebody like Hawking might say that's too simplistic! Like, what would he say in response to this?

Pat: Oh, my guess is he would say, well, that our universe is just one of a multiplicity of universes, and if everything looks nonsystematic all the way back to the Big Bang, at the Big Bang a multiplicity of universes are all joined, so to speak, at the umbilical cord; and some of them will be very systematic, and some of them will be highly nonsystematic; but they're all caused by the same Big Bang! And so it's just — we're one manifestation of a much larger thing that ultimately does trace back to the Big Bang! He has been looking for a Quantum-General Relativity Theory, in which our universe would be one state in the solution to a Quantum Equation!

Mike: And so is Lonergan's retort to this that it is just an Imaginative Synthesis, an exercise in presumption?

Pat: Right! Right! Because of one of two things: either the data that is the data of our universe is actually data on everything that we are related to — because remember science for Lonergan is about relatedness! And if Hawking's hypothesis that our universe is related to other critical possible universes, then you are not talking possible but actual! And so the question is whether there is data on this or not!! And if there's not, then it is Imaginative Synthesis! … Deb?

Deb: Well, what about when you're tracing back a factor to try to find the causative factors, and those causative factors are pertinent to the question you're trying to solve. Is that — At some point, you know, you can't trace it back all the way to the very beginning. But you can trace it back five steps, and that's important to solving your question of why x is there.

Pat: Yeah. And again, that's something he actually concedes all the way along the line beginning right in the second section in chapter two: that he would have no disagreement with that! *It's the implications that people draw from that*! So for example [Pat uses his pointer to pick out elements in the Diverging Series graph], if somebody's tracing back — let's continue to use your words, it's not exactly his word, but let's use your word: it's a pretty common way of thinking — what are the causative factors of this x right here? Ah, well, those three factors there! And each of those factors has — this one has three factors; that one has two; this one has two more. So there's a total of seven factors of the three factors, all of which a good scientist, in many cases, could be able to identify!

And what does that tell you? Well, that tells you why x happened! It doesn't tell you what the Intelligible Unification of all these xs are! *And that's what he's saying that the Grand Unified Synthesis Laplacian determinists are claiming: that just by knowing all the laws of science, and putting them together in some creative fashion, that you could then predict why all the xs happen just from those laws alone, without knowing anything about the concrete conditions under which those laws are happening*!

So, you know, there's a sentence — I think it's back in chapter two — where he says that each and every event can be completely determinate, but it's the aggregate of events that that isn't determinate, that doesn't reduce to this one individual rule that is responsible for them all! So it opens up the question of, well, why — These are the laws of science; they could have operated under all kinds of different conditions. Why are they operating with the conditions that they actually are? *That's one of those questions that can be raised that can't be answered by the methods of science*!

> *The methods of science will deliver to us, the classical method will deliver to us the classical correlations that relate events in our universe to one another! But they don't tell us under what conditions those laws have to operate. The statistical methods will tell us the probabilities of events. But the probabilities don't determine the specific ways in which actual events diverge from the ideal frequencies! And so we have a further question: why is the universe — why are the laws of probability and the laws of*

classical correlations operating as they do? The probabilities and the classical correlations don't determine the conditions under which they operate!! *So it asks a further kind of question about the universe which Lonergan is saying the extra-scientific opinions attempt to answer, but they don't do so on either scientific, or for that matter, on legitimate philosophical grounds*!

Okay? Does that make some sense?

Deb: Yes, thank you!

Question about whether a Grand Unified Theory would be a claim that the whole is no more than the sum of its parts, whereas for Lonergan the whole is larger than the sum of its parts.

– Discussion of Lonergan raising the question about *what* the whole *is*.

Pat: Joao?

Joao: I hate to oversimplify this, but if a Grand Unified Theory were to come about, is that kind of along the lines of the whole is the sum of its parts, and Lonergan would be arguing that the whole is a lot more than the mere sum of its parts. Is that the kind of Laplacian —

Pat: — Well, sort of!! But it — You know, remember, the first day I said, you know, what's Lonergan's project about? *Lonergan's project is about what's the nature of the whole*! So yeah, a Laplacian or an Einsteinian or a Hawkingian are talking about the sum of the parts being no bigger than the whole. *But what's important is that there is an assumption about what the whole is*! *And what Lonergan is doing is raising — he is opening up the question about what the whole is. He's turning the question about what the whole is* *into an X, that we are now coming to get some understanding of*! And his account of Emergent Probability is going to be sort of the first step in the way that he would answer what kind of an X are we living in. It's going to get some further refinements as we go along! Okay? Okay!

***Insight*, Chapter 4: "The Complementarity of Classical and Statistical Investigations"**

Mainly focus on §2: "Emergent Probability."

Four Basic Kinds of Scientific Heuristic Methods:

– Classical, Statistical, Genetic, Dialectical.

What happens when Classical and Statistical Methods are combined?

Classical: Discovering functional correlations among data.

Statistical: Discovering Ideal frequencies among data.

Interaction between the two practices: worldview of Emergent Probability

Non-systematic Processes as the womb of novelty.

Probabilities themselves emerge (probabilities shift in time).

Probability indicative of the directionality of the universe.

Internal vs. external directionality of the universe.

"The Complementarity of Classical & Statistical Investigations"

Insight, Chapter 4

Emergent Probability

Okay. So let's make a transition now to Emergent Probability in Chapter Four (*CWL* 3, pp. 128-162). I don't think we're going to have — Oh, let's see how it goes! I don't think we are going to get through all of this!

Four Basic Kinds of Scientific Heuristic Methods

Earlier on I talked about the fact that *Lonergan is going to suggest that there are four distinct heuristic methods of modern investigation*. We've done two! Classical and Statistical. In this fourth chapter, he's going to do something that he didn't do in the previous chapter. *In other words, in the previous chapter he was making rules for the relevance and the objectivity of statistical methods and their implications*. So you may feel — and there are definitely times when I feel — that the opponent was down on the mat, and was being kicked in the face, and then beaten with a chain, and then having gasoline thrown over him.

It's a huge undertaking and focus in which he makes many points, but there's a consistent theme here: that statistics is important; it's important because it gives us a kind of intelligibility about the universe that's not to be found in what people take as the paradigmatic and in fact sole meaning to doing modern science. So up until now, he's been doing this big battle to keep things open!

Now he's going to say: "*In Chapter Three I talked about a systematic unification of the ways in which you could put together classical intelligibilities, and what do you get! Now in Chapter Four let's ask the question what happens if you put the classical* ***and*** *statistical* *intelligibilities together, what do you get?" The answer is you get a lot of things that he didn't talk about yet*!

So Lonergan's got a very specific objective that he's aiming at! There's more to the ways in which classical and statistical methods can be combined, and the implications of that! But he has a very specific orientation, and it has to do with coming up with this notion of Emergent Probability!

Complementarity

Ch 2 outlines Classical and Statistical Methods separately;

Ch 4 explores their interrelationships.

In §4.1 ("Complementarity in the *Knowing*"), Lonergan explores the structured interactions among the *practices* of the two methods;

In §4.2 ("Complementarity in the *Known*"), he explores the structure of the *world* that is known by the interactions among those methods;

That structure of the world, Lonergan's "World View" he calls "Emergent Probability."

In this chapter, he makes a distinction between complementarity in the knowing and complementarity in the known. And he has a number of points about how classical and statistical methods complement one another in their verification, and in their ability to — if you want to specify the kinds of categories that one ought to be applying statistics to. He has a throwaway remark about red-haired trombone players — that's the sort of thing that they — I'm trying to remember the name of the Senator, William Fulbright I think, who used to give the Golden Chicken Award, I think, to the most outrageous project that the Federal Government funded in the previous year!

[Subdued laughter]

You can imagine someone applying to the National Endowment for the Humanities to study the frequency of red hair in trombone players, getting a grant, publishing it, and then saying:

"Well, I've got numbers, therefore it's science!" His point is that unless you're doing a statistical study that is relying on the best classical correlations and categories that you've got at your disposal, you're not really making a significant scientific advance. So the determination of what kinds of statistical investigations are worthy of undertaking has a lot to do with the state of classical science. So there are a number of things he says about the complementarity between the ways of knowing.

But the second part is something that he took a certain amount of pride in, and we're going to see it comes back in important ways in some of the later chapters. And it has to do with this world view that he calls **Emergent Probability** (*CWL* 3, pp. 146-157)! *I want to emphasize that emergence is really characteristic of Lonergan's world view. And he does tend to regard determinism as being incapable of truly accounting for novel emergence*! He claims that really new intelligibilities do come into being in the course of time! And so he is going to argue that the reason for this is because the nonsystematic processes give us what he calls "**the womb of novelty**" (*CWL* 3, p. 75)! *It's precisely because of the nonsystematic processes — because of the 'coincidentalness' of the events in our universe — that they have the capacity to combine in ways that set unexpected conditions through the emergence of truly novel developments*!

And not only are there novel developments in the universe, but probabilities themselves emerge! *So we saw back earlier in class that probabilities can vary from time to time and from place to place. This is in a different kind of varying of probabilities, that probabilities can emerge: that what was once very improbable now becomes very probable! So that the universe is characterized by a progressive emergence.*

And that is why for him it is so important that there is this other kind of intelligibility to the universe, the intelligibility of probability! Because it is the factor that gives some indication that the universe has a directionality to it! It's probability, and the way in which

Lonergan sees the implications of probability, that means that the universe has a certain kind of directionality to it! It's directionality — you might say 'internal directionality' as opposed to 'external directionality'!

External directionality means that external to the process there's an outcome, and you can say that this process is headed towards the outcome! *Internal directionality* is the kind of direction the universe has even though you've no idea where it's headed! Later on he's going to use the phrase: "**upwardly but indeterminately directed universe**." *So we're in a universe that has got a directionality to it, but where it's headed is not something that the natural sciences can tell us in advance! It's something that we can identify the kind of direction it has, and it's an emergently probable directedness*!

Universe is not a big box. Universe is not a big space.

The Universe is a process constituted by Emergent Probability

Lonergan's "Worldview" = Emergent Probability.

The universe has a *kind* of intelligibility that does not eliminate contingency or nonsystematicity.

The World, The Universe

For Lonergan, the World, the Universe (Space),

Is <u>not</u> a Thing or a big Box:

The Universe is a Process — "a succession of events."

But not just a jumbled collection of successive events;

The events and their succession have a *structure* (what he calls the "*immanent intelligibility*" of the universe)

That structure or immanent intelligibility of the world Lonergan calls "Emergent Probability."

So a first thing — and we'll come back to this next week: the universe for Lonergan is not a box! It's not a big space! The universe for Lonergan is a process! I think it's a very difficult thing to overcome the tendency to think of the universe as a big space with stuff in it. For Lonergan, it's not a big space; it's a process! That will come home to us with abandon next class when we see how Lonergan is going to define space and time. *Space and time are intrinsically defined as the ordered relationships among processes*. That's not how we tend to think of it. *We tend to think of there being a space and the processes taking place inside of it; for Lonergan it's the opposite: that space and time are the relatedness of processes*!

A process is "**a succession of events**" — we talked about this a little bit before — but it's not just a random jumble process of events. Even though it's largely systematic, it's got a certain kind of order to it! And the order has what he has called an emergently probable order.

Definition of Emergent Probability: Abbreviated version & long, precise version.

World View = Emergent Probability

"A world process in which the order or design is constituted by emergent probability …" (*CWL* 3, 148).

Short Version of Emergent Probability:

"**The universe is upwardly but indeterminately directed.**" (*CWL* 3, 656 ??).

Long, Precise Version of Emergent Probability:

"**Emergent probability is the successive realization in accord with successive schedules of probability of a conditioned series of schemes of recurrence.**" (*CWL* 3, 148-149).

And this display says, again, more or less what I just remembered. The bottom of that slide is, after a long lead-up, Lonergan gives one of his typical, complex, dense, Lonergan definitions: "**Emergent probability is the successive realization in accord with successive schedules of probability of a conditioned series of schemes of recurrence**" (*CWL* 3, 148-149). So we're going to try to do the build-up to that.

Emergent Probability

So the element, the basic element for Lonergan, in thinking about the kind of intelligibility, the kind of design — though indeterminate — that the universe does have is to start with the notion of what he calls a **scheme of recurrence** (*CWL* 3, pp. 140-143, 148).

[Pat moves through the slide line by line, starting from the bottom and moving upwards]

And then importantly in this is that schemes of recurrence can be put into a series of schemes of recurrence which are conditioned by one another. And that series of schemes of recurrence have probabilities to them. And that those probabilities change — successive schedules — successive lists of probabilities. So a billion years ago, the probabilities of the occurrence of a series of schemes of recurrence were less than they are now! *And so emergent probability is the successive actualization in a nonsystematic way — but in a way that follows nonsystematically the ideal intelligibility that comes from probability of the emergence of schemes of recurrence! Okay?*

Illustration: Emergence of a volcanic island.

Conditions for the emergence of biological schemes were initially absent.

Once cool enough, certain vegetation schemes emerge and set conditions for later schemes of vegetation.

What emerges? Qualities? Things? Properties? Schemes?

How many different kinds of schemes there are in the natural order.

Emergence of Schemes of Recurrence: a series of events linked by classical correlations.

Let me stop there and see — This will hopefully become a little clearer as we look at some of the components.

I think that the key point I want to emphasize here is that Lonergan is talking about a kind of intelligibility the universe has that doesn't eliminate the unpredictability, the contingency, the nonsystematicity! Just as a probability not only doesn't eliminate the nonsystematic variations around that probability but in fact requires that there be nonsystematic variation around that probability, so *also the intelligibility of the universe as Lonergan describes it doesn't eliminate the fact that what actually happens is not uniquely, particularly, in every detail, determined but only in terms of the ideal frequencies of the emergences of new things*! Okay? …

Small-Scale Illustration:

Emergence of the Island of Surtsey

All right! Let's get a little more concrete! In 1963 a volcano erupted. This was a volcano that was under water. And as it erupted, the lava spilled out, cooled, and piled up; and spilled out, cooled, and piled up; and eventually there was created an island that was named Surtsey.

And this [Pat is referring to the slide] is a — On the right hand side are some photos of this volcanic eruption while it was happening, and on the left hand side is a picture after the volcano had cooled down, and that was the island that resulted. Needless to say, this island did not start out with any vegetation on it! It was a little too hot for vegetation! The conditions for the growth of vegetation on this island were not yet satisfied until it cooled sufficiently. So anything that has to do with biological growth, any classical correlations having to do with biological growth, operate under conditions, and among the conditions are temperature!

Emergence of the Island of Surtsey

Ah, this is the — I'm going to jump ahead here, and then go back!

> **Emergence of the Island of Surtsey**
>
> Each plant is an example of a complex set of schemes of recurrence; the emergences of the later plant schemes dependent upon the prior emergences of their conditions, namely, the earlier plants.

These are diagrams of the growth of vegetation on the island of Surtsey over — I think it's about ten years. And you can see initially there are only a few sites on the island that start to have vegetation of various kinds. And then a little bit later on, the areas of vegetation grow! *But importantly, notice that these vegetations* [Pat uses his pointer on the slide] *are able to emerge because those vegetations have emerged*! *And then likewise later on, you get much more variety of vegetation in the various parts of the island, all conditioned by the prior emergence of vegetation*.

So this is a perfect example of what Lonergan means by Emergent Probability. Under conditions of temperature, at one point the probability of the emergence of the schemes of vegetation, the cycles occurring, are zero! As the temperature changes, the conditions, the probability, for the emergence of vegetation go up. But it doesn't determine in any way exactly where the vegetation has to start! And in fact, where the vegetation in the next cycle grows depends on where it happened to begin. And the more sophisticated types of vegetation depend upon the environment provided by the earlier stages! *A successive series of schemes of recurrence*! The most elementary schemes of recurrence here [Pat uses his pointer on the slide], and then more here! And more sophisticated ones building upon those schemes, and here more sophisticated ones building upon those ones!

Emergence of the Island of Surtsey

In the summer of 1965 the first vascular plant was found growing on Surtsey, mosses became visible in 1968 and lichens were first found on the Surtsey lava in 1970.

And this display just gives you some — here [Pat uses his pointer on the slide] some of the most elementary forms of vegetation when they first developed. And you can see over a period of five years how this vegetation was able to grow because of the schemes of recurrence that were laid down for them to become the conditions for their emergence. So that's the general idea of what Lonergan is getting at!

Emergent Probability & Schemes of Recurrence

The Key to Emergent Probability is the notion of *Scheme of Recurrence*:

> **"Emergent probability is the successive realization … of a conditioned series of schemes of recurrence**." (CWL 3, pp. 148-149).

Problem of Emergence vs. Reductionism

What Emerges?

Emergent properties?

Descriptive or explanatory?

Emergence of intelligible recurrence of events.

Now one of the problems that comes up in the Philosophy of Science and scientific investigations in general is the whole realm of emergence. What emerges? Do qualities emerge? Do things emerge? Lonergan's answer to this is to start with the notion of s scheme of recurrence! Almost everything — *Once you start to look at the world using these ideas, you start to realize how many recurrent patterns there are! In our planet earth, in our human ecosystems, in our universe, there's a lot of recurrent repetitiousness.* And in fact, that's almost always a signal to investigators to say to themselves: "Gee, maybe there is some reason why this recurrence is taking place?

Schemes of Recurrence

The notion of the scheme of recurrence arose when it was noted that the diverging series of positive conditions for an event might coil around in a circle. In that case, a series of events, A, B, C, … would be so related that the fulfilment of the conditions for each would be the occurrence of the others. Schematically,

then, the scheme might be represented by the series of conditionals, If A occurs, then B will occur; if B occurs, C will occur; if C occurs, … A will recur. (*CWL* 3, p. 141).

This is just a passage from *Insight* where Lonergan is talking about a scheme of recurrence. *The key thing to a scheme of recurrence is a series of events in which the events are linked to one another by classical correlations*.

Schemes of Recurrence

Diagram

So for example, if A occurs, then under the appropriate conditions, then B occurs because of classical correlation or Law # 1; but if B occurs, then C occurs according to classical correlation or Law # 2. And likewise for — So they are linked together, the point being; under, you know, whatever conditions, temperature, pressure, concentration, appropriate combination of ph's and so on, whatever the conditions are given, once one of these events happens, because the conditions for A giving rise to B according to classical correlation or law # 1 occurs, this will become a recurrent pattern. That's what he means by a Scheme of Recurrence!

I've a feeling that that Review Class is required again today! So I think we will stop there. And we'll finish up the discussion of the Emergent Probability next time. Hopefully, this gives a sort of an overview of what he is talking about in terms of Emergent Probability; *why it's the probabilities that emerge is something we will begin to talk about next time*. Okay. So have a good week!