Insight & Beyond

Class 7, Part 1: October 21st 2009

Chapter 4 §2: "Complementary in the Known": Emergent Probability

Summary of Material

In-depth discussion of Emergent Probability and Schemes of Recurrence.

Linking of a cycle of events by one or more classical laws (correlations).

• Example of hydrological cycle.

Additional examples from biology; the ATP cycle and the oxidative phosphorylation cycle.

The latter as a conditioned scheme of recurrence.

• The pervasiveness of schemes of recurrence throughout the world.

Schemes of recurrence as conditioned.

• The dependence of schemes of recurrence on the classical correlations (laws) that link their constituent events.

Discussion of: “What does it mean for classical correlations to be abstract?”

• What conditions enable classical laws to operate at all?

Nonsystematic processes as setting the conditions of emergence for classical laws to operate and for schemes of recurrence to appear.

• *A* is one condition for *B*, but there is also a vast set, or environment, of “other conditions being equal.”

Diagram & elucidation of how schemes of recurrence are conditioned by the way that their constituent links are conditioned.

“Quasi-Schemes of Recurrence” as Non-Systematic.

In the absence of the fulfilment of environmental conditions for a scheme of recurrence, the sequences of individual events of a scheme of occurrence can still occur, but as a merely random, independent series of events.

Student question as to whether this model is restricted to the natural sciences.

Student question as to whether the scheme of recurrence is circular.

Probability of Quasi-Schemes of Recurrence resumed. The unlikelihood of a series of events occurring in a given pattern (A, B, C, D) if no classical correlations are in play.

• Then the probability of A & B & C & D … will be $p \cdot q \cdot r \cdot s$ … (N.B.: The probability associated with event D on the diagram should have been *s*, not *q*.)

• Then the probability of even 4 such events in sequence would be extraordinarily low.

Student question about whether the probabilities of events depends on to what the events are related. The legitimacy of isolating and selecting particular events; i.e., odds of me winning the lottery versus someone's winning the lottery.

– "What is the probability of this *single* event?" is a meaningless question.

– Discussion of probabilities, statistical frequencies, statistical methods as *only* applicable to collections or populations in a concrete, determinate space and time.

Question about the diagram of the series of events where the arrows for the classical correlations have been subtracted from the cycle.

• Response. Water jumping out of a glass does not violate any classical laws; it is just extremely improbable.

• Question: Is it possible for these quasi-schemes of recurrence to create a situation where they become more probable? Only if they change the conditions of the environment where the classical correlations actually begin to forge connections among the events.

Diagram of the evolution of series of events in time, albeit not connected by classical laws.

Extreme unlikelihood of *multiple* occurrences of a scheme in such a case.

Brief discussion of the implications for Intelligent Design and the order of the universe as such.

Scientists, therefore, treat recurrent schemes as heuristically indicative of some classical correlation.

• Question as to whether the order of the events in the quasi-scheme of recurrence affects the probability.

Probabilities of Conditions

Comparing classical and statistical laws, i.e., what happens when conditions are fulfilled versus how often one may expect them to be fulfilled.

The Kind of Intelligibility that Probability is: a "funny kind of governance of events," different from the intelligibility of classical correlations of events.

• Not the kind of causality we are accustomed to thinking of.

• Ideal frequencies, probabilities, can change over time – setting new norms from which events diverge nonsystematically.

Empirical method requisite for determining probabilities (ideal frequencies).

Shift of Probabilities of Emergence when conditions are fulfilled.

Reasons for dramatically increased odds of the recurrence of the scheme.

– Any one of the events in the scheme triggers the whole cycle.

– Probability jumps from a product to a sum.

– The probability of A & B & C & D … will now be the much higher $p + q + r + s$ …

• Animation of shift of probabilities of emergence when conditions are fulfilled.

• But the conditions for this shift of probabilities, and for the emergence of the scheme, are fulfilled nonsystematically.

Nonsystematic Assembly of Conditions source of Creative Emergences.

• Genuine self-appropriation of natural science implies that the universe is creative, not deterministic.

Prior schemes of Recurrence as Conditions for Later Schemes.

• Pyramids of schemes resting on schemes.

Universe as upwardly but indeterminately directed.

• Teleology of the universe: Directed but an unknown, unpredetermined outcome.

Student Questions:

Question about development of increased systematicity of the universe over time.

– Distinction between the universe as having a more systematic elements *versus* being more systematic as a whole.

Question about how the events and their probabilities can be independent, have no intrinsic connection to one another, if there are conditions.

– Conditions have to do with classical laws, not probabilities. Methodological presumption of events as independent.

Question about whether it is ever possible to truly know ideal frequencies, given their dependence on time and space and their changeability.

– Methodological decisions help determine what is statistically significant, and these methods are evolving.

Has a scheme of recurrence ever proven to be merely a quasi-scheme of recurrence, or vice versa? Isn't the onus on a scientist to prove that a series of events is really a scheme of recurrence, and not a quasi-scheme of recurrence?

– Discussion of both situations, some illustrations, and their implications.

Class 7, Part 1: October 21st 2009

Chapter 4, § 2

"Complementarity in the Known"; Emergent Probability

PL 772: Insight & Beyond, 1

Fall 2009

In-depth discussion of Emergent Probability and Schemes of Recurrence.

Linking of a cycle of events by one or more classical laws (correlations).

• Example of hydrological cycle.

So in today's class we're going to finish up the discussion of Emergent Probability, and then transition to the chapter on Space and Time.

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).

So I just want to recall Lonergan's definition of Emergent Probability and the centrality of this idea of a scheme of recurrence; and therefore the conditioned series of schemes of recurrence. We didn't really go too much further than that.

So what Lonergan says about schemes of recurrence is that when he was talking about the diverging series of conditions, that there might be some occasions or some situations in which the A, caused by B, caused by C — the A giving rise to B giving rise to C giving rise to D could actually then become the occasion for the D giving rise to A giving rise to B, and so on.! He mentioned that in passing, and now he is going to make hay of it.

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).

And so his notion of a scheme of recurrence is that a series of events are linked together by a combined, or a combination of classical correlations, so that when one event occurs, a repeating recurring series occurs.

Schemes of Recurrence

Diagram

So for example, A occurs; the scheme of recurrence of A, B, C recurs. *What I want to draw your attention to here is that A leads to B because of one classical correlation or law.* B then leads to C not necessarily — possibly, but not necessarily — by the same classical correlation; C leading to D by yet a third possible correlation; and D leading back to A by a fourth classical correlation.

Now a couple of weeks ago we were looking at systematic processes, one of them being *the planetary system. The classical correlations involved we know as Newton's laws of motion, or what I would prefer to call Newton's correlations of motion, and Newton's law of gravity. And in that case*, *all four combinations are one and the same*! But that's not necessary! It just is a general possibility that this linking can occur through different kinds of combinations of classical correlations.

Schemes of Recurrence:
Hydrological Cycle

So what are some examples? Now let's get a little bit more concrete. *That's a very general schematic way of thinking about schemes of recurrence*. What are some examples? One that Lonergan mentions in *Insight* is the hydrological cycle. The hydrological cycle — *you could begin in any place: that's important about a scheme of recurrence*. But you could say, for example, water evaporates from the sea; the evaporated water condenses at a cooler temperature. *So notice, it's not the same law that's responsible for the evaporation of water and the condensation of water in clouds*! The clouds, when they become cold enough, dense enough, the drops — the sources of water in those clouds become heavy enough to be able to overcome the buoyant forces of air; and they fall down; they fall upon the earth! When they fall upon the earth, they may just run down the hill. But what in fact is being described here in the display is the fact that they are absorbed into the soil and into the rocks, in which a whole different set of laws or correlations come into operation, having to do with osmosis, and so on! So the water then goes back into the sea and sets up the conditions for the possibility of a recurrence of the cycle! So that is one example of a scheme of recurrence!

Additional examples from biology; the ATP cycle
and the oxidative phosphorylation cycle.

The latter as a conditioned scheme of recurrence.

• The pervasiveness of schemes of recurrence
throughout the world.

Another example is the *Adenosine Triphosphate Adenosine Diphosphate cycle* that takes place in your mitochondria. This is *the* biologically useful or accessible form of energy!

Explanatory Scheme of Recurrence
Adenosine Triphosphate

We'll see a little bit later on how that happens! You need it for example to have a functioning nervous system! You need it to be able to synthesize proteins in your body! You need it to be able to break down carbohydrates into sugars! You need it for almost every biological process that forms energy that is used in almost all living organisms — you need Adenosine Triphosphate! When Adenosine Triphosphate is converted into Adenosine Diphosphate, there is released biologically useful energy, usually in the form of energetic electrons!

But the cycle of ATP and ADP is not a two part cycle; it's a four part cycle! Because in order for there to be a transition from ADP, a chemical reaction has to occur here [Pat uses his pointer] in which energy is put it, either through photosynthesis or chemosynthesis or fermentation, or some other processes. And then energy is released into biological operations of one kind or another! And then ADP is restored! So this is another example of if A then B, if B then C, if C then D, and if D, then A again!

Explanatory Scheme of Recurrence
Adenosine Triphosphate
diagram enriched

This next slide presents a more complicated example of a scheme of recurrence. *This* [Pat uses his pointer] *is the cycle we just saw: the Adenosine Triphosphate cycle. It's now situated within a set of conditioned schemes of recurrence.*

Explanatory Conditioned
Schemes of recurrence

And the one I want to look at in particular is this one here [Pat uses his pointer]! This is called the Oxidative Phosphorylation Cycle! The input to oxidative phosphorylation comes, first of all, from sugars or carbohydrates, which are converted through another scheme of recurrence called the Krebs Cycle; and the outputs of the Krebs cycle are, for our intents and purposes, electrons, energetic electrons, which enter into the oxidative phosphorylation cycle; and the output from the oxidative phosphorylation cycle is the energetic electrons which energize the phosphate radicals, which then become combined with adenosine diphosphate to give us the adenosine triphosphate. *Here's another example of a scheme of recurrence.*

Explanatory Conditioned
Schemes of recurrence
diagram enriched

Now in all these cases, I've chosen schemes of recurrence which happen to have just an A, B, C, and D. *But they don't all have to have just four components! And in general, especially in biological organisms, the schemes of recurrence that take place have many more stages to them*. But this is just to give you some concrete illustrations of what Lonergan is talking about when he's talking about a stream of recurrence! In the first case, the classical correlations had primarily to do with thermodynamic physics. In the last two cases, they have primarily to do with chemical reactions, the laws of classical correlations governing chemical reactions.

And one of the things that's very interesting is that once you start to think about this business about schemes of recurrence, *you start to realise that they are everywhere*! *There are just scads* [a large number or quantity] of them. *There are all kinds of different ones*. But we don't usually walk around the earth thinking about things being in schemes of recurrence. *But once you start to think about it, there are just tons of them! And Lonergan is going to make a great point and a great deal of this*!

Schemes of recurrence as conditioned.

• The dependence of schemes of recurrence on the classical correlations (laws) that link their constituent events.

Discussion of: "What does it mean for classical correlations to be abstract?"

• What conditions enable classical laws to operate at all?

Nonsystematic processes as setting the conditions of emergence for classical laws to operate and for schemes of recurrence to appear.

• *A* is one condition for *B*, but there is also a vast set, or environment, of "other conditions being equal."

Schemes of Recurrence

As Conditioned

Schemes of recurrence are utterly dependent upon the classical correlations (laws) that form the connections among the sequence of events, A, B, C, D, …

> But as Lonergan points out, classical correlations are “abstract,” meaning that they depend upon conditions being fulfilled.
>
> E.g., laws of chemistry determine that the events in the oxidative phosphorylation cycle follow regularly only under the proper conditions (e.g., temperature, pressure, and pH ranges, and only if sufficient quantities of O^2 and e^- are provided somehow).

Now, having drawn attention to the fact that conditions for the occurrence of events can be set in cyclical fashion, Lonergan then becomes a little more concrete! And in becoming concrete, he says that *always classical correlations have multiple conditions*! That it isn’t just that the schemes of recurrence — The schemes of recurrence are utterly dependent upon classical correlations, or what we’re used to calling the laws of physics, the laws of science. But as Lonergan points out, *classical correlations are abstract*! Now what he means — Remember when he talked about that back in Chapter Three, where we were talking about his argument about the canon of statistical residues — *What does Lonergan mean by saying that classical correlations are abstract? What is his meaning there*?

Jeff: Oh, I guess that the opposite would be that they are not concrete, so in any one situation it could vary nonsystematically from the ideal frequency that is — or the ideal form of the classical law.

Pat: Ah, yeah [slightly hesitantly]. You put two things together: you put together the nonsystematic variation from a probability, and then the classical law, or some version of a classical law, forming something like that ideal frequency from which the variation diverges. Okay! But *let’s just stick with the notion of the abstract, just like the classical law itself.* … Matt?

Matt: Could we say that there are — The conditions would be like *external interferences*. So like, if you have like say the laws of physics and things like baseball! You're going to hit a fly ball and also a bird flies away and you hit the bird! And the ball like stops going on like the trajectory that it would go like according to the laws of physics. So when you get into the concrete, you have an abstract principle that's sort of guiding this, but something could get in the way and kind of mess the whole thing up!

Pat: Okay. You have to go back one more step!

Matt: Okay.

Pat: It's not just interferences, but enablers!

Matt: Right! Okay!

Pat: Okay! So before the bird gets in the way of the baseball — Angels' fans and Dodgers' fans, Los Angeles people everywhere, hoping for such things in the next two innings!

Matt: Okay!

Pat: Before the bird gets in the way of the flying baseball, what happens?

Matt: There has to be contact with the bat!

Pat: Exactly! And the contact with the bat is itself the condition for the possibility of the flight of the ball! And you could say, from another point of view, that the bat got in the way of the pitcher's pitch!

Matt: Sure!

Pat: *But what from one point of view is an interference, from another point of view is an enabling condition. And Lonergan, for all intents and purposes here, is more concerned with conditions as enablers*! *Under what conditions will certain concrete manifestations take place*? So Jeff was saying this thing about the nonsystematic divergence from something abstract. *But it's not just the nonsystematic divergence; it's the nonsystematic as setting the conditions for the emergence, for the occurrence of things*! So the classical correlations don't allow you to predict anything until *the conditions under which those classical correlations are actually functioning* are brought to bear! Okay?

Right! *So classical laws are abstract! Schemes of recurrence are concrete combinations of classical correlations*! *One of the conditions for B is A, but it's usually not the only condition for the occurrence of B when A occurs! There are usually other conditions as well*!

So for example, in the biological cycles that we just saw, if you put any organism at a high enough temperature or a low enough temperature, you change the conditions under which its life is going to be functioning! You change the conditions under which its classical correlations are going to be operating, and you change those conditions in such a way as A occurs and B no longer occurs. B doesn't occur not because A didn't occur, because it did! B doesn't occur not because somebody changed the classical correlations, because they didn't! *B doesn't occur because A is not the only condition, not the only concrete condition that brings the relationship, the concrete relationship between A leading to B in virtue of that classical correlation*! Okay, is that clear? … Okay!

So for example [drawing on third paragraph of the slide "Schemes of Recurrence as Conditioned"], the oxidative phosphorylation cycle needs not only a proper temperature range, it needs proper pH values, it needs sufficient quantities of oxygen and of energetic electrons; none of which, either the cycle itself, or the classical correlations that are the links in that cycle — they don't provide any of those conditions! Those conditions have to be given from outside!

Let me page back to an earlier slide!

Explanatory Conditioned

Schemes of recurrence

Enriched diagram

So each of these events [Pat uses his pointer] *is a condition for the occurrence of its successor, provided other conditions are given in accordance with the classical correlations of chemistry. So that's what Lonergan means by saying that classical correlations are abstract*! And that means therefore that schemes of recurrence function not only when A occurs, which sets off B, C, and D, but they also function when a vast sometimes unnamed —

and perhaps in some cases not easily nameable — environment of other conditions are in place.

Diagram & elucidation of how schemes of recurrence are conditioned by the way that their constituent links are conditioned.

Schemes of Recurrence

Diagram

So to talk about the schemes of recurrence more concretely is to say [Pat uses his pointer] that the cycle occurs when the proper conditions W for classical correlation #1 occur, and then A occurs and then you get B! And if in addition, the proper conditions X occur for classical correlation to bring about C as a result of, so to speak, the last condition that needed to be fulfilled, namely B; and likewise if other conditions are fulfilled for this, other conditions are fulfilled for that.

So schemes of recurrence are themselves conditioned because their constitutive links, their constitutive classical correlations, are themselves conditioned! So don't think that just — that the laws of physics say whenever A happens the cycle occurs! A, B, C, and D, are but a small fraction of the conditions that are essential for the occurrence of a scheme of recurrence! The conditions can be complex or they can be simple, depending on the nature of the scheme! But no scheme is itself self-conditioning! Okay?

"Quasi-Schemes of Recurrence" as Non-Systematic.

In the absence of the fulfilment of environmental conditions for a scheme of recurrence, the sequences of individual events of a scheme of occurrence can still occur, but as a merely random, independent series of events.

Student question as to whether this model is restricted to the natural sciences.

Student question as to whether the scheme of recurrence is circular.

Quasi-Schemes of Recurrence as Non-Systematic

What if the conditions for the connecting classical correlations are not fulfilled?

It can still happen, however, that a series of events that resembles a scheme of recurrence can still occur in the same sequence, but under conditions where the classical correlations do not work.

Then the sequence of events, A, B, C, D, … occurs as a merely coincidental, random series of events, each with its own respective probability of occurrence, p, q, r, s, …

Now, what happens if the conditions — that set of W and X and Y and Z, that environmental conditioning — what if that's not in place? Could you still get a scheme of recurrence? And the answer is: Sort of! But it would be a scheme of recurrence in which the events would become increasingly improbable! So in any given environment, the event A might happen, and there is some finite probability that it would happen. There are of course environments in which A would never happen! There's no way to grow a mushroom on the Sun! It's too darn hot!! So there the probability of a mushroom scheme of recurrence is just absolutely zero! But in a range of situations you might get the emergence of event A, even though the conditions for it to give rise to B are not there! It's the wrong environment for that classical correlation to bring about that effect under the added condition A! Could B occur? Yeah! It could occur! But not because of A, and not because of classical correlation # 1. It could also occur. It will have a probability associated with it! And likewise C and D! Each of them will have a probability!

Now a simple principle of probability theory is: if you have two un-associated events, two independent events, and the probability of one is p and the probability of the other is q, the probability of both happening is p times q. I just want to take that as a dogmatic fact. We're not going to prove that part of it! So that means that the probability of A, B, C, and D happening when they have no connection with one another — when they are independent events — will be the product of p, q, r, and s. Okay.

Somebody had a hand up there? Okay: Byron?

Byron: Are we still — Am I to assume that this is still strictly under natural science — the schemes of recurrence in terms of the natural sciences?

Pat: *Ahm, the answer — perhaps surprisingly — is no! It's — He's sketching out in a very general way*! And we will see in Chapter Seven that he has some implications — he's going to draw some implications for the human world. *The difficulty is that at this point we don't know what will be the difference between a natural science and a human science.*

Remember that the change in Lonergan's language is the change from law to correlation! So it's possible that in the human world there are ways in which people — and people are related to one another — people are related to things not human in regular and general and universal types of way. What that might be, and how they might be, remains to be seen! It isn't a matter of — *Notice I've been trying to make — trying to avoid the language of 'cause' here! I'm not saying A is the cause of B. Lonergan doesn't say that! Lonergan says A is one of the conditions for B. So a human science in the sense of the ways in which people behave because of the way that they are related to one another: that would be the rough framework — the rough heuristic — for what a human science would be about*! *And he's going to talk about the significance of emergent probability, of schemes of recurrence, in the human realm*. But we'll see that — We'll get a hint of it next week when we're looking at Chapter Six! We'll get a little bit more of it the following week — actually two weeks later — when we work on Chapter Seven. Okay?

Byron: Thank you!

Pat: So for the moment, no! He's using as illustrations here — *He's building an account that is flowing out of his account of the natural sciences, but there's nothing in classical correlations that's limited to the natural sciences*! … Michael?

Michael: Would it be right to say that a scheme of recurrence is a concrete, conditioned, circular, systematic process?

Pat: Yes, I think that's right! The tricky word there is 'circular.' For the moment we've been sticking with fairly simple examples of schemes of recurrence. *They can be a little more complicated, and not necessarily exhibit clearly or obviously circular patterns! Recurrences can have lots of side-trips and mutual conditionings that take place in them. And some of the more interesting biological ones are in fact like that*! But, with the exception of the word 'circular' and the dependence on 'circular,' yes!

Okay! Other questions? All right!

Probability of Quasi-Schemes of Recurrence resumed. The unlikelihood of a series of events occurring in a given pattern (A, B, C, D) if no classical correlations are in play.

- Then the probability of A & B & C & D … will be *p* • *q* • *r* • *s* … (N.B.: The probability associated with event D on the diagram should have been *s*, not *q*.)

- Then the probability of even 4 such events in sequence would be extraordinarily low.

Probability of Quasi-Schemes of Recurrence

So we're at the question of: *Well, what might it look like to have an A, B, C, D, … pattern in which the conditions are not appropriate for those linkages by means of the classical correlations*? You'll notice I've deliberately omitted the arrows from this slide: there are no arrows here! *That means the classical correlations are not responsible for the sequence of events*! *They just happen to happen! They just happen to occur in that order according to a divergent series of conditions that do not connect A to B. A is connected to its conditions, B is independently connected to its conditions; and they occur in accord with the probabilities*. So I just chose one over a hundred, three over one hundred, five over one hundred and two over one hundred, so that I could get a nice product, that wasn't too unwieldy. And that gives us a product of thirty times ten to the power of minus eight, or three over a billion!

Now, stop and think about that for a moment! *Something that happens once every hundred times is really not that infrequent*! You wouldn't want your salary to happen once every a hundred times [some laughter], and a number of other things! *But that's not that infrequent of a happening in the order of the universe*! And anything that is in that scale — five over a hundred is one in twenty times! *Those are not terribly infrequent events*! *But to say that they all happen in the order that they — concretely now we have hypothetically assumed — did happen, the probability of them happening in that order is three over a billion! That's extraordinary! It's only four events*! Okay.

So Lonergan is going to say that a site of pattern of events could happen, but the probability of that pattern of events is a very small fraction! …

Student question about whether the probabilities of events depends on to what the events are related. The legitimacy of isolating and selecting particular events; i.e., odds of me winning the lottery versus someone's winning the lottery.

– "What is the probability of this *single* event?" is a meaningless question.

– Discussion of probabilities, statistical frequencies, statistical methods as *only* applicable to collections or populations in a concrete, determinate space and time.

Pat: Mike?

Mike: I guess it's hard to phrase my question, but wouldn't the probability be in reference to a reference point, as far as trying to make a system out of what you see? So that like things happen all the time that are improbable, only in depending on the reference frame. So like, you're relating A to B, C, and D, but if you relate A to maybe something else, the probability could be higher, or lower. Do you see what I mean? It's a reference frame which the probability arises from, because you're relating it to B, C and D, whereas you could relate it to another scheme, that it might be more probable!

Pat: Okay. Let me see if I get the terminology! The terminology of a reference frame is actually jumping into chapter five. *The terminology for probability is place and time. So there has to be some concrete setting, some environment, in which you're talking about the probability of events A, B, C, D, ... occurring. So that was one of the conditions that we said that was necessary for doing a statistical, empirical study*! *It requires that one gets to say where and for what period of time are we talking about the probabilities*! I'm assuming that's what you meant by reference! There's a difference between what Lonergan, and in fact what scientists in general, mean by *reference frame*, and what's meant by *a concrete setting* in which you're doing your statistical study!

I think there was another part to what you were asking, and it's how frequently does A happen relative to something else, some other event, like maybe E! Is that what you're saying?

Mike: Uh, uh!

Pat: The answer to that is no!

[Laughter]

Student: The N word!!

[Laughter]

Pat: The probability is — The way that statisticians do their measuring is they say: *Well, in the ideal, let's take a look at this territory for the next hour, and we'll count the number of times that event A happens! Period*!! *Not relative to anything*! Relative only to the classification A!! So, if you've got a classification A, B, C, D, and E, E is only relevant in the sense that it helped you get your classification. It doesn't determine anything about how frequently events of type A occur! Okay? … Now, so the probability that there are more complicated settings or more complicated types of tests that you want to do, or you want to say not only how often does A happen, but how often does B following A happen, yeah; or in the case that you're saying, how often does A following E happen: then you've got something like a relative, but it turns out that it's the same kind of thing! It's just you've got a two events event, so to speak! Okay? Does that answer — Did I get the gist of your question?

Mike: Yeah, I think so! I was just thinking in terms of like the probability of *me* winning the lottery versus the probability of *somebody* winning the lottery. Like, someone is going to win the lottery every time to some extent, but me winning it is a lot less probable.

Pat: Okay.

Mike: Like, two references, I guess. That's what I meant by a reference frame.

Pat: I don't know if I said this before! But Mike has given me the occasion to say one of my favourite iconoclastic things. I've only got about three iconoclastic things to say!

[Some laughter]

And one of them is that *the notion of the probability of a single event is a meaningless notion! It doesn't mean anything!! The probability of me winning the lottery is a meaningless thing*! Has anybody got a coin?

[Pat searches in his pockets to no avail; a student helps out! Pat tosses the coin.]

Okay. What's the probability that that's a head?

Student: Fifty.

Pat: Wrong! You didn't listen to anything I just said!!!

[Laughter]

You didn't listen to anything I just said!

Maggie: There is no probability!

Pat: That's exactly right! Thank you, Maggie! Maggie said: "There is no probability of that coin being a head!" It is either a head or a tail! It has no probability whatsoever!

[Pat dons his spectacles and peers at the coin]

Pat: It's a head!!

[Loud laughter!]

So there's no probability of a single event! *Probability always has to do with a coincidental manifold!! Probability always has to do with some collection of events! It's an ideal frequency from which actual frequencies diverge! And one event does not constitute a coincidental aggregate! It's just an event*!

And you know, what Lonergan says, it's — *We bring certain kinds of presuppositions to the reading of any text, this one included*! And one of them is certain common presuppositions we have about probability and chance and so on. And *one of those presuppositions that we bring is that chance means "does not have any cause to it*!" *Lonergan says, at least three times, that each individual event in a nonsystematic process — each individual event in a coincidental manifold — can be fully determined*!! The problem of a concrete inference about a nonsystematic process is not that, given enough time, money and research grants, you couldn't figure out the classical connections between a divergent series of conditions that led up to this particular event! *The problem is that you're not dealing with just a single event, you're dealing with an aggregate, a collection, a population of events! And probabilities only mean something in that situation.*

So for Mike to say "the probability of *me* winning the lottery is different from the probability of *someone* winning the lottery" is the difference between saying something in which the term 'probability' is being used in an inappropriate way, and when the term 'probability' is being used in an appropriate way! Okay? So does that help?

Mike: Yeah.

Pat: So I think that if that was what was behind your question, then no!! Because *the reference frame is, as I said, a place and time! It's a location and a period of time in which you're doing the counting*! And then you're going to use the methods of statistical analysis to sort out what the ideal frequency from which that is a nonsystematic divergence. Okay? All right!

Other questions? …

Question about the diagram of the series of events where the arrows for the classical correlations have been subtracted from the cycle.

• Response. Water jumping out of a glass does not violate any classical laws; it is just extremely improbable.

• Question: Is it possible for these quasi-schemes of recurrence to create a situation where they become more probable? Only if they change the conditions of the environment where the classical correlations actually begin to forge connections among the events.

Pat:		Greg?

Greg:		I guess I'm wondering about this schema you have up on the board [the Probability of Quasi-Schemes of Recurrence slide]! And having removed the arrows, what does that now represent in terms of the processes we've been talking about?

Pat:		It's just a series of events!

Greg:		So referring back to the hydrological cycle which you were talking about a second ago, are we saying that say the conditions are such that A won't occur; but other conditions give rise to B, that aren't A! Is that —

Pat:		— No, no, let's start — No, no. Go back to A. So remember A was the evaporation of water.

Greg:		Right! Okay.

Pat:		This was one of the great moments in my education!

[Laughter]

My teacher for Statistical Physics walked into the class one day. And he had a glass of water. And he put it down! And at last he said: "Why doesn't all the water in that glass just jump out and splash on the table?" And we all said: "Well, it would violate the law of gravity!" And he said: "No. It wouldn't violate the — See, that's where I learned that! It wouldn't violate the law of gravity!! *It's just a highly improbable event*!!

[Class a little numbed]

And then the rest of the class we — And that's where I really began to understand what statistical method was all about!

So this [the diagram] is not a matter of the conditions of A not being present. Water could in fact, in a very improbable way, evaporate when the sun is not shining, when the temperature is not high. In fact, water evaporates off of ice — just not very often! It's very infrequent! That is why — That is actually part of the reason why freeze drying takes place. You can put things in a freezer and extract water from them at sub-zero temperatures! That's not something — It's just less probable than the water evaporating when there is a lot of heat being found. Okay?

So A can happen! But the conditions for B happening are not given! So A can happen; B can happen for a totally disconnected set of reasons or conditions that are given. Okay? So what we're seeing here [in the slide] is a series of events, each happening in sequence —

Greg: — So I think that's — in sequence! They happen —

Pat: — In sequence. They're happening in sequence! Yeah, but for no special reasons that link them! Okay? … Stephanie?

Stephanie: Is it possible for these isolated coincidental schemes of occurrence to create a situation where the same scheme of occurrence could happen more frequently, to increase the probability of that happening then?

Pat: Ah, not without the conditions for the connections of some kind of classical correlation.

Stephanie: So they would have to create somehow a product that would be a condition …

Pat: Yes, that's right! They would have to change the conditions of the environment so that then they would happen more frequently! Okay? And — I'm going to try to illustrate it! So one cycle of this — very improbable — Now be warned! I've changed the probabilities on the next slide just because they got a little bit too cumbersome!

Diagram of the evolution of series of events in time, albeit not connected by classical laws.

Extreme unlikelihood of *multiple* occurrences of a scheme in such a case.

Brief discussion of the implications for Intelligent Design and the order of the universe as such.

Scientists, therefore, treat recurrent schemes as heuristically indicative of some classical correlation.

Probability of
Quasi-Schemes of Recurrence
(Graph)

So think of this as *the evolution through time of a series of events which have no classical correlations between them*. So A is no longer one of the conditions for the occurrence of B. A has a certain probability of occurrence; B has a certain probability of occurrence; and so on! And we're going to see them happen through time. I've got this here [Pat uses his pointer] just really to separate them — You can think of them as occurring in different places. So A occurs here, B here, C here, D over here! Or you can think of that bottom line as being other kinds of ways of separating — *For the moment, let's just assume they are separated spatially somehow*!

And here [Pat uses his pointer] we have the divergent series of the conditions of A. So whatever these conditions are, they're what's responsible for A. And an independent set of conditions are responsible for the occurrence of B. A still further independent series of conditions are responsible for the occurrence of C. And likewise for D. These sets of conditions don't have any connection with one another. That was the point to Lonergan's argument about the diverging series of conditions in the section on **The Canon of Statistical Residues** (*CWL* 3, pp. 109-125).

And as I said, I changed the probabilities. So let's just assume they are all one in a hundred! And so what we get is the probability of that sequence of events occurring, in sequence, given their independence and given their — each of them has a certain probability — it is ten to the minus eight! *Now notice that's not a scheme of* ***re****currence! That is a scheme of* ***o****ccurrence*! Right? We've just got A, B, C, D! So we've got a pattern of events. *And in general, just about anything in the world is a series of events that has a set of probabilities associated with it.*

We tend to think of things as being improbable or probable, or likely or unlikely, quite frequently! *This is one of the things that comes up in the discussions of Intelligent Design: that certain things couldn't have happened merely randomly! Therefore there has to be some other kind of agency involved in bringing about their design*! And I used to like to say: "Well, for example, the 'Man in the Mountain' in New Hampshire."[1] And somebody quickly says: "Well, it's not there anymore, because that rock bunch collapsed!" *And the point I'm trying to make with that is that the collapse of that humanoid shape into a pile of rubble is just as probable as the occurrence of that humanoid shape*! It's not *exactly* just as probable, but … People tended to say: Well, certain kinds of things that appear to us to have a design are less probable than things that seem not to have a design. But *because they are all concrete occurrences, they are all very, very low in probability*!

What we've tended not to be able to do is to discriminate between this pile of rocks and that pile of rocks: if a pile of rocks looks like something, then we notice it and we remember it. But the fact that when we think it's special, it may very well be special to us — maybe we've cut rocks in there — but the point is *within the context of probabilities, they are all on an equal footing*!

So Lonergan has got a way of talking about these kinds of things! He ultimately is going to have **an** argument for design, but it's not going to be those arguments for design. *His argument for design is going to be an argument for the design of the universe! His argument is going to be an argument for design that he calls Emergent Probability. Emergent Probability itself is responsible for the sub-designs within the universe. And most of the Intelligent Design arguments try to say that something has to intervene in the natural process in order for these types of schemes of recurrence to have occurred*! And Lonergan is going to argue that there is no need for that! It remains to be seen whether there is any other kind of argument for it, but on the basis of statistical sciences and classical correlations, a great many very intricate, complex forms can come to be!

But there is something about the nature of the universe itself that calls for an explanation! Remember that funny little section in the "**Canons of Empirical Method**," *the* ***Canon of Complete Explanation*** (*CWL* 3, pp. 107-109): *nothing is self-explanatory*! That's sort of a — And *the thing that he was particularly concerned with at that point was the way*

[1] The 'Old Man of the Mountain', also known as the 'Great Stone Face' or the 'Profile,' was a series of five granite cliff ledges on Cannon Mountain in the White Mountains of New Hampshire, that, when viewed from the north, appeared to be the jagged profile of a face. The rock formation was 1,200 feet (370 m) above Profile Lake, and measured 40 feet (12 m) tall and 25 feet (7.6 m) wide. The site is located in the town of Franconia. The first recorded mention of the 'Old Man' was in 1805. It collapsed on May 3, 2003.

in which extension and duration took on the role of being self-explanatory in terms of which everything else was going to be explained. And if there's a deconstructive bone in Lonergan's body, that's where he uses it to beat something!!

[Laughter]

That's just a metaphor there!! That's where he brings it to bear: *that extensions and durations don't have any special privileged status, and they don't therefore allow you to automatically explain anything! That the design of the universe is itself something about which we can ask: "Well, why does it have that design and not some other design?*" *This is the design he says that the natural sciences in their broadest strokes, in their broadest heuristic features, are going to give us a picture of what kind of universe we live in*! But you can ask: Why is it that kind of universe? It could have been lots of other kinds of universes!! That's where the question of design comes from — not the question of whether or not cilia on certain kinds of unicellular animals could have come about through something like Emergent Probability.

All right! So back to the chart here [**Probability of Quasi-Schemes of Recurrence** graph]! *The scheme of* ***o****ccurrence is a highly unlikely scheme of occurrence*! But notice that it doesn't have zero probability! *It just has low probability*! It is the sort of sequence that could happen once in ten million times! *But what happens if the scheme repeats itself*? *And then repeats itself again*? Now, we've got a scheme of **re**currence! And now we've got not one, two, three, four events in sequence [Pat is using his pointer], but twelve events in sequence! *And the fundamental theorem of probability still is in place: the probability of those twelve events is still the product of their probabilities*! So the probability of a scheme recurring just three times with what are actually not very, very low probabilities, one in a hundred times for each of those events, is ten to the minus twenty-four, *if there are no classical correlations connecting those*!!

Scientists therefore tend to think that if something happens repetitively, there is probably a classical correlation responsible for it! They don't know what it is! But they use their heuristic anticipation of a classical correlation to seek the insights that will help them understand the why of recurrences! My best-friend in High-School's father once told me this joke: he said to the radical sceptic, If somebody jumps off the building and hits the side-walk and survives, he'll say that was *an accident*! The guy gets up and goes back up and jumps off the building again and survives, he'll say it was *a coincidence*! He goes back up and does it a third time and survives, he'll say it was *a conspiracy*!!

[Laughter]

Low probabilities!! If events are happening in nature in regular recurrent patterns, this is not evidence for — but at least the highly — It's going to make a scientist look for the intelligibilities that are relating those events, that explain them! Okay?

• Question as to whether the order of the events in the quasi-scheme of recurrence affects the probability.

Any questions about that? … Deb?

Deb: So does order matter? In this case here it says —

Pat: — It actually doesn't't! It actually doesn't!

Deb: Okay!

Pat: *If you did A, A, B, C, C, D, it would still be the same probability*! *The order doesn't matter*! I just did it this way because we're interested in recurring patterns! You're right! *The order doesn't matter*! This ordered version is just one of the ten to the minus twenty-four possible combinations that could happen! … Actually it's not, because these things would only take up four one-hundredths of the possibilities of whatever population of events you're actually looking at!

Probabilities of Conditions.

Comparing classical and statistical laws, i.e., what happens when conditions are fulfilled versus how often one may expect them to be fulfilled.

The Kind of Intelligibility that Probability is: a "funny kind of governance of events," different from the intelligibility of classical correlations of events.

- Not the kind of causality we are accustomed to thinking of.

- Ideal frequencies, probabilities, can change over time – setting new norms from which events diverge nonsystematically.

Empirical method requisite for determining probabilities (ideal frequencies).

Probabilities of Conditions

"Classical laws determine what would happen if conditions were fulfilled, while statistical laws determine how often one may expect conditions to be fulfilled." (*CWL* 3, p. 134).

Now here's where Lonergan's — I think there's some subtlety and something of genius here!! Remember Lonergan says: nonsystematic events — *Every event in a nonsystematic process has an intelligibility that can be treated by classical methods*! You can figure out why A happened according to the Zs that led up to it, Ys that led up to the Zs, Xs that led up to the Ys. You could do that so that, depending on how far back you wanted to go, the occurrence of each event could be fully intelligible, fully determined, is in combinations of classical laws.

> But *the probability is the different kind of intelligibility! Nonsystematic processes have a different kind of intelligibility*! *Coincidental aggregates have a different kind of intelligibility than do the events in them*! *And the kind of intelligibility that they have is called probability*, *ideal frequency*! Now, there's a funny kind of governance, so to speak, that probability exerts! *It's a governance that things cannot systematically diverge from the probability if that's really the probability*! *If they systematically diverge from that ideal frequency, then that's not the probability*! *That's what probability is: a probability is an ideal frequency from which actual occasions diverge in nonsystematic ways! And if there's a systematic divergence, then you're not talking about a probability*!!

When Lonergan begins to explore what happens when we bring together the kind of intelligibility that is proper to classical-side types of investigation, and the kind that's proper to statistical-side types of investigation, this is one of the things he observes:

> **Classical laws determine what would happen if conditions were fulfilled, while statistical laws determine how often one may expect conditions to be fulfilled**. (*CWL* 3, p. 134).

Classical laws can determine what would happen if conditions were fulfilled; and statistical laws will determine how often we may expect the conditions to be fulfilled; but only as an ideal frequency! Now, what that means is: over a sufficient period of time you have the expectation that maybe a thousand of these events ought to have occurred, but you don't know where or when. To know where and when with precision is the sort of thing that a classical correlation could give you! To know that over a period of time a hundred of them will occur — but some of them might occur very close together in place and time, others distant in place and time for no systematic pattern — that's the kind of intelligibility that statistics is concerned with! *So statistics will tell you how often events occur; classical correlations will tell you that those are really interesting events that occur with that frequency, because they can be conditions for other kinds of events taking place*!

So classical laws determine what would happen if conditions were fulfilled over a specified time; and statistical laws determine how often we may expect those conditions to be fulfilled!

The Kind of Intelligibility

That Probability is.

IF the probability of rain is truly is 90/365 (ideal frequency), *then* occurrences of rain (actual frequency) *will* happen in patterns that vary non-systematically around 90/365. A quasi-causality.

Now, the kind of intelligibility that probability is: *If* the probability of rain is truly 90 over 365 — 90 over 365, say ninety days out of 365 days in the year, then on average for — actually the probability of the rain would be ninety days in 365 days of a year. That doesn't mean, of course, that if you get towards the end of the year and it only rained eighty times, that you can be sure it's going to rain in the last ten days of the year!! That might be the year in which it falls below ninety, only to be compensated for in following years. So on the average, that's the probability.

Now notice what I'm saying! I'm saying, *let us suppose for the moment that we know ninety over three hundred and sixty-five to be the true probability governing that class of events*. *It's a big supposition! I'm just saying let's suppose we know that's true*! Then, that means that the actual occurrences of events will happen in patterns that vary non-systematically around that ideal frequency! *It's what I would call a kind of quasi-causality*! *It's not causality of the type that we are used to thinking of when you are thinking of efficient causality, it's not causality in the sense that the laws make it happen*! *But if you know for* *certain that that's the probability, then it is not the case that it never rain*s! On any given day it might not rain, in any given month it might not rain. But if it never rains, year after year, decade after decade, then that's not the probability: because that's a *systematic* divergence from that expectation!

It can happen that the probability is changing! Sometimes it seems to us that the probability of rain in Boston is going up!! *Scientists now have some pretty good evidence that the atmosphere is heating up! We don't know for certain whether or not that's totally due to human activity*. *It seems pretty likely*, but we don't know this for certain: because the earth's climate has gone through very long cycles of tens of thousands and hundreds of thousands of years. We could be going into one of those and the human component is just an add-on! Probably not, but! … What that means is that as you have a cycle of the earth heating and cooling as you move in and out of glacial periods, which clearly did not have anything to do with human industrial pollution — *as you move in and out of glacial periods, the probability of rain goes up or it goes down according to those cycles*. *But to say it never rains, and the probability of it raining is 90 over 365, those are not — those are two incompatible statements*! And scientists very quickly begin to suspect — if after long periods of time, they are not getting anything close to the ideal frequency in the samples of the actual frequencies — they begin to suspect that they were wrong about the probability. But *if the probability is correct, then that acts as though it were a kind of governance of the pattern of events; that they are going to happen in a way that oscillates around the ideal frequencies!*

This is terribly important for Lonergan's account of Emergent Probability!

The Kind of Intelligibility

That Probability is.

IF the probability of rain is truly is 90/365 (ideal frequency), *then* occurrences of rain (actual frequency) *will* happen in patterns that vary non-systematically around 90/365. A quasi-causality.

But *knowing that* the probability of rain *truly* is 90/365 requires empirical method.

But actually knowing that 90 over 365 is the truth — the true probability for that class of events in this realm — requires the exercise of *some sophisticated* statistical methods! So when you are doing *the mathematics* of probability you can say "*Let us suppose* this is the probability!" Or "*Let us suppose* that all these events have equal probability!" Empirical investigators can't get away with that!

There's a passage in a book by Evelyn Fox Keller, a biography of Barbara McClintock,[2] which I use in another class; and one of the geniuses of Barbara McClintock was that she was so familiar with the concreteness of the way in which Corn Brew can reproduce, that she began to be bothered by very, very slow deviations in the probabilities. And she developed a very complicated theory as to what was going on: what systematic factors were operating that were responsible for these very subtle variations in actual frequencies. And she had some difficulties — *because the theory was so complex, she had some difficulty communicating it to other people, and it wasn't accepted; later on it turned out that she was right*! But they were very, very subtle variations in the actual frequencies,

[2] Evelyn Fox Keller, *A Feeling for the Organism: The Life and Work of Barbara McClintock*. (New York: Times Books), 1984. Barbara McClintock (1902–1992), the 1983 Nobel Laureate in Physiology or Medicine, was an American scientist and one of the world's most distinguished cytogeneticists.

and *she put her statistical method and her mind to work on this problem, and she came up with another kind of explanation of what that systematic variation was*! So you have to actually do statistical empirical method to figure out what the probability *actually* is; but *that there is a probability means that there is a kind of quasi-governance of events*. It can't just not happen if that's a part of it!

Shift of Probabilities of Emergence when conditions are fulfilled.

Reasons for dramatically increased odds of the recurrence of the scheme.

– Any one of the events in the scheme triggers the whole cycle.

– Probability jumps from a product to a sum.

– The probability of A & B & C & D … will now be the much higher $p + q + r + s$ …

Shift of Probabilities of Emergence, when Conditions are Fulfilled

But if the conditions for all of the connecting classical correlations are fulfilled, a dramatic change occurs.

Now, to go back to what we were looking at a moment ago! I said *suppose* that the conditions are such that those classical correlations are *not* operative so that the condition A leads to the event B, and the event B leads to the event C, and the event C leads to the event D, and the event D leads to the re-occurrence of A, which then shapes the cycle. *So we were saying, suppose the conditions aren't given, you could still have something like that pattern of recurrence, but with astronomically small occurrence*. That ten to the minus twenty-fourth is getting up at the edge of the number of nano seconds that happen in the universe! [Pat reflects:] I'm not sure if that's right!?! … *It's pretty close, yeah*! The number of nano seconds in the universe is about ten to the twenty-fourth. It would take the whole universe long for that triple recurrence to occur merely by chance — merely non-systematically.

But now let's suppose that everything's cooled down; we've got the right pHs,[3] the pressure is right, and that the birds are singing, the leaves are out, we have got a lot of fulfilment of conditions; then what happens?

Shift of Probabilities of Emergence, when Conditions are Fulfilled

But if the conditions for all of the connecting classical correlations are fulfilled, a dramatic change occurs.

In that case, as soon as any one of the events, A or B or C or D or …, occurs, then the entire sequence of events as a whole emerges (i.e., begins to operate) in virtue of the classical correlations.

What Lonergan says is that then we are — then the scheme occurs, not just when A *and* B *and* C *and* D all happen to occur according to their probabilities, but independently of one another — *What happens now is that if any one of the events in that scheme occurs, the scheme will occur! And it will recur, as long as the conditions are given*! *And that means — again according to the simple theory of probability — that the probability of the scheme as a whole beginning to occur and recur is not the product of the probabilities, but the*

[3] In chemistry **pH** is a measure of the activity of the (solvated) hydrogen ion. **p[H]**, which measures the hydrogen ion concentration is closely related to, and is often written as, pH. Pure water has a pH very close to 7 at 25°C. Solutions with a pH less than 7 are said to be acidic and solutions with a pH greater than 7 are basic or alkaline. The pH scale is traceable to a set of standard solutions whose pH is established by international agreement.

sum — because any one of those events can kick off the cycle and make it become a recurring pattern!

• Animation of shift of probabilities of emergence when conditions are fulfilled.

• But the conditions for this shift of probabilities, and for the emergence of the scheme, are fulfilled nonsystematically.

Shift of Probabilities of Emergence, when Conditions are Fulfilled

But if the conditions for all of the connecting classical correlations are fulfilled, a dramatic change occurs.

In that case, as soon as any one of the events, A or B or C or D or …, occurs, then the entire sequence of events as a whole emerges (i.e., begins to operate) in virtue of the classical correlations.

The probability of <u>either</u> A or B or C or D or … occurring is p + q +r + s + … = the probability of emergence.

This means that the recurrence can begin anywhere in the cycle; that any event can kick off its emergence. And it will continue to recur as long as the fulfilling conditions remain stable (*caeteris paribus*: "other things being equal").

And so we just saw the scheme occur because A occurred, and A had — watch out, I'm shifting back to the other probabilities — A had the probability of one in a hundred. So one in a hundred times — *When the conditions for those classical correlation connections are satisfied, any time A occurs, the scheme will occur, and in fact will keep* ***re****curring! So the probability of* ***o****ccurrence of the scheme is one in a hundred; and in fact the probability of the* ***re****currence of the scheme is also one in a hundred. Once it gets going, as long as the enabling conditions are still being fulfilled in whatever way they are — the proper temperatures and so on — it's going to keep recurring*!

Schemes of Recurrence

(Diagram)

So that the pattern will not only **o**ccur, but **re**cur one in a hundred times. But things get better!! Because not only will the scheme begin if event A happens to occur in that atmosphere, in that environment of proper conditions; but if B happens to occur, it too will set off the cycle! And now notice what happens! The cycle can occur with the probability of one in a hundred if A happens; *plus* three in a hundred if B happens; *plus* five in a hundred if C happens; *plus* two in a hundred if D happens!! *So any one of those events can set off the cycle, because the conditions are present for the classical correlations to make those connections*! And *now we have something bordering on the occurrence of the scheme being close to one tenth, as opposed to one over ten to the minus twenty-fourth power*.

So that's what Lonergan means by saying that the probability of emergence jumps from a product to a sum! That the conditions for the emergence of that cycle are fulfilled not systematically. *Schemes can happen if the conditions come together in the right place at the right time, and thereby enable the classical correlations to make those conditions so that the environment becomes fertile for the possibility of the emergence of that scheme if any one of those events happens*! And when the conditions are satisfied, you have an environment that's ready to give birth to these schemes of recurrence!!

Scheme of Recurrence

(Graph)

And now notice, I have the arrows in there [on the graph] to show the classical intelligibilities of relatedness among those events where before there was no relatedness! *And it not only occurs, but it recurs if any one of those events happens in the first place*! [Graph is filled in further]. *So the probability of occurring, and indeed recurring, is a very high probability! It's very dramatic*! Very dramatic! Okay! Any questions about that much? …

Now the important thing for Lonergan, of course, is not just the emergence of a scheme! *This is the fundamental meaning for Lonergan of Emergence: he is going to draw some consequences for the emergence of **kinds of things** as a result of his analysis of the emergence of different **kinds of schemes***! *But for the moment, the fundamental component here is the emergence of a scheme of recurrence! And then he generalizes it to talk about the fact that now schemes of recurrence — once they emerge — they themselves can be conditions for other kinds of schemes of recurrence*! I'll give you some examples of this!

Nonsystematic Assembly of Conditions source of
Creative Emergences.

• Genuine self-appropriation of natural science
implies that the universe is creative, not deterministic.

Prior schemes of Recurrence as Conditions for
Later Schemes.

• Pyramids of schemes resting on schemes.

Universe as upwardly but indeterminately directed.

• Teleology of the universe: Directed but an
unknown, unpredetermined outcome.

Non-systematic Assembly of Conditions for Creative emergences

“Systematic process is monotonous, but nonsystematic process can be the womb of novelty. … Hence, as will appear in chapter 4, within a large nonsystematic process there can be built a pyramid of schemes resting on schemes in a splendid ascent of novelty and creativeness.” (*CWL* 3, p. 75).

As he says, “**Systematic process is monotonous, but nonsystematic process can be the womb of novelty. … Hence, as will appear in chapter 4**,” — This is back in Chapter Two that he is writing this — “**within a large nonsystematic process there can be built a pyramid of schemes resting on schemes in a splendid ascent of novelty and creativeness.”** (*CWL* 3, p. 75).

> *So this is what Lonergan is saying, that really paying attention to natural science, really appropriating insight and its fundamental role in natural science, and paying attention to these two different kinds of scientific insights that are sought by investigators, that they give us not a deterministic universe, but a universe that is full of novelty and creativity and emergence*!

Okay? … Okay!

Prior Schemes of Recurrence
As Conditions for Later Schemes

Lonergan's brilliance comes in his realization that some schemes can themselves become conditions for the regular recurrence of subsequent schemes.

This, combined with his discovery of the conditioned shift in probabilities emergence implies that the universe, at least as far as the methods of classical and statistical sciences are concerned,

is *inevitably* "**upwardly but indeterminately directed.**" (*CWL* 3, p. 655).

So just to repeat what I just said before, *his analysis of the ways in which the two kinds of intelligibilities can be combined give a picture of the universe which is, as he puts it* "**upwardly but indeterminately directed.**" (*CWL* 3, p. 655). '**Indeterminately,**' *because of the intrinsic, nonsystematic quality of the processes in our universe*! But '**upwardly,**' *because if there is a probability of certain events occurring, and there is a probability of those events being the conditions for certain kinds of connections among other events, that sooner or later those schemes emerge; and once those schemes emerge, they therefore set the conditions for the possibility of the emergence of other, more complex schemes of recurrence* [word 'recurrence' uncertain as sound becomes blurred here], *those schemes being supplied as the conditions for the higher schemes*. '**Upwardly**,' *because later schemes rely upon earlier schemes as their conditions*! '**Indeterminately,**' *because the whole thing happens, as he says, not by some iron — not running down the iron rails of some deterministic universe — but in accord with nonsystematic processes that nevertheless have a kind of intelligibility to them, that is the intelligibility of probability*! *The universe is not* *deterministic*; *but neither is it purely chaotic*! *Randomness is actually compatible with a kind of intelligibility called probability*! And the probability is responsible for the upward bit! And the nonsystematic is responsible for the indeterminacy of that upward bit. It's a funny kind of teleology! *It's a teleology of the universe that has a directedness to it, but the outcome is not a known outcome*! Okay?

Student Questions:

Question about development of increased systematicity of the universe over time.

– Distinction between the universe as having a more systematic elements *versus* being more systematic as a whole.

Question about how the events and their probabilities can be independent, have no intrinsic connection to one another, if there are conditions.

– Conditions have to do with classical laws, not probabilities. Methodological presumption of events as independent.

Okay! Any questions about that? … Yes, Stephanie?

Stephanie: So if we take up the idea that Lonergan believes that as the universe moves forward it becomes more systematic —

Pat: Right!

Stephanie: — Is it possible then that emergent probability becomes less likely, or more limited as you progress through time; or is it like a Bell Curve, where you start up more system or more systematic and then less systematic, or then more systematic? Or — Because emergent probability seems like a progressive thing, but he seems to think that the future is more systematic!

Pat: *By "more systematic" he means that there is more systematic stuff happening! Not that the whole process necessarily becomes more systematic! There's a possibility of that! There's a possibility that at some stage, the complex sets of schemes of recurrence that are actually functioning become the conditions for the emergence of something that could be systematic! So it's not ruled out*! But what he really means when he uses the phrase "more systematic" —

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).

Emergent Probability

[points (2) to (9)]

What he means when he says that the universe is increasingly systematic is just that there is more systematic stuff in it! Not that the whole is systematic! It's possible that a grand system could emerge, but he's not predicting that! … Deb?

Deb: I don't understand conditions with the independence of probability that's shown either in multiplying or adding the probabilities. So how can there be conditions without dependent probabilities?

Pat: Okay. Well, the conditions are — How do I want to say this? — *The conditions have to do with the classical correlations. Classical correlations take on different manifestations under different conditions! The conditions don't — So in other words, when* *we speak of the 'conditions' for things, that's a term that has its valence with regard to classical correlations, not with regard to probabilities*! *Not with regard to coincidental aggregates*! *Coincidental aggregates are co-inciding — They are coincidental! Because they will just happen to be there, but not for the same set of reasons*! Classical correlations — You give me the conditions under which the classical correlations are operating, and I'll tell you, if event A happens, what will follow it! If event A happens under these conditions, maybe B won't happen but something: L will happen. Because — now you change the conditions, A happens, I will tell you that instead Q happens. Because classical correlations tell us: under these conditions when A happens, this will be the outcome! But it doesn't have to do with probabilities!!

I don't want to complicate things too much! There's — Probabilities change when conditions change! The frequency of molecules with certain kinetic energy will change as the temperature goes up. That's actually a combination of classical and statistical things, so it gets a little complicated. *But the simple answer is that the conditions, as we're talking about them, have to do with classical correlations and not with the probabilities*! Even though all the events have no intrinsic connection to one another, they nevertheless oscillate around an ideal frequency! Okay?

Deb: But how can they have no intrinsic connection to each other, I guess, is what I'm asking! So in the scheme — You know, where you showed earlier that A leads to B to C to D. If you switch C for A, or you can switch any one of those, and sure you can change the likelihood of A and B because then you'll do A and C! But it still wouldn't — I mean, you would still have some point in time in which B is dependent upon A! Or you would have cases where B would be depending upon A. And A would change so —

Pat: *Only because some classical correlation would make that connection*! The probability doesn't make that connection in and of itself! When we talk about a statistical sample, the presumption — In fact, the methodological — It's methodologically necessary that they be independent events! If they're not independent events, you have to change the way in which you're doing your sampling, you have to change the way in which you're measuring your probabilities, you're measuring your actual frequencies! Okay?

Deb: Okay!

Pat: So concretely it could, in some phenomenon that you're investigating, A eventually affect things in such a way that B will happen! Sure!! *But that is because of a classical correlation! It's not because of a statistical phenomenon*! Okay?

Deb: Yeah.

Question about whether it is ever possible to truly know ideal frequencies, given their dependence on time and space and their changeability.

– Methodological decisions help determine what is statistically significant, and these methods are evolving.

Has a scheme of recurrence ever proven to be merely a quasi-scheme of recurrence, or vice versa? Isn't the onus on a scientist to prove that a series of events is really a scheme of recurrence, and not a quasi-scheme of recurrence?

– Discussion of both situations, some illustrations, and their implications.

Pat: Elizabeth?

Elizabeth: About ideal frequencies: I was just wondering *can we ever truly know an ideal frequency*! Just because, I mean, knowing that since it requires a certain space and time, a sample, right, in space and time; But they can never have a big enough sample. Or, you know, time! As an economist, you can look back on the past, and say: well, this is probably what will happen in the future! But you cannot ever *really know* because, you know, *things might change in the future*! You know. Do you see what I'm saying?

Pat: Yeah. That's a really, really, good question! How do I want to say this? It would get us into a little more complicated version of Philosophy of Science.

Elizabeth: Okay!

Pat: At any point in time scientists make what Karl Popper[4] and Imre Lakatos[5] and Paul Feyerabend[6] called "methodological decisions"!

Elizabeth: Uh, uh!

Pat: *Among the methodological decisions are that this is a better way to do science than we have been doing it in the past! That's not the same as saying, I'm changing my hypothesis, or I'm correcting my results! It's the way of proceeding that is going to be changed*! And just the very idea of starting to use statistical methods is one! Galileo's idea of using the theory of proportions, and then being succeeded by people like D'Alembert[7] in using algebraic formulas — And Descartes! *Those are all methodological decisions about how to do science*! *One of the methodological decisions is what you choose as statistically significant*! So with P now. Why should P be one over a thousand or one over a million? *That is a methodological decision! And they do change*!

Elizabeth: Uh, uh!

Pat: *So can we ever really know*? [Pat pauses over this]. *I think the answer is yes, but it's not something that we have got to the end of the world with in terms of figuring out how to do statistical methods to get to the best accounts of what ideal frequencies are*! There are certain areas in which scientists are pretty good at coming up with statistics.

---

[4] **Karl Popper** (1902–1994) was an Austro-British philosopher and professor at the London School of Economics. He is generally regarded as one of the greatest philosophers of science of the 20th century. He also wrote extensively on social and political philosophy. In 1992 he was awarded the Kyoto Prize in Arts and Philosophy for "symbolizing the open spirit of the 20th century" and for his "enormous influence on the formation of the modern intellectual climate".

[5] **Imre Lakatos** (1922–1974) was a Hungarian philosopher of mathematics and science, known for his thesis of the fallibility of mathematics and its "methodology of proofs and refutations" in its pre-axiomatic stages of development, and also for introducing the concept of the "research programme" in his methodology of scientific research programmes.

[6] **Paul Feyerabend** (January 1924–1994) was an Austrian-born philosopher of science best known for his work as a professor of philosophy at the University of California, Berkeley, where he worked for three decades (1958–1989). He lived a peripatetic life, living at various times in England, the United States, New Zealand, Italy, Germany, and finally Switzerland. His major works include *Against Method* (published in 1975), *Science in a Free Society* (published in 1978) and *Farewell to Reason* (a collection of papers published in 1987). Feyerabend became famous for his purportedly anarchistic view of science and his rejection of the existence of universal methodological rules. He is an influential figure in the philosophy of science, and also in the sociology of scientific knowledge.

[7] **Jean-Baptiste le Rond d'Alembert** (1717–1783) was a French mathematician, mechanician, physicist, philosopher, and music theorist. He was also co-editor with Denis Diderot of the *Encyclopédie*. D'Alembert's formula for obtaining solutions to the wave equation is named after him.

Economics is not always one of them! But in Quantum Mechanics they are actually pretty good, for the most part! Okay?

Elizabeth: Thank you!

Pat: Mike?

Mike: I've got a Lakatos related question. If from the perspective of a scientist, I'm trying to figure out whether I have a scheme of recurrence on my hands; the onus is on me to demonstrate that some classical correlation is setting conditions for the next event! So D sets the conditions for A!

Pat: Uh, uh!

Mike: But if I'm unable to determine that, and then continue to see A and then B, and then C and then D in the *quasi-scheme* of recurrence, I'm not going to abandon my research programme and say there's not a scheme of recurrence. I'm probably going to think that I've missed some sort of correlation —

Pat: — Right! That's right!

Mike: — that's setting the conditions!

Pat: That's right!

Mike: So if that's the case, I guess my question is: how does the scientist determine — or let me phrase it this way — Does the history of scientific discovery ever show instances where one has thought they had a scheme of recurrence, when in actuality it was later discovered to be a quasi-scheme, or vice versa; a scientist thinking he had a quasi-scheme when in actuality that was later discovered to be a scheme?

Pat: *Ahm, the first: yes*!

Mike: Okay.

Pat: For example, heat was thought to be a fluid. Caloric was for a while thought to be a fluid of some kind.[8] And it was investigated as though it were so. And the

[8] Several theories on the nature of heat were developed. In the 17th century, Johann Becher proposed that heat was associated with an undetectable material called phlogiston which was driven out of a substance when it was burnt. This was finally refuted by Lavoisier demonstrating the importance of oxygen in burning in 1783. He proposed instead the caloric theory which saw heat as a type of weightless, invisible fluid that moved when out of equilibrium. This theory was used in 1824 by the French engineer Sadi Carnot when he published *Reflections on the Motive Power of Fire*. He set forth the importance of heat transfer:

theory of thermodynamics is exactly that: it was the dynamics of heat-flow! And for certain programmes in scientific investigation, they were tying to figure out the nature of that fluid, its compressibility, why it was so permeable — why it could pass through things, and so on. It was Joule[9] and — I forget the other guy [perhaps Mayer is intended] — who — and then finally Clausius[10], who made the strong case for the fact that heat is a fundamental statistical phenomenon, and not a scheme of recurrence of that kind! So that would be the most obvious example!

Mike: Okay!

Pat: If I could give it some thought and I might come up with some more. But that would be an obvious one!!

There's a thing called the Carnot cycle.[11] It's a cycle that basically is the phenomenon of an internal combustion engine! Heat expands and then it contracts, and the

---

"production of motive power is due not to an actual consumption of caloric, but to its transportation from a warm body to a cold body, i.e. to its re-establishment of equilibrium." According to Carnot, this principle applies to any machine set in motion by heat.

Another theory was the kinetic theory of gases, the basis of which was laid out in 1738 by the Swiss physician and mathematician Daniel Bernoulli in his *Hydrodynamica*. In this work, Bernoulli first proposed that gases consist of great numbers of molecules moving in all directions, that their impact on a surface causes the gas pressure. The internal energy of a substance is the sum of the kinetic energy associated with each molecule, and heat transfer occurs from regions with energetic molecules, and so high internal energy, to those with less energetic molecules, and so lower internal energy.

The work of Joule and Mayer demonstrated that heat and work were equivalent forms of energy, and led to the statement of the principle of the conservation of energy by Hermann von Helmholtz in 1847. Clausius demonstrated in 1850 that caloric theory could be reconciled with kinetic theory provided that the conservation of energy was employed rather than the movement of a substance, and stated the First Law of Thermodynamics.

In 1851, William Thomson outlined the essentially modern view, as based on recent experiments by those such as James Joule on the dynamical theory of heat, that:

Heat is not a substance, but a dynamical form of mechanical effect.

On this view, he argued that we must "*perceive that there must be an equivalence between mechanical work and heat, as between cause and effect.*"

[9] **James Prescott Joule** (1818–1889) was an English physicist and brewer, born in Salford, Lancashire. Joule studied the nature of heat, and discovered its relationship to mechanical work. This led to the theory of conservation of energy, which led to the development of the first law of thermodynamics. The SI derived unit of energy, the joule, is named after him. He worked with Lord Kelvin to develop the absolute scale of temperature, made observations on magnetostriction, and found the relationship between the current through resistance and the heat dissipated, now one of the two laws called Joule's law.

[10] **Rudolf Clausius** (born **Rudolf Gottlieb** (1822–1888)), was a German physicist and mathematician and is considered one of the central founders of the science of thermodynamics. By his restatement of Sadi Carnot's principle known as the Carnot cycle, he put the theory of heat on a truer and sounder basis. His most important paper, *On the mechanical theory of heat*, published in 1850, first stated the basic ideas of the second law of thermodynamics. In 1865 he introduced the concept of entropy.

[11] The **Carnot cycle** is a theoretical thermodynamic cycle proposed by Sadi Carnot in 1824 and expanded by Benoit Paul Émile Clapeyron in the 1830s and 40s. It can be shown that it is the most efficient cycle for

piston moves up and moves down. That was thought to be a fairly systematic thing. It turns out to be a statistical thing! And once you use the statistical approaches, certain things that turn out to be funny about a Carnot cycle become explainable: the fact that you can't make a hot air do as much — or cold air do as much work as hot air, for example!

Mike: But does it create the converse problem that if I have what one research programme calls a quasi-scheme of recurrence, I can never be sure that it's a quasi-scheme of recurrence because there may be some condition correlation that would set the conditions!

Pat: Yeah! The fact of the matter is that in the history of the physical sciences as we are living them now, we have — the classical correlations we have, and indeed the probabilities that we have, are the best ones that we have available, with a lot of further questions hanging! *Our knowledge of the scientific correlations and probabilities is not absolutely certain; it's the best available understanding that we have*! And that's another dimension of scientific investigation. It gets into the question of *judgment and unconditioned judgments and probably unconditioned judgments* which are a little bit further down the road! Okay?

But our scientific knowledge is not absolutely certain! It's the best understanding that we've got right now! But that tends to mean that whatever is going to be true, is not going to be ***drastically*** *different — that the results that have been attained so far are not going to be wiped out*!

Mike: Right, right! It's just the perspectival — It's the perspective of the scientist in calling one a quasi and one a scheme of recurrence?

Pat: Well, you can only call it a scheme of recurrence if you've got a classical correlation that shows why it connects! And scientists do come up with those!

---

converting a given amount of thermal energy into work, or conversely, creating a temperature difference (e.g. refrigeration) by doing a given amount of work.

Every thermodynamic system exists in a particular thermodynamic state. When a system is taken through a series of different states and finally returned to its initial state, a thermodynamic cycle is said to have occurred. In the process of going through this cycle, the system may perform work on its surroundings, thereby acting as a heat engine. A system undergoing a Carnot cycle is called a Carnot heat engine, although such a 'perfect' engine is only a theoretical limit and cannot be built in practice.

Otherwise, it looks like it's probably a scheme of recurrence, but I don't see anything but a random thing so far! Okay?

Okay! So why don't we take a break here? And we'll come back in — I'll finish this up with some illustrations of this notion of the conditioned series of schemes of recurrence. And then go on to talk about the intelligibility of Space and Time.

Insight & Beyond: Lecture 7, Part 2:

Chapter 4, § 2 “Complementarity in the Known: Emergent Probability (continued),” and Chapter 5 §§ 1&2: “Space and Time:” Kind of Spaces and Times

Summary of Material

- Discussion of Emergent Probability.
- Characteristics of emergent probability: the world process is open, increasingly complex types of systems emerge based on more basic level schemes.
- Lonergan’s worldview – emergent probability – unique.
- Neither “runs along the iron rails laid down by determinists,”

nor “a non-intelligible morass of merely random events.”

- This world process admits of differentiations; the classical correlations that underlie processes and schemes of recurrence open to vast range of possibilities.
- World process of emergent probability is liable to breakdowns, and is continually evolving.
- It is an evolutionary worldview, similar to, but distinct in important ways from Darwinism.
- Why later schemes are more narrowly distributed in space.

- In order for certain later schemes to emerge, need favourable conditions, which will only be a small subset of all the actual events. Hence, universe has to go down a great many "blind alleys" in order that certain later schemes may emerge. Universe as "fiddling around."
- "Highest" schemes depend upon the realization of a great many events that *seem* meaningless.
- Conditioned Series of Schemes of Recurrence, and ever-shifting "schedules" of probabilities.
- Various examples from ecology and physics: Emerging vegetation forms and recurrent ecosystems. The emergence of oxygen and oxygen-based life forms from anaerobic life-forms.

Stellar fusion and radiation cycles. Planetary system formation.

- Series of Student Questions:
- Student question about the status of classical correlations during the first instants after the Big Bang, prior to any schemes of recurrence.
  - – Classical correlations always apply, but are open to various manifestations depending on the conditions. Discussion of abstract and concrete conditions with regard to emergent probability and nonsystematic schemes of recurrence.

- Student question about the relation of schemes of recurrence to insight and knowledge.
  - Clarification of the *noesis-noema* distinction: the activity and content of consciousness.

  Once verified, our insights do apply to reality, not just in our minds.
- Remark about initial conditions for early schemes not necessarily being needed to continue in order to support later schemes.
- Question about the proportion of what we can know versus what we cannot; in an ever more complex universe.
- Question about the upper and lower blades of empirical method and the implication that this means the lower schemes must always be incorporated into the higher & later schemes.
  - Discussion of scissors metaphor pertaining to our methods of knowing, but not necessarily transferable without qualification to the structure of the known.
- Question about whether the distinctions between systematic and nonsystematic, and the distinctions between lower and higher schemes, are merely arbitrary, or really grounded. Especially if it is merely "correlation" and not "law."
  - Lower and upper means nothing more than conditioning and conditioned.
  - Discussion of classical correlations as ingredient in and constitutive of systematic regularities (schemes of recurrence).

— Classical correlations both (a) link the components of the scheme to each other and (b) link them to their enabling conditions.

• Question about the meaning of ‘linking.’

— Linking has to do with functional correlations, which comes to our attention because of its regularity.

• Student remark about the falling away of original ways of fulfilling being replaced by other ways of fulfilling conditions in both insights and in natural processes (pertains to above question).

• Chapter 5: “Space and Time”

• Space and Time as *intelligibly ordered totality of* concrete extensions and durations.

• Examples of rich diversity of our experiences of extensions – extended bodies.

• Examples of the richness of our experiences of durations – different experiences of durations.

• However, Space ≠ experiences of extension and Time ≠ experiences of duration.

• Space and Time as the *intelligible ordering of* experienced extensions and durations by means of insights.

- Kinds of Space and Time.
- Personal Reference Frames – descriptive, personal orderings of extensions & durations.
- Public Reference Frames – descriptive, socially constructed orderings of extensions & durations.
- Special Reference Frames (scientific orderings).
- The distinction between the concrete and abstract intelligibilities of Space and Time.
- The concrete intelligibility is significant in its own right.
- Questions for Intelligence: Evidence that *insight* figures into our *ordering* of Space and Time.
- Examples of such questions: Where am I? What time is it?
- The problem of ordering extensions and durations.
- Our own *experiences* of extensions and durations are "only a fragment" of the totality of all concrete extensions and durations, of the ordered totality of Space and Time.
- Our *understanding* and *knowledge* of Space and Time transcends our *experience* and can be connected, via insights, to extensions and durations that we cannot actually experience.

Insight & Beyond: Lecture 7, Part 2:

Chapter 4, § 2 "Complementarity in the Known: Emergent Probability (continued),"

and Chapter 5 §§ 1&2: "Space and Time:" Kind of Spaces and Times

• Discussion of Emergent Probability.

• Characteristics of emergent probability: the world process is open, increasingly complex types of systems emerge based on more basic level schemes.

• Lonergan's worldview – emergent probability – unique.

• Neither "runs along the iron rails laid down by determinists,"

nor "a non-intelligible morass of merely random events."

• This world process admits of differentiations; the classical correlations that underlie processes and schemes of recurrence open to vast range of possibilities.

• World process of emergent probability is liable to breakdowns, and is continually evolving.

• It is an evolutionary worldview, similar to, but distinct in important ways from Darwinism.

• Why later schemes are more narrowly distributed in space.

• In order for certain later schemes to emerge, need favourable conditions, which will only be a small subset of all the actual events. Hence, universe has to go down a great many "blind alleys" in order that certain later schemes may emerge. Universe as "fiddling around."

• "Highest" schemes depend upon the realization of a great many events that *seem* meaningless.

Emergent Probability

(2) World process is open.

(3) World process is increasingly systematic.

(4) The increasingly systematic character of world process can be assured.

(6) World process admits enormous differentiation.

(7) World process admits breakdowns.

(8) World process includes blind alleys.

(9) The later a scheme is in the conditioned series, the narrower is its distribution.

(*CWL* 3, pp. 149-150).

I want to talk briefly first of all about these points that Lonergan makes on pages 149 through 150. Let's talk about it briefly! These are claims, or if you like, conclusions that he draws from this analysis:

Emergent Probability

(2) World process is open.

(3) World process is increasingly systematic.

(4) The increasingly systematic character of world process can be assured.

(6) World process admits enormous differentiation.

(7) World process admits breakdowns.

(8) World process includes blind alleys.

(9) The later a scheme is in the conditioned series, the narrower is its distribution (*CWL* 3, pp. 149-150).

Conditions systematically coming together give rise to systematic schemes of recurrence! Once those systematic schemes of recurrence begin to function, they set the conditions for more complex, more interesting, more sophisticated schemes of recurrence, which in turn set the conditions for more and further schemes of recurrence! And that, he says, gives us a number of interesting qualities about the systemat — about the world, about the universe!

He concludes that the universe is open, that's it's not determined! Let me go through some of the things that he says here [Pat picks up his copy of *Insight*]:

> **The consequent properties of a world process in which the design is emergent probability run as follows:**
>
> **(1) There is a succession of world situations. Each is characterized (a) by the schemes of recurrence actually functioning, (b) by the further schemes that now have become concretely possible, and (c) by the current schedule of probabilities of survival for existing schemes and of probabilities of emergence for concretely possible schemes.**
>
> (2) **World process is open. It is a succession of probable realizations of possibilities. Hence it does not run along the iron rails laid down by determinists, nor on the other hand is it a nonintelligible morass of merely chance events.** (*CWL* 3, p. 149).

He seems to be somewhat unique — I won't say totally unique — in holding both ends of that equation open!

> (3) **World process is increasingly systematic.** (*CWL* 3, p. 149).

So this is the question that Stephanie asked, and somebody asked this before, I think.

> **For it is the successive realization of a conditioned series of schemes of recurrence, and the further the series of schemes is realized, the greater the systematization to which events are subjected**. (*CWL* 3, p. 149).

Again, as I mentioned before, *it doesn't mean that the whole universe becomes a grand system. It's just that there is more systematic stuff happening*! *It's happening because the conditions for more complicated and more advanced types of systems are gradually being fulfilled, and therefore gradually emerge*!

(4) The increasingly systematic character of world process can be assured. No matter how slight the probability of the realization of the most developed and most conditioned schemes, the emergence of those schemes can be assured by sufficiently increasing absolute numbers and sufficiently prolonging intervals of time. For actual frequencies do not diverge systematically from probabilities; but the greater the numbers and the longer the time intervals, the clearer the need for a systematic intervention to prevent the probable from occurring.

(5) The significance of the initial or basic world situation is limited to the possibilities it contains and to the probabilities it assigns its possibilities. By the initial world situation is meant the situation that is first in time; by the basic world situation is meant the partial prolongation through time of initial conditions, such as arises, for instance, in certain contemporary hypotheses of continuous creation.

In either case, what is significant resides in possibilities and their probabilities, for in all its stages world process is the probable realization of possibilities. While the determinist would desire full information, exact to the *n*th decimal place, on his initial or basic situation, the advocate of emergent probability is quite satisfied with any initial situation in which the most elementary schemes can emerge and probably will emerge in sufficient numbers to sustain the subsequent structure.

(6) **World process admits enormous differentiation**.

> **It envisages the totality of possibilities defined by classical laws. It realizes these possibilities in accord with its successive schedules of probabilities. And given sufficient numbers and sufficient time, even slight probabilities become assured.** (*CWL* 3, pp. 149-150).

There's a lot of possibilities defined by classical laws. That's terribly important!! That's again why I'd like to insist on the use of the word 'correlation' rather than 'law', even though Lonergan himself uses the word 'law.' 'Law' makes it sound like everything is under control! *This is a sort of an uncontrolled controlled universe, in which there is a lot of different possibilities*! *So what classical correlations give us is lots of possibilities; and which possibilities are going to be realized depends upon the conditions! And the classical laws are not in charge of the conditions*!! *The nonsystematic processes are in charge of the conditions, but the nonsystematic processes conform to probabilities*!

(7) **World process admits breakdowns.**

> **For no scheme has more than a probability of survival, so that there is for every scheme some probability of a breakdown; and since earlier schemes condition later schemes, a breakdown of the former entails the breakdown of the latter.** (*CWL* 3, p. 150).

It's a designed universe in which breakdowns are a part. It has blind alleys!

(8) **World process includes blind alleys**.

> **For schemes with a high probability of survival have some probability of emergence. Insofar as they emerge, they tend to bind within their routines the materials for the possibility of later schemes, and so to block the way to full development.** (*CWL* 3, p. 150).

And then he says:

> **(9) The later a scheme is in the conditioned series, the narrower is its distribution.** (*CWL* 3, p. 150).

So a conditioned series — *This is an evolutionary world view*!! Probably you have noticed that! We haven't used the word 'evolution' yet! *He's avoiding it because it's got certain kinds of connotations, among which is a certain kind of determinism that is adopted by a lot of evolutionary thinkers*! Not all, but a lot!! *A lot of evolutionary thinkers tend to regard natural selection as though it were God; as though it were in charge of everything*! And some of the debates within the various Darwinian schools are concerned with just how much is explainable by natural selection alone, and how much other kinds of factors need to be brought to bear in giving a Darwinian evolutionary account.

> **(9) The later a scheme is in the conditioned series, the narrower is its distribution.**
>
> **For actual realization is less frequent than its concrete possibility; and each later set of schemes is concretely possible only where earlier, conditioning schemes are functioning.** (*CWL* 3, p. 150).

"The later a scheme is in the conditioned series, the narrower is its distribution." (*CWL* 3, p. 150). Why? Okay! Why would he say something like: *the later the scheme is in time, the more limited its occurrence in space will be*! That's what that translates! Why would he say that? … Matt?

Matt: Well, you would have to have more conditions; and more like — You'd have to have more and more things that would have to happen; not just like a single correlation, but — He uses the example of kind of the chemicals give way to like biological, which give —

Pat: Right!

Matt: And each time you have to have a whole sort of thing established before you can sort of jump up to the next level.

Pat: Right! Okay! So that tells us something about the conditions have to be fulfilled. Why, if they're fulfilled later in the scheme are they going to be fewer in spatial distribution — more limited in their spatial distribution? … Maggie?

Maggie: Because there is already in existence a lot of other schemes that occupy space.

Pat: Okay! That's right! And remember that *the favorable schemes are only part of the total possible schemes*. So you need the whole possibility [Pat makes a sweeping gesture] for the sake of the favorable ones. *The favorable ones are some subset of all the possible ones*. Each of the possible ones, or let's say, each of the *actual ones* has its probability, but not all the events are conditions for the emergence of later schemes!

So in other words, what Lonergan is saying here is: Given the kind of universe we live in, if there are to be certain kinds of entities, *you need a lot of waste; it's a very wasteful universe*! *You need to just have a lot of fiddling around, a lot of random events, so that some of them eventually converge, and set the conditions for the emergence of schemes*! But because they don't happen in any determined place at any determined time, there's a lot of noodling[12] around that's going on!

So there's an upward directedness in which the meaning of the whole universe is all interconnected; the highest things are dependent upon things that seem to have no meaningfulness to them! Those are part of the conditions that are essential for the emergence of some of the most sophisticated and mature and advanced things! Okay? All right!

And he has a number of other things to say. Each one of those [statements on the "Emergent Probability" slide] is sort of worth a little moment of meditation and reflection on the implications, the vastness, the amazingness, of the universe.

[12] noodle: 1. to improvise a musical passage in a casual manner, especially as a warm-up exercise. *2. Informal . a. to play; toy: to noodle with numbers as a hobby. b. to improvise, experiment, or think creatively: The writers noodled for a week and came up with a better idea for the ad campaign.*

• Conditioned Series of Schemes of Recurrence, and ever-shifting "schedules" of probabilities.

• Various examples from ecology and physics: Emerging vegetation forms and recurrent ecosystems. The emergence of oxygen and oxygen-based life forms from anaerobic life-forms.

Stellar fusion and radiation cycles. Planetary system formation.

Conditioned Schemes of Recurrence

But having said that, let me just give you some examples to move from the very general heuristic character of his account of *the conditioned series of schemes of recurrence realized in accord with an ever-shifting set of schedules of probabilities: that's what he says emergent probability is*! *He says that it's a process that is largely underpinned by emerging schemes, and the probabilities of the schemes change*! *So that as you get certain schemes in place, suddenly the possibility becomes a higher probability, because the older schemes — the earlier schemes — have set conditions in place that make it possible for classical correlations to lead to a higher synthesis*! Okay?

So here's [the "Conditioned Schemes of Recurrence" slide] an example! Just — The earliest kinds of plant life were aquatic plant life. [Pat uses his pointer] And one of the things that they do is, when they die, they lay down sediment that sets the conditions for the possibility of grasses. And grasses, when they die, set the conditions for the possibility of shrubs and trees, and so on! And this also illustrates the different conditions under which different kinds of plant-schemes of recurrence will function! Some will only function in very wet climates, some in moist, and some in dry. *So a conditioned series of schemes of recurrence*!!

Ecosystems and Recurrent Schemes

Here's another, somewhat more complicated, illustration of a conditioned series of schemes of recurrence. [Pat uses his pointer.] The replenishment of the atmosphere is dependent on a whole lot of different phenomena. One is the ultra-violet radiation, which sets up schemes of recurrence for the formation of an ozone layer, which then screens off some of the ultra-violet radiation, so as to set conditions — that change, if you like — that change the conditions under which biological life on the surface of the earth functions! And that biological life operates in such a way as to replenish, in a cyclical fashion, the amount of oxygen in the atmosphere.

The earliest atmosphere on the surface of the earth didn't have any oxygen — didn't have any fixed oxygen, or let's say, diatomic oxygen! It had carbon dioxide and water; it had nitrous oxide. All the oxygen was tied up with something besides another oxygen. The oxygen in our atmosphere came about because of anaerobic bacteria.[13] Anaerobic bacteria ingested non-oxygen molecules and other kinds of molecules and spit out oxygen. And ultimately kill themselves off, because they are anaerobic! They don't survive in oxygen very well.

[Some subdued if dark laughter].

Oxygen is a highly toxic substance! When Lavoisier did his early investigations into chemistry, into the elements of chemistry, he gave the name 'oxygen' to the gas that was previously called "dephlogisticated air."[14] He named it oxygen, going back to the Greek for "acid-generating." 'Oxy' was the root in Greek meaning acidic! And he thought that oxygen generated acid. We have a more — a different acid theory than he had. He had some very interesting reasons why he thought that the addition of oxygen would cause something to be acidic.

---

[13] Anaerobic bacteria, or anaerobes, are bacteria that do not need oxygen to live. In humans, these bacteria generally live in the gastrointestinal tract, but they may also be found in other places outside the body, including in the soil and water, in foods, and in animals. Some anaerobes are beneficial to humans, but others can cause illnesses, such as appendicitis, diverticulitis, and gingivitis. Characteristics of an anaerobic bacterial infection are bad-smelling pus, the formation of abscesses, and the destruction of tissue.

[14] The name *oxygen* was coined in 1777 by Antoine Lavoisier, whose experiments with oxygen helped to discredit the then-popular phlogiston theory of combustion and corrosion.

But the fact of the matter is that if we didn't have the schemes that we have, we would be eaten alive by oxygen!! We have a very interesting biological system that makes use of oxygen. If we were anaerobic bacteria, we would all be dead!! [Pat has a grim smile!].

But we can turn [word uncertain] to see how this oxygen in our atmosphere and the cycles of oxygen replenishment in our atmosphere was a scheme that emerged at a certain period in the history of the earth when certain conditions were given!

Conditioned Schemes of Recurrence

We saw this one already, so I'm not going to talk about that!

Profile of a Young Star like our Sun.

This is another one! This is a profile of how physicists think that the sun operates! The interior of the sun is a fusion cycle, a hydrogen helium fusion cycle. And the energy from the hydrogen fusion cycle — Well, the fusion cycle can only take place in the interior of the sun, because you need a tremendous amount of gravitational pressure to force the nuclei of hydrogen — well, the hydrogen and helium nuclei together in such a fashion as they can engage in [some inaudible words] a scheme of recurrence.

The outer layers of the sun are very, very hot gases. They are heated by the fusion cycles going on in the interior of the sun, and they set up convection cycles. So there is the first convection here, the second convection here, and the third convection cycle here [Pat uses his pointer], whereby the heat is eventually radiated. So the cycles of fusion here set the conditions for the cycle of the first convection zone, which sets the conditions for the cycle of the second convection zone, and therefore the third convection zone. And this is where the heat is radiated out to the universe, and out to the earth in particular; which if you remember was essential for the oxidative phosphorylation cycle, and also for the oxygen replenishment cycle.

So this is what he means by a conditioned series of schemes of recurrence! This scheme conditions this one, and this scheme conditions this one, and this scheme conditions this one, which conditions the emission of solar radiation to the earth; which conditions the formation of the ozone layer, which conditions the kind of energy that makes it to the surface of the earth; which conditions plant-life, and so on. And so it's scheme upon scheme upon scheme!

And remember that *the thing for Lonergan is the feature of relatedness! What natural science is about is how are we related to one another — how are things related to one another*!!

Helium-Carbon fusion cycle in the interior of an older star.

Now this is the Helium-Carbon fusion cycle, not in our sun, but in the interior of an older star.

Star-Planet System Formation

And this is just something I think you are familiar with: *the initial nonsystematic processes that were present in the universe in the first instance after the Big Bang! No schemes of recurrence whatsoever*!! But as the density and the heat of that energy began to decrease with the expansion of the universe, galactic systems and then solar systems began to form in it. [Pat uses the pointer again]. *So from a nonsystematic process, you begin to get systematic processes leading to systematic processes*!

A Chronology of the Universe

This is just a chart which we saw a little bit earlier about the way in which initial formations of schemes of recurrence lead to the formations of other schemes of recurrence; which ultimately are the conditions for the schemes of recurrence that are the schemes of recurrence of life on our planet!

• Series of Student Questions:

• Student question about the status of classical correlations during the first instants after the Big Bang, prior to any schemes of recurrence.

– Classical correlations always apply, but are open to various manifestations depending on the conditions. Discussion of abstract and concrete conditions with regard to emergent probability and nonsystematic schemes of recurrence.

• Student question about the relation of schemes of recurrence to insight and knowledge.

– Clarification of the *noesis-noema* distinction: the activity and content of consciousness.

Once verified, our insights do apply to reality, not just in our minds.

• Remark about initial conditions for early schemes not necessarily being needed to continue in order to support later schemes.

• Question about the proportion of what we can know versus what we cannot; in an ever more complex universe.

Okay! I'm going to stop there. There's a little bit of discussion that bothers me! I think I'll just stop there, and see if people have questions about emergent probability. … Matt?

Matt: Specifically in this theory here: the schemes of recurrence were not formulated yet, but things were still nonsystematic! The correlations, the classical correlations, the laws of physics, Newtonian physics, and all these, they still existed?

Pat: They still existed!

Matt: And so it wasn't that — It not that there was a point when like Newtonian physics didn't count, didn't —

Pat: Well —

Matt: Well, maybe like the first nanoseconds out there, or something like —

Pat: Let's say, there was no point when the classical laws of physics didn't apply! Newton's laws, we now know, are approximately correct but not exactly correct!

Matt: Okay!

Pat: *And we don't know exactly what is correct!! But whatever those laws are, they were operating at that time. There wasn't a time when they weren't*!

Matt: Okay! So we could kind of — This kinda helps — because then we're saying that the classical laws are kind of like the rules of the game so to speak, that then the systems of recurrence operate within the correlations; and it's not that we are creating new correlations —

Pat: That's right! *We're not creating them! We've been discovering the correlations! But remember there's a difference between the abstract and the concrete*! We'll see a little bit more in the treatment of Space and Time, the invariant and the concrete.

So classical correlations themselves are open to many, many possible manifestations! The classical correlations are always there; they manifest themselves according to the conditions! The conditions are something that the classical correlations have to deal with! What emergent probability tells us is that the classical correlations, along with probabilities, exercise a certain kind of creativity with the tremendous randomness of the nonsystematic conditions, where gradually things emerge and emerge and emerge!

But the classical correlations in their most general, universal form, invariant form — they're always the same! The conditions under which they operate keep changing, and therefore their manifestations keep changing! Their manifestations include in very important ways, schemes of recurrence! Okay!

Matt: Thank you!

Pat: Okay. Somebody else had a question? … Mary?

Mary: Ah, I just want to make sure that I'm grasping it right: that the schemes of recurrence are insight? They're not just schemes of recurrence more generally —

Pat: *Actually so far, what he's really been focused on is the schemes of recurrence of events in the world*!

Mary: But there's also schemes of recurrence —

Pat: It turns out that there are also schemes of recurrence of insights! And he is going to talk about that in chapters six and seven!

Mary: But isn't it that the laws of the universe are necessarily insights?

Pat: Ah, well, *remember that* noesis-noema *distinction.* Noesis *is the activity of consciousness; the* noema *is the content! The* noesis *is an insight, and the intelligibility or the correlation or probability is the content*! *Now, if those insights turn out to be true, then the universe really has those intelligibilities*! *To the extent to which your insights are correct, it isn't just correct in our minds: it's part of the truth about reality*!! Okay? So schemes of recurrence are not just in our minds; they are probably true! Some of them are definitely true! … Ahm, let's see … Stephanie?

Stephanie: So talking about anaerobic bacteria setting the conditionings, is it — it seems possible that you might have an initial conditions that creates the possibility for a scheme of recurrence, and then other schemes of recurrence follow from that.

Pat: Uh, uh!

Stephanie: But later schemes of recurrence don't necessarily have to have that original condition there, in order for them to kind of work, continue —

Pat: — No! That's quite right! —

Stephanie: The original condition can just —

Pat: — That's right! That's exactly right! And that's what happens! We don't need the anaerobic bacteria anymore, because they set conditions for oxygen in the atmosphere, and then once that oxygen was in the atmosphere, other schemes of recurrence started taking place to replenish the oxygen in the atmosphere [inaudible words]. That's right! *So it isn't that everything hangs around*!! *Good point*!! …

Ah, let's see? Greg, and then Julian, and then Katie?

Greg: I was wondering what Lonergan would say about the proportion between what we know, the more that we know, the more that we discern, you know, classical laws and statistical, other things; and that is proportionate to what we are able to know. In other words, as we know more, does the universe — Is it also sometimes increasing in complexity? Is there always more to know?

Pat: Yes!

Greg: Okay!

Pat: There's always more! But we'll get to that later on!

Greg: Okay.

• Question about the upper and lower blades of empirical method and the implication that this means the lower schemes must always be incorporated into the higher & later schemes.

— Discussion of scissors metaphor pertaining to our methods of knowing, but not necessarily transferable without qualification to the structure of the known.

Pat: Katie?

Katie: I was just wondering about how the question that — I forget your name — just asked relates to —

Pat: — Stephanie.

Katie: — Stephanie! Thank you Pat! — relates to the concept of the higher and lower blades. Because I thought that whatever the lower blade was would always be incorporated into the higher and that it would continue the process of integration. But eventually it seems like that continued, like whatever, disappears.

Pat: Okay. *Maybe a way to think about that is* that *the scissors metaphor, the higher and lower blades, is something that Lonergan uses as a metaphor to help us understand and appropriate how scientists do their thinking. So it really is focused on the thinking, and particularly scientific thinking! And what you said is quite right: that the results of each of those steps, as the lower blade starts to move upward is going to eventually be incorporated by the insight, which is also accomplished by the upper blade moving downward. But that is a way of describing thinking processes.* It isn't automatically transferable to what the insights are about! *So it is a description of how our minds put elements of our thinking together*. It isn't automatically an account of how the things we think about are put together!

Katie: So the difference is between the insight versus things we have insights into —

Pat: That's right! That's right! *So it's an account of how our insights develop*. The way — *The fact that the universe develops is pretty certain*! *And Lonergan gives an account of why you would expect it to develop if we had classical and statistical sciences*. *The fact that our minds develop is pretty evident as well*. That doesn't automatically mean that exactly every development in our mind has an exact correspondent in the development of the universe! There's going to be a sort of a —

> *Later on he's going to make a large general argument that there's a parallelism of dynamics between our minds and the world*! But it doesn't follow that everything he has to say about the way our minds develop, especially the scissors metaphor, automatically transfers. Okay?

• Question about whether the distinctions between systematic and nonsystematic, and the distinctions between lower and higher schemes, are merely arbitrary, or really grounded. Especially if it is merely “correlation” and not “law.”

— Lower and upper means nothing more than conditioning and conditioned.

— Discussion of classical correlations as ingredient in and constitutive of systematic regularities (schemes of recurrence).

— Classical correlations both (a) link the components of the scheme to each other and (b) link them to their enabling conditions.

• Question about the meaning of ‘linking.’

— Linking has to do with functional correlations, which comes to our attention because of its regularity.

Pat: Greg? … No, Jem?

Jem: So I want to push against the distinction between systematic and nonsystematic, say in terms of questions of complexity, and that sort of thing. I want to push against that a little bit. Because if we’re going to talk about ‘correlation,’ and we want to use that language instead of ‘laws’ and sort of pushing us to determinism: I heard a really interesting paper given by a graduate student talking about — his sort of bold thesis was that our distinction between inanimate and animate matter, or objects, is thoroughly arbitrary! We make this sort of line in characteristics of complexity between rocks, and trees, and people. But that really what you have is this sort of emerged, evolving, noodling of matter obeying the rules. He said “of frequency and sort of stability,” or something like that. And so I guess my question has to do with: why call it an upward movement? And is this idea of systematic versus nonsystematic fully grounded in anything? If it's not — if it's really correlation and not causation, not law-like determinism, does that distinction really hold? And if it doesn't hold, why call it 'upward'? Why not just call it 'indeterminate'? … Does that make sense?

Pat: Ahm, I think it does! *It's called 'upward' for the fairly simple reason that schemes emerge as dependent upon the conditioning of earlier schemes! So it's upward in the sense that there's a sequence to them*! It's upward in the sense that some schemes *could not* emerge in any kind of recurrent pattern — which is to say that they could only kind of accidentally happen in this really wild once in a billion, trillion years type of a fashion, and you would almost never expect them to recur! *But these schemes recur in virtue of the kinds of classical correlations that are constitutive of their function*. And I think that's part of the answer to the paper you were talking about!

The classical correlations are endemic in those schemes! *Without those classical correlations being true classical correlations, those schemes would not operate, and they would not recur*! *And those classical correlations depend upon conditions being fulfilled in order for those conjunctions to be able to take place*! *And that's the meaning of 'upward'*! *'Upward' is: could not have come about in this recurrent — intelligibly recurrent — fashion, were it not for some previous conditions. And when those previous conditions are themselves schemes, then you get the language for upward*!

Jem: So, if I'm understanding you correctly, what you're saying is that the sort of — this is not quite the word I want — but the sort of *grounding* of the classical correlations is not so much in the intelligibility of the correlation within the scheme, but more in the recurrence; that what makes it a classical law in that sense is the probabilities involved in its recurrence?

Pat: *Not probabilities! Regularities*!

Jem: Sure!

Pat: *It's the systematic regularities*!

Jem: Okay!

Pat: *Within the scheme you get systematic regularities*! But notice that the classical correlation does two things at once:

(a) It links the components of the scheme together. It links the components of the scheme to each other.

(b) But it also links the components in the schemes to the conditions that made it possible! It links them to their enabling conditions.

It's got that very interesting role to it! *And yet it isn't itself deterministic!! It's completely beholden to conditions under which it has to operate*!

Jem: I guess, I just have a little bit of trouble asking what 'linking' there means?

Pat: Ah, it is the linking of functions, a functional correlatedness!

Jem: I'll chase it down. Okay.

Pat: The simplest example is: the distance is correlated to the time by the classical correlation of Galileo's law! *I left the force of gravity out very deliberately*! *There's a connectedness between distance travelled and time travelled! It's the correlatedness, the functional relatedness, that puts those together*!

Jem: So I guess … we come to know that correlatedness through the regularity of the recurrence!?

Pat: We come to suspect that there is a correlatedness because of the regularity! And then we go looking for what is the correlatedness!

Jem: The function!

Pat: Okay.

• Student remark about the falling away of original ways of fulfilling being replaced by other ways of fulfilling conditions in both insights and in natural processes (pertains to above question).

Pat: Okay. … Stephanie?

Stephanie: I was just going to reply to Judith's question: It seems like we have a condition that like anaerobic bacteria that really sets the possibility for other schemes to occur; and those schemes create the same conditions that made that original scheme possible. You can see sort of a correspondence with the mind in the sense that when you grasp a mathematical concept, you might find other ways of arriving at that same concept. And those ways — the original condition that allowed you to get to those concepts might fall away, and you would be able to step forward in other ways —

Pat: — That's very well said. That's a very good point!

Stephanie: So that kind of corresponds to the world process and mind process: how conditions could fall away in preference of other more easily acceptable or more preferred conditions.

Pat: Yeah. That's very good! Thank you for that!

• Chapter 5: "Space and Time"

• Space and Time as *intelligibly ordered totality* concrete extensions and durations.

• Examples of rich diversity of our experiences of extensions – extended bodies.

• Examples of the richness of our experiences of durations – different experiences of durations.

• However, Space ≠ experiences of extension and Time ≠ experiences of duration.

• Space and Time as the *intelligible ordering of* experienced extensions and durations by means of insights.

Okay. I'm going to make a transition here and give us at least the beginning of an introduction to Chapter Five, the chapter on **Space and Time** (*CWL* 3, pp. 163-195). We certainly don't have enough time to do all of it! So we'll return to it next week.

So what I'd like to do is begin with Lonergan's definitions of Space and Time, and to draw attention to some of its features.

> **Let us now define Space as the ordered totality of concrete extensions, and Time as the ordered totality of concrete durations.** (*CWL* 3, p. 166).

And just to clarify, he has spoken in the previous paragraphs[15] about what he means by "**concrete extensions**" and "**concrete durations.**"

> **Our concern is not with imaginary extensions or imaginary durations but with the concrete extensions**

[15] The next quoted passage in fact follows, rather than precedes, the already quoted passage.

and durations correlative to experience. (*CWL* 3, p. 166).

Later on he is going to talk about our experiences of extensions and durations.

Space and Time
"Let us now define Space as the ordered totality of concrete extensions, **and Time as the ordered totality of concrete durations. ….** **Our concern is not with imaginary extensions or imaginary durations but with the concrete extensions and durations correlative to experience.**" (*CWL* 3, p. 166).

So let's focus on that for a moment: our experiences of extensions and durations. [Pat holds up a paperback copy of *Insight*.] So this is an extended body, and we have an experience of it! [He puts it down on a chair.] The chair is an extended body! My body is for you as an extended body! The room is an extended body! We're in an extended — We're in an extension that is bounded by the four walls, and the floor, and the ceiling! And when you go outside, you're still in an extension! Or, you're in a big room! You're in a room that has a floor, that has concrete, that has cement and grass and mud and gravel; and it has a ceiling that's blue and white, and sometimes grey! And it's got walls that are green and brown. And sometimes the walls — so that when people think of the walls of a house, they tend to think of the walls as being on the outside of the house; and then they go inside. But when you're out walking the street, the exterior walls of the buildings that you're walking past are the interior walls of the extension that you're in!

So your experiences of extensions are very rich! We have Descartes contemplating the wax and how it melts and how it still has extension even though its shape is changing and so on. That's not exactly the world's richest experience of concrete extension! *So the first task here in self-appropriation of space and time is to appropriate the richness of our experiences of extension*!

Likewise our experiences of duration! When you're with a bunch of friends, time goes fast! When you're sitting in a comp exam —

[Laughter] — [Pat has a broad smile]

— it goes too fast!

[Laughter]

When you're sitting in a boring lecture, time doesn't go fast enough! So concretely, time is not a homogeneous phenomenon as we encounter it and experience it concretely!

> *Space however is not concrete extension! Time however is not concrete duration*! *Space is an ordering of extensions! And time is an ordering of durations! And that's where the insight business comes in! It's actually already there in the richness of our concrete experiences of extension and duration*. But for the moment I want us to dwell on *the ordering business*. *Space and Time are not just experiences of extension and duration!* [Pat looks towards the overhead display.] *They are the "**ordered totality**" of experienced extensions and durations*!

Also I want to point out that Lonergan is very crafty here! Notice I substituted the word 'experience' for 'concrete' here. Lonergan doesn't do that! He doesn't do that because otherwise the definition becomes dependent upon there being a being which actually has experienced that extension and that duration. And he's not going to get sucked into that morass! He is a very clever person when it comes to doing his definitions of things. So Space and Time as ordered!

• Kinds of Space and Time.

• Personal Reference Frames – descriptive, personal orderings of extensions & durations.

• Public Reference Frames – descriptive, socially constructed orderings of extensions & durations.

• Special Reference Frames (scientific orderings).

• The distinction between the concrete and abstract intelligibilities of Space and Time.

• The concrete intelligibility is significant in its own right.

Before we go very far down this, I wanted to focus on a couple of things. Primarily, I have to thank Bert for a conversation I had yesterday for making me think to emphasize it in quite this way.

There's not just one kind of space and time. There are kinds of space and time! That they have some connection with one another we'll see hopefully down the road.

Kinds of Space and Time

Personal Reference Frames — Personal Orderings

(Individually Meaningful, Descriptive Spaces and Times)

Public Reference Frames — Intersubjective Orderings

("Socially Constructed " & Meaningful,
Descriptive spaces and times)

Special Reference Frames — Scientific Orderings

(Explanatory Spaces and Times)

Lonergan begins by talking about *Personal Reference Frames*. Personal Reference Frames we'll see, I think, before we leave today, I'll have a chance to explore that a little bit more. But *they are the personal orderings of extensions and durations*. *So there are extensions and durations as experienced, and then there is the ordering of them*. And one way in which that is done is what he calls 'Personal' or 'Individual.' And it's done in the descriptive mode!

Then he also speaks of Public Reference Frames*, Intersubjective Orderings of extensions and durations*. And I threw in the sometimes popular phrase, "socially constructed." I put it in quotes because it's true as far as it goes, but the problem with the notion of social construction is that it doesn't go far enough! *What tends to happen in the language of "social construction" is: therefore it's not real! It's arbitrary! And we can change it as often as we change our socks! None of which are true*!! That it is a phenomenon that *public spaces, Public Reference Frames, are indeed something that we do as groups of people; and that we do something like constructing is all true enough*! *It's just not the whole truth*! But that — What the whole truth is is going to have to wait until the Second Coming!

[Laughter]

But at least until later on in the semester!

Special Reference Frames are scientific orderings of concrete extensions and durations! *And they have to do with explanatory Spaces and Times*. We're going to spend a lot more time in this class on the first two than Lonergan does! Now Lonergan's after — he's got a point that he's driving after; and we'll get to that! But he does it in such a way as to jump over some things that are very important! They are very important for self-appropriation! *Insights don't occur only in Explanatory Special Reference Frames, Explanatory Scientific Spaces and Times*. *Insights occur in Personal Reference Frames and in Scientific Reference Frames*! I'm sorry: in Public Reference Frames!

***Kinds* of Space and Time**

Concrete Intelligibility of Space and Time

Abstract Intelligibility of Space and Time

Another way of slicing the pie is to observe that there's a distinction in this chapter between *Concrete Intelligibility of Space and Time*, the concretely intelligible ordering of extensions and durations; and the *Abstract Intelligibility of Space and Time*! That is a little bit like this distinction we were drawing a moment ago between the fact that the same classical correlations operated in the first moments of the Big Bang as are operating today, but they manifest themselves differently! So when he's talking about the *Abstract Intelligibility of Space and Time,* in no way is he attempting to say: "And that is the whole story about Space and Time!" The *Abstract Intelligibility of Space and Time* is a component, and an important component, in what he is going to mean by the intelligibility of Space and Time; *but it's not the only component in the intelligibility of Space and Time*!

As you know from having read this, Lonergan is going to talk about the *invariant intelligibility of Space and Time*; which seems like it wipes out all the significances of differences in experiences and meanings of space and time. He does not intend to do that! *He intends to focus on particular issues with regard to space and time by focusing on the Abstract Intelligibility of Space and Time*! *But in no way does that eliminate the fuller account of the Intelligibility of Space and Time. Okay*?

I want to emphasize that! *Don't come out of this chapter thinking that Lonergan thinks that everything to be said about Space and Time has to do with the Riemannian geometry of Space and Time. That's important, but it's not the whole story*! Just as force is equal to mass times the second derivative of the displacement is an important component in motion, but it's not the whole story. There are concrete dimensions to Space and Time as well that are not exhausted by that! But that are very importantly dependent upon that [final words uncertain].

• Questions for Intelligence: Evidence that *insight* figures into our *ordering* of Space and Time.

• Examples of such questions: Where am I? What time is it?

• The problem of ordering extensions and durations.

• Our own *experiences* of extensions and durations are "only a fragment" of the totality of all concrete extensions and durations, of the ordered totality of Space and Time.

• Our *understanding* and *knowledge* of Space and Time transcends our *experience* and can be connected, via insights, to extensions and durations that we cannot actually experience.

***Questions* for Intelligence**
Where am I? Where are you? Where is it?
When did that happen?
What time is it?

Okay! That insight has something to do with *space and time* — that insight has something to do with *the ordering of our experiences of extension and duration* — *shows up in the fact that we have to ask! We have to ask questions which seek insights*!

Where am I? Where are you? Where is it?

When did that happen?

What time is it?

What are we asking when we are asking those things? The heuristic answer to that is that we're seeking some kind of ordering of extensions and durations! …

Now why is there a problem? Why do we have questions? Why do we ever ask: "Where am I?" Why do we ever ask: "What time is it?" There's always an obvious answer! "Where am I?"

Student: Here!

Pat: Exactly!

[Some laughter]

The *Problem* of Ordering Extensions and Durations

For neither the totality of concrete extensions nor the totality of concrete durations falls within the experience of the human race, let alone the human individual.…

Only a fragment of concrete extension and of concrete duration falls within human experience. Still, one can take that fragment as origin. *Beyond* the extension that is experienced, there is further extension; and … *beyond* the duration of experience, there is further duration. (*CWL* 3, pp.166-167).

Pat: What time is it?

Several students: Now!

[Some laughter]

Pat: Exactly! … What are we asking when we are asking: "Where am I?" and "What time is it?" when the answer is always so obvious?

This is part of the reason that we have to ask: "**For neither the totality of concrete extensions nor the totality of concrete durations falls within the experience of the human race, let alone the human individual.** (*CWL* 3, p. 166). *Remember I said: Notice how Lonergan talked about* ***concrete*** *extensions and durations and not* ***experienced*** *extensions and durations*! Very, very true [inaudible].

But that's the problem! Now, my whole life has been lived either in a very small extension in upstate New York or in a slightly larger extension in eastern Massachusetts, and a thin ribbon that runs between them, called Eye Ninety [unclear]. And then one year in north-west Indiana, and then, a few pockets elsewhere: including some places in Europe and in the western United States, and so on! That's it!! I have a very impoverished experience of concrete extensions and durations! Durations because I'm only as old as I am! I have a richer experience of duration than you folks do —

[Some laughter]

— though it's starting to take its toll on my body! So, that's it! That's it, you know! Why is there a problem? Why do we ask — *Why do we have questions about space and time, and where and when*?

The very first part of that is that we don't have the experience of all spaces and all times. "**Only a fragment of concrete extension and of concrete duration falls within human experience** (*CWL* 3, pp.166-167). *But! And this is the important 'but!' You can take that fragment as an origin. Beyond that fragment, there is a further extension, and beyond the duration of now, there is a further duration*! Beyond that fragment of extension, *there is a further extension which we are not concretely right now experiencing; maybe never have yet experienced; maybe never will ever experience*! And yet our comprehension of the intelligibility of extensions and durations is not limited to our actual experiences of extension and duration.

> **One can take that fragment as origin. *Beyond* the extension that is experienced, there is further extension; and … *beyond* the duration of experience, there is further duration**. (*CWL* 3, pp.166-167).

Our knowledge of space and time transcends our experience of space and time. Our questions about where and when take us out of the limits of our experiencing towards intelligible insights into intelligibilities that connect our concrete experiencing to concrete durations and extensions that we do not now and maybe never will experience!

A perfect example of this is the moons of Jupiter. The experiences that we have, such as we have had, of *little dots appearing through the lens of a telescope; those are the concrete experiences that we actually have*! *And yet by a series of interconnecting insights, we connect that concrete experience of an extension with another concrete extension that we don't actually see! And that we certainly don't touch*! That's one simple example!

Okay! I'm going to stop here! We have only a couple of minutes left. What I'm going to do at the beginning of our class next time is to kind of walk through how — some of the insights that go into the construction of Personal Spaces, that go into the construction of Public or Social Spaces, cultural spaces; and then lastly, we'll look at the Special Explanatory Spaces, particularly those that come to light in the physics of relativity with Einstein, and so on. So we'll focus on that!

But I would ask you for next week to read chapter six of *Insight*. We probably will not get as far as "Dramatic Bias" (*CWL* 3, pp. 214-231) in our next class. I do recommend that you read that! But we probably won't get as far as that in our next class; but we probably will get up to and including "The Dramatic Pattern of Experience" (*CWL* 3, pp. 210-214).

All right! So we'll see you next week!