FEATURE: Putting the Pieces Together – Michael Polanyi (First in SERIES of 3)

PROF.: To ***analyze*** is to ***take apart.***

VOICE: But who will put the parts together to see what they make?

PROF.: Can chemistry and physics explain why life exists and how it began?

FORMAT: THEME AND ANNOUNCEMENT

PROF.: Author Alvin Toffler wrote, "One of the most highly developed skills in contemporary...civilization is ***dissection:*** the split-up of problems into their smallest possible components. We are good at it. So good, [that] we often forget to put the pieces back together again."

VOICE: Scientists specialize in analytically taking things apart. So philosophers try to put them together – to fit them into a ***meaningful context***. So we're glad when we discover the thoughts of an internationally-famous scholar who was BOTH a scientist and a philosopher.

PROF.: The late Dr. Michael Polanyi was a member of the academies of sciences in four countries. He taught at more than a dozen universities, including Oxford University in England and Yale University in the United States.

Professor Polanyi gained distinction in both the physical sciences and social sciences. He authored nine books on science, economics, and philosophy. His greatest fame is as a philosopher of science.

VOICE: Dr. Polanyi wrote an article for the professional journal, *Chemical and Engineering News*. Ever since its original publication in 1967, it has been considered a classic in its field.

We now present a discussion of the late Prof. Michael Polanyi's article entitled, "Life Transcending Physics and Chemistry."

PROF.: Prof. Polanyi begins, "The discovery by Watson and Crick of the genetic function of DNA...is widely believed to prove that ***living*** things can be interpreted...by the laws of physics and chemistry."

But Prof. Polanyi disagrees with that common opinion. He argues that something more than chemicals and physical forces is needed to produce human life – and especially human CONSCIOUSNESS.

VOICE: But the human body and brain ***contain*** chemicals and physical forces.

PROF.: Yes, but he's saying they also contain ORDER that physics and chemistry alone can't provide.

In Dr. Polanyi's words, "I differ from...most biologists, by holding that no mechanism – be it a machine or a machinelike feature of an organism – can be represented in terms of physics and chemistry."

He explains that machines have comprehensive features that are not due to spontaneous interaction between physical and chemical forces. Instead, they are "shaped by man."

He uses the word "artifacts" in this connection.

VOICE: "Artifacts" is a word that ***archaeologists*** use. What is he illustrating?

PROF.: If an archaeologist discovered a lever or other tool, he would know this is evidence that a human had lived in that place. He wouldn't consider the possibility that chemistry and physics had been clever enough in some past age to build a machine by themselves. The presence of a tool in a layer of excavation would convince him that a ***tool-MAKER*** had lived at the time that layer represents.

VOICE: In other words, the tool-maker would have made his tools from material substances. But materials alone would not have made the tool – without the brain and hands of the tool-maker.

PROF.: Precisely! Dr. Polanyi says machines are controlled by two sets of principles. In his words, "...the ***material*** of the machine is subject to the laws of physics and chemistry, while the ***shape*** and the ***working*** of the machine are controlled by its ***structural*** and ***operational*** principles."

VOICE: What was that quotation again? "...the ***material*** of the machine is subject to the laws of physics and chemistry..."?

PROF.: Yes. "...while the ***shape*** and the ***working*** of the machine are controlled by its ***structural*** and ***operational*** principles."

VOICE: In other words, machines ***operate*** in accordance with the laws of physics and chemistry, but they need something besides natural law to ***design*** and ***build*** them.

PROF.: That's right.

In a footnote, Dr. Polanyi uses the expression, "information content per unit of matter." In a ***living*** thing, the shape and function are much more complex than in a non-living substance. Its "information content per unit of matter" is much higher.

For example, a tree has roots, trunk, branches and leaves – formed in a fairly complex shape. But a tree's ***greatest*** complexity is in its ***metabolism*** – the process that makes it live and grow.

Living matter is ***informed matter.*** It contains a ***large*** information content per unit of matter.

VOICE: I'll remember that. "Living matter is ***informed matter.*** It contains a large information content per unit of matter."

Does Dr. Polanyi give examples of this concept?

PROF.: Yes. First he gives some ***non-living*** examples, in which there is something other than chemical and physical action. He writes of machines and of books, before applying the principles to living organisms.

He wrote when mechanical watches were much more common than digital watches. So Prof. Polanyi illustrated, "Try to describe a machine in physical-chemical terms." A complete physical-chemical topography of my ***watch*** would not tell us what this object is.

"On the other hand, if we know watches, we would ***recognize*** an object as a watch by a description…which says that it tells the time of the day, by hands sweeping around a face, marked by the hours of the day. We know watches and can describe one only in terms like 'telling the time,' 'hands,' 'face,' [and] 'marked,' which are all incapable of being expressed by the variables of physics, length, mass, and time."

VOICE: So we describe a watch more accurately when we talk about its FUNCTION, than when we speak only of its CONSTRUCTION.

PROF.: I would say we describe a watch more ***meaningfully*** when we talk about its function. That point comes out in Dr. Polanyi's second illustration.

He wrote, "Now, …let us pass on to ***books*** and other means of communication. Nothing is said about the ***content*** of a book by its physical-chemical topography. All objects ***conveying information*** are IRREDUCIBLE to the terms of physics and chemistry."

VOICE: In other words, we can do a chemical analysis of the paper and ink in a book, but there's more to a book than its chemical composition.

PROF.: Another philosophy professor amplifies the paper-and-ink illustration. Dr. John F. Haught [HOWT] asks, "Does chemistry determine the sequence of letters on this page?" Or is there something ***outside of*** chemistry that gives the specific sequence?"

VOICE: Applying ink to paper doesn't produce an intelligible book, unless there is ***type*** to apply the ink to the paper in meaningful patterns.

PROF.: Without "information content," the printing press doesn't even know which ***alphabet*** to use. Should it use the Latin characters that we use in the English language, the Cyrillic alphabet that Russians use, or Chinese or Arabic script?

And of course, if the book is to make any sense, it has to have an ***author --*** to choose the subject and the words in which to express his ideas.

VOICE: From a chemical standpoint, a book is merely paper and ink…

PROF.: …Plus enough thread and glue to hold the pages together and the covers in place.

VOICE: Yet a book is MORE than those chemical components. It's chemistry PLUS INFORMATION.

PROF.: But the information contained in a book is not a substance added to physical materials. The information is ***contained in the patterns*** into which the materials are formed.

VOICE: The difference between a Shakespearean classic and something the child next door wrote is more than the chemistry of the paper and ink used in printing it.

PROF.: Polanyi moves up the complexity scale from books to machines, pointing out that any functional machine has intricacy that shows a high information content.

He continues, "Up to a point, we can transfer what has been seen of machines to MACHINE-LIKE ASPECTS OF LIVING BEINGS. Take some examples from the higher animals – their organs of circulation, breathing, digestion, secretion, and thermal regulation…"

VOICE: …The way the body maintains a stable temperature in various environments.

PROF.: Think of their anatomy and of the way they operate in performing their functions. None of these can be explained by physics and chemistry.

VOICE: If chemistry and physics can't produce letters and arrange them into intelligent sentences on a printed page, why would anyone speculate that chemistry and physics could create the intricate double helix of a DNA molecule?...

PROF.: ...or produce minds capable of winning Nobel Prizes by ***analyzing*** that molecule?

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