The Republic of Science: Its Political and Economic Theory

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Michael Polanyi's encounter with the Soviet scientist Bukharin during his visit to the USSR in 1936 profoundly shaped his views on the importance of scientific freedom. Bukharin explained that in socialist states like the USSR, all scientific research was directed according to the needs of the state's Five-Year Plan. This centrally planned approach to science severely restricted intellectual freedom, as evidenced by the rise of Trofim Lysenko's pseudoscientific doctrines, which gained backing from the Soviet government. The result was that genetics, as a legitimate field of inquiry, was marginalized because it did not align with the state's ideological agenda.

Polanyi saw this as a cautionary tale about the dangers of central planning in science. It underscored his belief that science thrives on freedom and independent inquiry rather than being subordinated to state control or central authority. In response to similar ideas being promoted by Marxists in Britain, such as John Desmond Bernal, Polanyi became an outspoken advocate for the autonomy of scientific research. He saw any effort to direct scientific research according to a political or economic agenda as a threat to the very nature of scientific inquiry.

Polanyi, along with John Baker, founded the Society for Freedom in Science to defend the freedom of scientific investigation from political interference. In a series of writings, including The Contempt of Freedom (1940) and The Logic of Liberty (1951), Polanyi argued that science is a spontaneous order, analogous to a free market. Just as in a market, where independent buyers and sellers determine prices through voluntary transactions, scientists work independently yet in a coordinated manner through open debate and peer review. Their collective efforts, guided by a shared pursuit of truth, produce progress in knowledge, although no one scientist controls or predetermines the outcome.

According to Polanyi, the self-coordination of scientists pursuing their own research agendas leads to a greater collective result than any centrally planned system could achieve. Centralizing scientific research under a single authority would undermine this process by stifling individual creativity and initiative. In his view, this would "paralyze their cooperation" by reducing the effectiveness of the group to that of the single person giving directions from the center. This reflects Polanyi's broader belief in the importance of spontaneous order, which

aligns with the ideas of Friedrich Hayek, another proponent of decentralized knowledge and markets.

Polanyi's defense of scientific freedom resonates with his wider views on the nature of liberty and cooperation in society. He saw freedom in science as a microcosm of freedom in society at large, where individual autonomy, underpinned by mutual respect and cooperation, leads to the most fruitful outcomes. This belief has enduring relevance, as it underscores the importance of maintaining intellectual freedom in an era where both political and market forces can sometimes pressure scientists to align their work with particular agendas.

The phrase spontaneous order was derived from Gestalt psychology, which emphasizes that complex systems often self-organize without external control. This concept was popularized by the classical liberal economist Friedrich Hayek, although its roots can be traced back to Adam Smith and his notion of the "invisible hand" that guides markets. Hayek used spontaneous order to describe how decentralized decision-making in a free market leads to efficient outcomes without the need for central authority.

However, Michael Polanyi expanded this concept beyond Hayek's economic framework by distinguishing between higher and lower forms of spontaneous order. Polanyi argued that scientific inquiry represents a higher form of spontaneous order because it pursues ideals like truth and knowledge, which transcend mere utility. In contrast, markets, while valuable, represent a lower form because they primarily focus on material goods and economic efficiency. Polanyi believed that defending scientific inquiry solely on utilitarian or skeptical grounds (such as by arguing that science only exists to serve economic or political purposes) undermines the deeper purpose of science, which is the pursuit of objective knowledge and truth.

Polanyi extended his views on spontaneous order to a general defense of free societies. Unlike Hayek, who often defended freedom on negative grounds (the idea that we should respect "private liberties" to avoid tyranny), Polanyi advocated for "public liberties" as the positive foundation of a free society. He believed that a free society enables individuals to pursue higher, spiritual ends, such as truth, beauty, and justice. For Polanyi, these values are not merely subjective but transcend individual perspectives, even though they can never be fully grasped or defined by any one person or group.

Polanyi's argument that a free society should not be value-neutral is central to his defense of scientific and social freedoms. He believed that reducing all values to mere subjective preferences undermines the very ideals that justify freedom. At the same time, Polanyi emphasized the importance of fallibilism—the idea that all human knowledge is imperfect and subject to revision. This combination of the recognition of objective values and the acceptance of human fallibility is crucial for sustaining both scientific inquiry and the broader project of a free society.

Polanyi's views were a critique of the idea that societies can function purely on negative liberties (freedom from interference) or on neutral grounds without any shared commitment to higher values. In his view, a society that strives to be neutral or purely utilitarian undermines the very public liberties that allow

for the pursuit of collective and spiritual goals.

- In The Republic of Science: Its Political and Economic Theory (1962), Michael Polanyi draws an analogy between the structure of the scientific community and the functioning of a free society. He argues that science operates as a decentralized system where individual scientists make independent decisions about what research to pursue. Despite this autonomy, they form a cohesive and organized system that resembles certain aspects of a body politic or a free market economy. This cooperative arrangement functions without centralized direction, much like a free society in which individuals coordinate through independent actions rather than government control.

Polanyi highlights that scientists, in choosing their own problems and solutions, are actually engaged in a form of cooperative organization. Their freedom to explore different lines of inquiry results in an efficient and productive system for advancing knowledge, much like how free markets coordinate the production of goods and services through independent actors responding to price signals. In this analogy, the "market" in science consists of published results and peer recognition, which guide scientists in choosing relevant problems to solve, just as prices guide economic actors.

Polanyi's central argument is that this decentralized structure—where scientists adjust their work based on the findings and critiques of others—leads to the most efficient organization of scientific progress. He compares this to Adam Smith's "invisible hand," which describes how self-interested actions in a free market contribute to the overall well-being of society. Polanyi extends this idea by suggesting that the same principles of mutual adjustment apply to the advancement of science: individual scientists pursue their own goals, but in doing so, they contribute to the broader, self-organizing progress of knowledge.

Through this analysis, Polanyi shows that the scientific community offers a simplified model of how a free society can function without the need for central direction. In the scientific "republic," just as in a free market or democratic society, individuals coordinate their actions through mutual adjustment and the open exchange of information. Polanyi emphasizes that any attempt to centrally control scientific inquiry would stifle innovation and progress, just as central planning in economies is less efficient than decentralized decision-making.

Thus, The Republic of Science provides a valuable insight into the self-regulating nature of science and the broader implications this has for political and economic systems. Polanyi's analogy reinforces the importance of intellectual freedom, decentralized decision-making, and the role of individual initiative in both the scientific and societal contexts.

Michael Polanyi explains how the scientific community operates through what he calls "coordination by mutual adjustment of independent initiatives." He argues that although scientists pursue individual lines of inquiry, their efforts are naturally coordinated through their responses to the work of others. Each scientist makes decisions based on the current state of knowledge—what

has already been discovered, published, or theorized by others—so that their individual contributions align with the broader scientific enterprise.

Polanyi refers to this as a "spontaneous coordination," meaning that no central authority directs the research activities. Instead, scientists adjust their work in response to the advancements made by their peers, contributing to an organic, self-regulating system. This system relies on the free exchange of ideas and the open publication of results, allowing each scientist to make informed decisions based on the work that has come before them.

The "mutual adjustment" occurs because each initiative (or research project) is aware of and takes into account the outcomes of other initiatives in the same field. For instance, if one scientist publishes a groundbreaking study, others will adapt their research to build on, challenge, or refine those findings. This dynamic, decentralized process creates a form of collective progress without the need for top-down control.

Polanyi admits that describing this process in abstract terms can make it seem unclear or obscure, but in essence, he is highlighting the self-organizing nature of the scientific community. It works similarly to the "invisible hand" in economics, where individual actions, guided by local knowledge and incentives, lead to an overall coordination of efforts that advances science as a whole.

Michael Polanyi's reflection on scientific progress highlights a key argument about the importance of independent initiative and decentralized coordination in the advancement of knowledge, akin to how a market operates. He suggests that scientific progress is most efficiently organized when individual scientists pursue their own research interests freely, rather than under central control. Each scientist, in focusing on problems of their own choosing, contributes uniquely to the overall advancement of science, in much the same way that individual producers and consumers in a market contribute to the economy by responding to price signals.

Polanyi draws a parallel between the "invisible hand" of the market, as described by Adam Smith, and the "invisible hand" guiding scientific inquiry. Just as prices in a market transmit information that allows for the coordination of economic activity, published scientific results enable researchers to adjust their approaches based on what others have discovered. This process of mutual adjustment ensures that individual efforts are complementary, driving scientific progress forward without the need for centralized control.

He also contrasts the incentive structures of scientists and market participants. While market agents are motivated by financial gain, scientists are driven by intellectual standards and professional recognition. Both systems, however, rely on decentralized decision-making and the free flow of information to coordinate activities effectively. Polanyi argues that any attempt to centrally control or direct scientific research would stifle innovation and bring scientific progress to a halt, just as central planning tends to fail in economic systems.

Polanyi's insight emphasizes the self-organizing nature of science and its reliance on open communication and the free exchange of ideas. This resonates with his broader philosophical work on "tacit knowledge," where he argues that much of what we know cannot be fully articulated but is instead internalized

and applied through practice. The advancement of science, much like a market economy, depends on the implicit knowledge and judgment of individuals operating within a complex system.

"The existence or this paramount authority, fostering, controlling and protecting the pursuit of a free scientific inquiry, contradicts the generally accepted opinion that modern science is founded on a total rejection of authority. This view is rooted in a sequence of important historical antecedents which we must acknowledge here. It is a fact that the Copernicans had to struggle with the authority of Aristotle upheld by the Roman Church, and by the Lutherans invoking the Bible; that Vesalius founded the modern study of human anatomy by breaking the authority of Galen. Throughout the formative centuries of modern science, the rejection of authority was its battle-cry; it was sounded by Bacon, by Descartes and collectively by the founders of the Royal Society of London. These great men were clearly saying something that was profoundly true and important, but we should take into account today the sense in which they have meant their rejection of authority. They aimed at adversaries who have since been defeated. And although Page 8 of 11 mp-repsc.htm mp-repsc.htm other adversaries may have arisen in their places, it is misleading to assert that science is still based on the rejection of any kind of authority. The more widely the republic of science extends over the globe, the more numerous become its members in each country, and the greater the material resources at its command, the more there clearly emerges the need for a strong and effective scientific authority to reign over this republic. When we reject today the interference of political or religious authorities with the pursuit of science, we must do this in the name of the established scientific authority which safeguards the pursuit of science. Let it also be quite clear that what we have described as the function of scientific authority go far beyond a mere confirmation of facts asserted by science. For one thing, there are no mere facts in science. A scientific fact is one that has been accepted as such by scientific opinion, both on the grounds of the evidence in favour of it and because it appears sufficiently plausible in view of the current scientific conception of the nature of things. Besides, science is not a mere collection of facts, but a system of facts based on their scientific interpretation. It is this system that is endorsed by a scientific interest intrinsic to the system; a distribution of interest established by the delicate value-judgments exercised by scientific opinion in sifting and rewarding current contributions to science. Science is what it is, in virtue of the way in which scientific authority constantly eliminates, or else recognizes at various levels of merit, contributions offered to science. In accepting the authority of science we accept the totality of all these valuejudgments. Consider, also, the fact that these scientific evaluations exercised by a multitude of scientists, each of whom is competent to assess only a tiny fragment of current scientific work, so that no single person is responsible at first hand for the announcements made by science at any time. And remember that each scientist originally established himself as such by joining at some point a network of mutual appreciation extending far beyond his own horizon. Each such acceptance appears then as a submission to a vast range of value-judgments exercised over all the domains of science, which the newly

accepted citizen of science henceforth endorses, although he knows hardly anything about their subject-matter. Thus, the standards of scientific merit are seen to be transmitted from generation to generation by the affiliation of individuals at a great variety of widely disparate points, in the same way as artistic, moral or legal traditions are transmitted. We may conclude, therefore, that the appreciation of scientific merit too is based on a tradition which succeeding generations accept and develop as their own scientific opinion. This conclusion gains important support from the fact that the methods of scientific inquiry cannot be explicitly formulated and hence can be transmitted only in the same ways as an art, by the affiliation of apprentices to a master. The authority of science is essentially traditional. "

Michael Polanyi is exploring the paradox of authority within the scientific community, arguing that although modern science is often seen as rejecting authority—particularly in its early struggles against religious and philosophical dogmas—science itself operates under a form of authority. This scientific authority is not political or religious, but rather a communal and intellectual authority maintained by the scientific community itself. Polanyi makes several key points:

1. Historical Rejection of Authority: Historically, figures like Copernicus, Vesalius, Bacon, and Descartes rejected the intellectual authority of the Church and traditional figures like Aristotle and Galen to advance scientific inquiry. Their battle was against dogmatic authority, and their success led to the foundation of modern science. However, this rejection was specific to certain kinds of authority, not to authority itself.

2. Need for Scientific Authority: As science has grown and spread globally, Polanyi argues that there is a growing need for a "strong and effective scientific authority" to oversee the vast and complex network of scientific inquiry. This authority ensures that science progresses in an organized and coherent manner.

3. Scientific Facts and Interpretation: Scientific facts are not standalone truths; they are part of a system that is shaped by scientific interpretation and consensus. What constitutes a "fact" in science is determined by the collective judgment of the scientific community, based on evidence and plausibility within the prevailing scientific framework.

4. Value-Judgments and Merit: The scientific community constantly evaluates new contributions, sifting through them to recognize their merit. This process is complex and relies on the collective value judgments of many scientists, each an expert in a small fragment of the vast domain of scientific knowledge. The authority of science, therefore, is not centralized but is spread across a network of scientists whose collective judgments form the foundation of accepted scientific knowledge.

5. Transmission of Scientific Traditions: Polanyi likens the transmission of scientific knowledge and standards to the transmission of artistic, moral, or legal traditions. It is through a mentor-apprentice relationship—scientists learning from established figures in the field—that scientific methods and values are passed down. This is why Polanyi refers to the authority of science as "essentially traditional"—it is based on the perpetuation of a system of shared judgments

and values that evolve over time but are rooted in the scientific tradition.

Thus, while science historically fought against certain forms of authority, Polanyi argues that it has developed its own form of authority, necessary for the functioning and advancement of scientific inquiry. This authority is collective, based on the shared values and judgments of the scientific community, and it is fundamental to the way science operates and progresses.

Polanyi notices the tension between tradition and modernity, particularly in political and social theory. The tension is embodied in the contrast between Edmund Burke's defense of tradition and Tom Paine's advocacy for absolute self-determination. Burke, reflecting on the upheaval of the French Revolution, warned that an abrupt break from tradition could lead to despotism. He viewed society as a partnership among the living, the dead, and the unborn, arguing that this continuity is essential for societal stability. In contrast, Paine insisted on the right of each generation to chart its own course, free from the constraints of the past.

This debate continues to resonate in modern political thought. In England, despite the theoretical embrace of liberty and self-determination by influential thinkers like Bentham, Mill, and Berlin, the practice of governance still reflects Burke's view, where tradition, rather than unfettered freedom, plays a crucial role. This discrepancy between theory and practice can be explained by the enduring need for a "traditional authority," even in the face of claims for absolute self-determination.

Polanyi draws a parallel between the world of politics and the "Republic of Science." Just as science relies on a dynamic but traditional authority to guide its progress, modern society must balance the need for individual freedom with the necessity of adhering to a framework of tradition. This "dynamic orthodoxy" allows for innovation and progress, while still being rooted in a collective sense of continuity. The result is a society that encourages self-improvement and intellectual exploration, where individual initiatives are guided by a shared, though evolving, tradition.

This model of a free society stands in contrast to both the radical self-determination championed by Paine and the totalitarian impulse to impose a singular vision of the common good. Instead, it emphasizes the importance of individual freedom within the bounds of a shared pursuit of excellence. This fragmentation of initiatives, while seemingly chaotic and conservative to critics, is, in fact, the engine of progress and self-improvement. As society continues to expand its intellectual and moral endeavors, this fragmentation is likely to increase, further resisting any attempts at total societal renewal.

In essence, the tension between tradition and innovation, between individual freedom and collective wisdom, defines both the scientific community and broader society. This balance ensures that progress is made without severing the ties to the accumulated wisdom of the past.

1 Michael Polanyi's philosophy, as outlined in Science, Faith and Society (1946) and further developed in Personal Knowledge (1958), challenges the positivist view of science by emphasizing the importance of personal commitment in the process of knowing. Polanyi argues that scientific knowledge is not derived from a purely objective method or from mechanical rules. Instead, it is deeply rooted in personal judgments, beliefs, and the scientist's commitment to a hypothesis or theory.

Key Concepts from Polanyi's Personal Knowledge:

1. Personal Commitment in Science: Polanyi's central argument is that all knowledge, including scientific knowledge, relies on personal judgments. Scientists do not operate as detached observers; rather, they bring their personal experiences, commitments, and intellectual passions to their work. This subjectivity is essential for progress, as it motivates scientists to ask important questions, take risks, and pursue new discoveries. Polanyi's view opposes the idea that knowledge can be entirely objective and methodical, as suggested by positivist approaches. He uses the example of Copernicus, who was guided by his intellectual satisfaction in perceiving the universe from the perspective of the Sun, rather than just following a rigid method of discovery.

2. Tacit Knowledge: Polanyi introduces the idea of tacit knowledge, which he describes as the knowledge we possess but cannot explicitly articulate. This concept became a cornerstone of his later work. He argues that we often know more than we can say, and this unspoken knowledge is critical to scientific inquiry and discovery. For instance, a surgeon may not be able to explicitly describe every nuanced movement of a surgical procedure, yet their tacit knowledge allows them to perform successfully. Tacit knowledge connects us with reality, helping us make sense of the world even when we cannot fully explain how we do so.

3. The Structure of Tacit Knowing: Polanyi viewed his identification of the structure of tacit knowing as his most significant philosophical contribution. He posits that human awareness is divided into two levels: subsidiary awareness and focal awareness. We integrate subsidiary details (the background information or unspoken knowledge) into a coherent focal point (the specific object of attention). For example, when riding a bike, our attention is focused on balance and movement, while we are only peripherally aware of the sensations in our hands or feet. The integration of these subsidiary elements is what allows us to ride successfully, even though we may not be able to explain how we achieve it

in detail.

4. Rejection of Pure Empiricism: Polanyi critiques British Empiricism, which holds that experience can be reduced to sense data. He also rejects the view that humans are trapped within their interpretative frameworks, unable to perceive reality objectively. Instead, he argues that tacit awareness connects individuals with reality, allowing them to interpret and interact with the world, albeit imperfectly. This view contrasts with the empiricist notion that knowledge can be fully explained by sensory input.

5. Influence on the Philosophy of Science: Polanyi's ideas influenced other philosophers of science, notably Thomas Kuhn and Paul Feyerabend, who further explored the role of paradigms and subjective commitments in scientific progress. Polanyi's rejection of the notion that the mind can be reduced to a set of formal rules also influenced critiques of early artificial intelligence models, such as those presented by Hubert Dreyfus. Dreyfus argued that computers and early AI systems could not replicate the tacit knowledge and intuitive judgments made by human beings.

6. Fiduciary Post-Critical Approach: Polanyi advocates for what he calls a "fiduciary post-critical approach" to knowledge. In this framework, we must acknowledge that we believe more than we can know and that knowledge is inherently shaped by personal faith and trust in the institutions and traditions within which we operate. This does not mean abandoning skepticism but recognizing that all knowledge is underpinned by commitments that cannot be entirely justified by reason alone.

Science as a Spontaneous Order:

Polanyi draws parallels between the free market and the scientific community, arguing that science functions as a spontaneous order, where individual scientists freely pursue their own research interests and, in doing so, contribute to the advancement of knowledge as a whole. This decentralized, self-coordinated system ensures that scientists make independent discoveries that build on the work of others. Polanyi believed that this organic, bottom-up approach is essential for scientific progress and opposed attempts to centrally direct or plan scientific research, which he thought would stifle creativity and innovation.

Polanyi's work underscores the importance of personal involvement and trust in the scientific process, challenging the notion that science is purely objective and methodical. His emphasis on tacit knowledge and personal commitment reshaped the philosophy of science, moving it away from positivism and towards a more human-centered understanding of knowledge creation.

2 Tacit knowledge, a concept famously developed by Michael Polanyi in The Tacit Dimension (1966), refers to knowledge that is understood or applied without being explicitly stated or easily articulated. It stands in contrast to explicit knowledge, which can be readily expressed, codified, and shared, such as facts, instructions, or procedures written in manuals or documents. Tacit knowledge, on the other hand, is more personal, context-specific, and harder to formalize.

Tacit knowledge or implicit knowledge—as opposed to formalized, codified or explicit knowledge—is knowledge that is difficult to express or extract; therefore it is more difficult to transfer to others by means of writing it down or verbalizing it. This can include motor skills, personal wisdom, experience, insight, and intuition.

Key Features of Tacit Knowledge:

1. Personal and Experiential: Tacit knowledge is deeply personal and often acquired through individual experience and practice. For instance, a master craftsman may develop intricate skills in woodworking or metalworking over years of experience, but might find it challenging to put every aspect of their expertise into words. This is because tacit knowledge is often learned through doing rather than telling.

2. Embodied and Practical Skills: A hallmark of tacit knowledge is its embodiment in skills or practices. A common example is riding a bicycle or playing a musical instrument. Someone might know how to ride a bike through experience but may struggle to explain the exact bodily movements involved in balancing, pedaling, and steering. This is also true for athletes, artists, and musicians who often operate on "muscle memory" or intuitive practices that go beyond verbal description.

3. Subsidiary and Focal Awareness: In The Tacit Dimension, Polanyi introduces the idea that human awareness operates on two levels: subsidiary and focal awareness. Subsidiary awareness refers to the background, often unconscious, aspects of knowing—like being aware of the pressure on the soles of your feet while walking. Focal awareness is the specific, conscious focus of attention—like focusing on walking toward a destination. Polanyi argues that tacit knowledge operates at the level of subsidiary awareness, providing the context for explicit, focal knowledge. This dual awareness allows people to perform tasks intuitively without necessarily thinking about each minute step.

4. Emergence and Ontology: Polanyi extends his analysis of tacit knowledge

into the realm of ontology, suggesting that tacit knowledge facilitates the process of emergence—where higher-order knowledge or capabilities arise from the interaction of simpler components. For example, the complex skill of playing a musical instrument emerges from the integration of multiple tacit skills, such as hand-eye coordination, muscle control, and intuitive timing.

5. Indwelling and Personal Engagement: Polanyi also introduces the concept of indwelling, where individuals internalize aspects of their environment, tools, or knowledge through prolonged interaction and use. A doctor, for instance, might "indwell" in medical tools or techniques, making them an extension of their own abilities. This personal engagement with the knowledge being used underscores Polanyi's idea that knowing is an inherently personal act.

The Role of Tacit Knowledge in Science and Innovation:

Polanyi emphasized that tacit knowledge plays a crucial role not only in practical skills but also in scientific discovery and intellectual inquiry. Scientists, for example, rely heavily on tacit knowledge when forming hypotheses, recognizing patterns, or interpreting data. Many scientific insights arise not from strictly following rules or formulas but through intuitive judgments developed through years of experience in a specific field. The idea of personal knowledge—where all knowing involves personal judgment—is central to Polanyi's critique of positivist science, which tends to reduce knowledge to objective and easily articulated facts.

Implications for Organizational Learning and Knowledge Management:

In modern discussions of organizational learning and knowledge management, tacit knowledge has become a critical concept. Since it is difficult to capture and formalize, organizations often struggle with how to preserve and transfer tacit knowledge when employees leave or retire. This has led to the recognition that tacit knowledge is best shared through apprenticeship, mentorship, and collaborative practice, where learning occurs through close interaction with more experienced practitioners.

Tacit knowledge also underscores the limitations of purely codified systems for knowledge management. Databases, manuals, and written procedures can capture explicit knowledge, but the subtle, intuitive aspects of expertise often remain locked in individuals' experiences and practices. Encouraging environments where people can share experiences, stories, and informal interactions is thus essential for fostering tacit knowledge transfer.

Conclusion:

Michael Polanyi's concept of tacit knowledge reveals the depth and complexity of human cognition and skill. By emphasizing that much of what we know cannot be fully expressed in words or rules, Polanyi challenges the assumption that all knowledge can be made explicit or formalized. Tacit knowledge, rooted in personal experience, intuition, and practice, plays a crucial role in everything from everyday tasks to scientific breakthroughs. This insight has profound implications for education, innovation, and knowledge management, highlighting the importance of learning by doing and the irreplaceable value of personal expertise.

3 Michael Polanyi's critique of reductionism, particularly in his works Life's Irreducible Structure (1968) and Transcendence and Self-Transcendence (1970), presents a deep challenge to the reductionist worldview prevalent in modern science. He argues that higher-order phenomena, like life, consciousness, and human intentionality, cannot be fully explained by the laws of physics and chemistry alone.

1. Reductionism vs. Emergence:

Reductionism suggests that complex systems can be entirely explained by their individual components, implying that life and consciousness are merely the result of physical processes. Polanyi counters this view with the theory of emergence, which posits that there are multiple levels of reality, each with its own distinct causal powers. For Polanyi, DNA serves as a key example: while it possesses physical and chemical properties, its function in encoding biological information is governed by higher-order organizing principles that are not reducible to its molecular structure alone.

In this sense, biological systems possess emergent properties—characteristics that arise from the interaction of simpler components but are not simply the sum of those parts. Emergent systems have a degree of autonomy that is constrained by the lower-level physical laws but not dictated by them. The higher-level realities, such as life and consciousness, possess their own causal powers, which cannot be explained solely by their constituent parts.

2. Boundary Conditions and Downward Causation:

Polanyi introduces the idea of boundary conditions, which represent the constraints or conditions that a system operates under. He argues that these conditions allow for degrees of freedom within systems, which are governed by higher-level principles. This reflects his notion of downward causality—the idea that higher-level systems can exert causal influence on lower-level physical processes. For example, consciousness, which operates on a higher level than neural networks, can influence physical actions through intentional decisions.

This concept of downward causation emphasizes that while higher-level phenomena depend on lower-level processes, they are not reducible to them. Consciousness, human decision-making, and intentionality are examples of emergent realities that, once present, interact with and shape lower-level phenomena, such as neuronal activity.

3. The Mechanistic Worldview and its Shortcomings:

In Transcendence and Self-Transcendence (1970), Polanyi criticizes the mechanistic worldview, which traces back to Galileo and dominates modern science. This view treats the world as a closed, mechanistic system where everything

can be understood through physical laws. Polanyi argues that such a worldview dismisses higher-order phenomena, reducing everything to matter and mechanism. This leads to an impoverished understanding of reality, particularly when it comes to complex, purposeful systems like human consciousness, creativity, and moral values.

4. Moral Inversion and Modern Pathologies:

Polanyi introduces the concept of moral inversion, where the higher-order moral and intellectual values, such as truth, justice, and freedom, are rejected in favor of purely material or mechanical explanations. He considers this moral inversion to be one of the major pathologies of modern thought, especially within Marxism, which he views as reducing human behavior and societal progress to economic and material forces.

In Polanyi's view, Marxism exemplifies moral inversion by allowing the State to justify immoral actions through the appeal to historical necessity. By rejecting higher moral values in favor of deterministic materialism, Marxism endorses coercive control in the name of "historical logic." This is particularly dangerous, Polanyi argues, because it disregards the personal commitments and moral values that are essential to a truly free and flourishing society.

5. Science and Personal Commitment:

Polanyi also emphasizes that all forms of knowledge, including scientific inquiry, are rooted in personal commitment. He challenges the positivist belief that scientific knowledge is purely objective and impersonal. In reality, scientists, according to Polanyi, make personal judgments and are guided by tacit knowledge—knowledge that cannot be fully articulated but is essential for innovation and discovery.

Polanyi's critique of reductionism is not just a defense of life sciences or the humanities; it's an argument for understanding human knowledge and progress as complex, layered, and driven by personal, moral, and intellectual commitments. He argues that the reductionist attempt to explain away higher-order phenomena in terms of lower-order physical processes leads to a distorted and incomplete view of reality, ultimately generating what he calls nihilism in the humanities and social sciences.

6. Implications for Science and Society:

Polanyi's broader philosophical approach calls for a recognition of the multilayered structure of reality and the acknowledgment that different levels of reality require different explanatory approaches. In a scientific context, this means accepting that physical, chemical, biological, and psychological explanations are all valid at their respective levels but cannot be collapsed into one another.

In society, this philosophy suggests that reductionist ideologies, which attempt to explain human behavior purely through material or economic terms, fail to capture the richness of human experience, leading to moral and social distortions. Polanyi advocates for a more holistic view of human beings and the world, one that recognizes the role of personal judgment, creativity, and the moral dimensions of our actions.