Personal Knowledge and Human Creativity

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ABSTRACT Key Words: Michael Polanyi, personal knowledge, tacit knowing, levels and hierarchies of knowledge, emergence, creativity.
The keystone of Polanyi's epistemology is his idea that tacit knowing integrates subsidiary knowledge and creates personal meaning. However, Polanyi's preoccupation with scientific discovery seems to have prevented him from developing the idea of tacit knowing in the context of human creativity. This omission leaves Polanyi with a static universe in which personal knowledge is subsumed under impersonal fields. This calls for further work.

1. Anthropocentric Knowledge

In the opening pages of his great work *Personal Knowledge*.[1] Michael Polanyi throws down his gauntlet to challenge the positivist philosophers who want to separate objective knowledge from human persons holding that knowledge. For this purpose he uses the example of the Copernican revolution, which replaced the geocentric by the heliocentric model of the earth and the planets. That change displaced the earth from its primary position at the centre of the universe and, in the minds of many therefore displaced humankind from its assumed role of special importance in our world. Polanyi believes that this is a mistaken conclusion.

He asks, 'What is the true lesson of the Copernican revolution?' and then answers that question in two stages. First, he accepts that the Copernican theory has greater objectivity than the Ptolemaic theory that preceded it. Secondly, however, he denies that this objectivity arises from replacing the egocentric view of the Ptolemaic system by objectively detached knowledge. He asserts that the reason why the Copernican view is more objective is because it is intellectually more satisfying. With great daring he writes, 'We abandon the cruder anthropocentrism of our senses-but only in favour of a more ambitious anthropocentrism of our reason.'[2]

No doubt Polanyi chose the word 'anthropocentrism' deliberately and provocatively. He was not an academic philosopher writing with scholarly detachment. Although *Personal Knowledge* is a work that has made a profound contribution to the study of epistemology, Polanyi had a wider purpose in writing it. He was engaged in the defence of human freedom, the freedom of science in particular and the freedom of thought in general. Nazi persecution had driven him and many of his colleagues out of Germany. He had studied Soviet Communism at first hand and had been appalled by its betrayal of freedom. Even while he was writing his book in England, he was fearful of the growing support for Marxist ideas in the universities of Britain and America and was afraid that central planning would destroy scientific freedom.

Beyond Polanyi's passionate desire to defend freedom lay the need to defend human values and meaning itself. Polanyi's last book is *Meaning* and it starts with the words, 'In a sense this book could be said to be about intellectual freedom. Yet its title, *Meaning*, is not really misleading, since, as we shall see, the achievement of meaning cannot properly be divorced from intellectual freedom.'[3] However, even meaning in its various forms, as analysed in that book, is not Polanyi's primary concern. That concern is with what it means to be human.

This basic interest is very perceptively captured in Drusilla Scott's book *Everyman Revived*.[4] Lady Scott takes as the framework for her discussion of Polanyi's ideas the mediaeval 'mystery play' *Everyman*, whose main character is summoned by death to give an account of his life to God. One by one, Everyman's friends, who are personifications of his qualities and possessions, desert him. These are Fellowship, Family, Goods, Discretion, Strength, Beauty and Five Wits. Only Good Deeds and Knowledge go with him to the end. In the play, these two represent the authority of the Church. In Polanyi's view, that authority has been replaced in our time by the tyranny of a misguided 'scientism', which 'fetters thought as cruelly as ever the churches had done'. Polanyi saw it as his task to 're-equip men with the faculties which centuries of critical thought have taught them to distrust'.[5] Everyman's friends are to be re-instated because they are all essential to human knowledge. That is why Polanyi describes human knowledge as anthropocentric as well as personal.

2. Objective Knowledge

It was the contention of the positivists that the subjective component of human knowledge could be eliminated, or at least reduced, by relying entirely on direct observation of the external world. Polanyi uses the term 'anthropocentrism of the senses' to point out that such sense experience is always conditioned by the human observer and has no claim to be regarded as totally objective. Knowledge is inevitably personal knowledge. Moreover the 'anthropocentrism of our reason' has a greater claim to be regarded as providing truly objective information about the world.

Polanyi shows that this is so because the change is validated by subsequent developments. Thus in his example of the Copernican revolution, the heliocentric theory led Kepler to the laws of planetary motion and these led Newton to the discovery of universal gravitation. Newton's theory was found to be consistent with countless observations and was embodied in countless human devices and systems. Polanyi writes, 'a theory which we acclaim as rational in itself is thereby accredited with prophetic powers…In this wholly indeterminate scope of its true implications lies the deepest sense in which objectivity is attributed to a scientific theory'.[6] The new features revealed by a theory confirm that this theory relates to the external world. Nevertheless such objective theories are human discoveries and achievements. They cannot be detached from human persons.

Polanyi reinforces his choice of the term 'anthropocentrism' by his insistence that he has in mind individual human beings rather than populations. In a lecture on emergence,[7] he distinguishes between ideogenesis and phylogenesis and criticises the theory of adaptive evolution by natural selection as unable to account for the evolution of individuals. His concern is with individual human consciousness and with human beings as active centres of personal knowledge. He speaks of this knowledge as a personal achievement.

He is well aware that, taken out of context, his anthropocentrism can easily be misunderstood. His stress on human achievement might suggest subjective rather than objective knowledge. Such knowledge could be useful for the purposes of calculation without having to be accepted as having any deeper significance. That was the view urged on Copernicus by Osiander, who hoped thereby to avoid a conflict with the then prevailing Aristotelian ideas.[8] Or it might imply agreement with Kant's notion that human knowledge of the external world is shaped by the structure of our minds and is therefore knowledge of appearances only, so that it cannot penetrate into the nature of 'things in themselves'. Polanyi dismisses this view and also the other Kantian idea that scientific theories should be treated as no more than working hypotheses.[9]

Anthropocentrism might also be mistaken for introspection or even narcissism, with the implication that personal knowledge consists entirely in the enjoyment of patterns in the mind, but these ideas are foreign to Polanyi's advocacy of personal knowledge. His contention is that true personal knowledge is objective knowledge of the external world, because it is validated by the implications of that knowledge. Moreover personal knowledge is no private possession. Polanyi describes the scientific community as a 'society of explorers'.[10] This community accredits the discoveries of individual scientists.[11] Scientific knowledge is shared objective knowledge and it cannot be detached from human persons. For example, it is relatively easy to build and equip scientific laboratories, but without scientists brought up in the pursuit and the traditions of scientific research, such institutions will produce nothing of value.[12]

3. Tacit Knowledge

Scientism, in Polanyi's view, is not only destructive of human values but also thoroughly mistaken in its understanding of the nature of knowledge. Human knowledge does not consist of isolated facts available for inspection in the external world, because an act of observation is always a skilfull performance. This idea leads Polanyi to what is perhaps his most valuable insight, which is that observation always has a tacit component. The concept of tacit knowing is the keystone of Polanyi's epistemology and the description and explication of tacit knowledge play a crucial role in all his philosophical papers and books.[13] (He uses many metaphors and analogies and in this section they will be printed in italics.)

The paradigm for tacit knowing is the conscious act of visual perception. Perception is something that has to be learned and the learning process can be observed in the development of perceptive vision in infants. All perception involves bodily effort, as for example in stereoscopic vision, which requires the co-ordinated control of the eye muscles. It also involves mental effort, as for example in the recollection of a person's face. The successful combination of bodily and mental effort requires skill and is a personal *achievement*. That achievement depends on the operation of tacit knowledge, which is used with conscious i*ntent* and, although this is a logical procedure, the use of such knowledge is tacit because it cannot be formalised or stated explicitly.

The reason why such knowledge is essentially tacit is that it is *subsidiary* to the focal perception of the object that is being perceived. The act of knowing has a *from-to* structure, being directed *from* the subsidiary *to* the focal perception. The tacit component enables the person to *integrate* the *clues* leading to the *meaning* of the focal knowledge.

The chief instruments that we use in perception are our bodies. We do not (in general) focus our attention on our bodies, because we *indwell* them and use them to focus on the external world. We look *from* our bodies *to* the external world. To facilitate the *exploration* of the external world we use *tools* and *probes*, which we *interiorise* so that they become extensions of our bodies. The most important tool is the use of language, which distinguishes human beings from animals.

The interiorisation of tools requires effort and skill. One of Polanyi's favourite examples is the skill of interpreting X-ray photographs of human organs. Medical students have to learn the meaning of the shadowy outlines by listening to the explanations of experts. They have to use their *imaginative powers* to indwell the photographs in order to grasp the *meaning* of what they see. The use of the imagination requires *commitment*

to the belief that the experts are to be trusted and that there is meaning to be *discovere*d. Commitment starts with the appreciation that there is a problem capable of *solution*. Commitment to a problem acts as a *heuristic field*, which draws the explorer to a solution of the problem.

The concept of tacit knowledge resolves several long-standing philosophical difficulties, such as the question how it is possible to search for an unknown object or how one can define a class of objects apart from a specific object. The answers lie in the unspecifiable components of commitment to standards of health and normality and to values. These components of tacit knowledge draw attention to the personal pole of knowledge. That personal aspect carries with it the possibility of a mistaken commitment. Polanyi illustrates this with reference to erroneous belief systems like the Zande belief in poison-oracles or the commitment to so-called scientific materialism. He does not regard the possibility of error as a weakness, but glories in it as an opportunity for the exercise of personal responsibility. The human calling to knowledge requires the commitment to hold and to declare that knowledge *with universal intent*. This distinguishes personal knowledge from merely subjective opinion.[14]

It might be thought that tacit knowledge could be made explicit by focusing attention on it as on an external object. That is, however, impossible because focal attention destroys the action of tacit knowledge. For example, if a concert pianist diverts his focal attention from the score to the motion of his fingers, he can no longer play the musical composition. Another example given by Polanyi is an experiment with inverting spectacles. Although the wearer knows explicitly how to correct his movements, he is unable to find his way until his tacit knowledge has been realigned and that requires a lengthy learning experience. The integration produced by tacit knowledge is not merely a summation of knowledge but the perception of a new coherence. Subsidiary and focal knowledge act together, but they act differently. A tool becomes a tool when it is used as a tool.

This gives insight into the mind/body problem. Thus a physiologist examining the brain of a patient might conceivably obtain complete knowledge of all the neural processes involved in the patient's act of perception, but he would not see what the patient is seeing. Focal attention to the brain cannot reveal the subsidiary knowledge used by the brain. The physiologist attends to the brain as an external object, whereas the patient indwells the brain and uses it as a tool. Thus the mind can be regarded as the meaning of the brain.

How then can one understand the mind of another person? Polanyi explains that this needs empathy. First of all, we need to *affirm* the other person as a *functional* whole rather than a collection of behavioural properties. Then we need to pay close and imaginative attention to the other person in order to achieve an indwelling in his personality as a whole. We have to look out of his eyes rather than into his eyes.[15]

This short account of Polanyi's concept of tacit knowledge cannot do justice to the range and importance of the ideas involved. It is a concept that needs long and careful attention so that one can indwell it and use it as a tool. A danger that has to be avoided is to regard tacit knowledge as a single object, because that would be equivalent to an attempt to render it explicit rather than tacit. Tacit knowledge describes an operation rather than an object. By virtue of our common humanity, every person will have large areas of common tacit knowledge, but as an individual there will also be differences. The nature of individuality precludes us from fully entering into the tacit domain of another person. Moreover, an individual will use different parts of his tacit knowledge under different circumstances. Different kinds of tacit knowledge are involved in riding a bicycle or in solving a crossword puzzle. Sometimes Polanyi seems to treat tacit knowledge as a unique entity and this leads to difficulties, which we shall discuss in the next section of this paper.

4. Levels of Knowledge

The dehumanising effect of the objectivist analysis of human knowledge, against which Polanyi was contending, is seen particularly in the idea that whole entities must be explained by dividing them into their constituent parts. This reductionism has been taken to imply, for example, that the behaviour of living beings can be described entirely by the laws of physics and chemistry. Polanyi repeatedly cites the famous statement of Laplace that complete knowledge of the past and the future of the universe would be available to an intelligence that knew the forces and positions of all material bodies at a particular instant of time[16]. He argues that, since such Laplacian information would consist entirely of co-ordinates and impulses, it would be virtually meaningless. In his view, the followers of Laplace have substituted, by a conjuring trick, knowledge of experience for knowledge of atomic data. Modern claims that all study of living beings can be reduced to molecular biology constitute a return to this mistaken Laplacian ideal. [17]

Polanyi counters reductionism by reference to the operational principles of machines, which he explains as follows. Machines operate under dual control.[18] At one level, they obey the laws of physics and chemistry. However, these laws are insufficient to explain the function of a machine, although they can account for its failure. Dual control is exercised by an operational principle, which imposes boundary conditions that are not controlled by the laws of physics and chemistry. Thus the machine operation needs two levels of explanation. At one level the operation depends on physical and chemical topography described by the laws of physics and chemistry and at another level the operation depends on the topography of the materials used in the construction of the machine. A natural choice is to regard the construction of the machine as providing the higher level and the laws of physics and chemistry as providing the basic lower level. This description in terms of levels is analogous to the description of tacit knowledge in terms of subsidiary and focal components. There is a further analogy inasmuch as the operation of tacit knowledge provides meaning at the focal level and the function of the machine provides an independent meaning, which is not inherent in the subsidiary laws by themselves. Just as focal knowledge cannot be reduced to subsidiary knowledge, so the operational principles of machines cannot be reduced to the laws of physics and chemistry. Reductionism therefore cannot be applied successfully to the operation of machines nor indeed to any whole entity that possesses a functional property. *A fortiori,* it cannot be applied to living beings.

The use of the term ‘level’ is metaphorical. In its primary use it refers to the height or depth referred to an arbitrary datum such as sea level. The choice of datum level does not matter when the levels of two objects are compared, but when there are more than two objects there has to be an agreed common datum. The use of the metaphor of level becomes confusing when more than one meaning is to be ascribed to a particular level. Polanyi moves from two-level structures such as occur in particular instances of tacit knowledge to the multiple levels of hierarchical structures of meaning. His favourite example is the hierarchy involved in making a speech. Voice production, which is the lowest level of speech, leaves open the next level, which consists of the combination of sounds into words controlled by a vocabulary. The next level consists of the combination of words into sentences controlled by the rules of grammar. At the next higher level sentences are combined into style controlled by the principles of literary criticism. Above this is the speech itself controlled by the principles of rhetoric. Each level is subject to its own controlling principles and is open to he next higher level, which exercises marginal control on it. The attempt of reducing a level to the one below it destroys the meaning of the higher level.[19]

This idea of hierarchies of meaning is effective in showing the weakness of a reductionist approach. It has a wide appeal to philosophers of science. Peacocke takes it as the paradigm of the scientific attitude. He speaks of nature's hierarchies and distinguishes between hierarchies of natural systems and of scientific theories.[20] Polanyi links hierarchies of meaning with hierarchies of living beings in the context of evolutionary theories. He writes that living beings form a sequence of levels controlled by a series of boundary conditions, which stretch from the lowest level of the forces of inanimate nature to the highest level of man's responsible choice. [21]

Although the idea of hierarchical structures is attractive in providing a unifying metaphor, particularly in biology, it faces some severe difficulties. Consider the example of the making of a speech, which Polanyi uses on many occasions. First there is the problem of applying the idea of level to objects like sentences. Apparently the use of the term is connected with the complexity of the object. Certainly a sentence is more complex than a word because it consists of a combination of words. However, Polanyi's discussion is concerned with the meaning of the sentence and not with the number of words. The meaning may not be improved by making the sentence more complex, nor is it easy to understand what is meant by the level of a meaning. Perhaps that difficulty can be set aside by speaking of the function of a sentence or the complexity of its functions. However, it is not certain that the functions of sentences are more complex than the functions of words. How then does one assess the levels in this hierarchy?

An even greater difficulty arises from the lack of uniqueness of this hierarchy. The hierarchy as an entity does not uniquely give the choice of the terms. Sentences could be divided into types of clauses or different kinds of logical assertions. Words do not necessarily have to be divided into sounds. In fact such subdivision is very difficult to consider as meaning. Speeches do not just consist of style but of content, nor does style generally refer to sentences. The hierarchy lacks cohesion, or at any rate it lacks independence. The trouble with Polanyi's operational principles is that these do not stand alone, but form an intricate web of connections. Reference to the operation of tacit knowledge suggests that instead of a hierarchy of connected entities one is faced with a non-denumerable network of branches and loops. As in an electrical, or neural, network there will be many connections, but no single hierarchical ordering.[22] Thus in Polanyi's example of a machine there are many operational principles and many boundary conditions besides those of shape and choice of material. The design of a machine does not consist of the discovery of a hierarchy of meaning but in the examination of a bewildering number of variables subject to many different constraints. An engineer has to select the variables that appear to be most significant and to arrange them in groups of manageable size having related properties. Thus in the example of a machine consideration has to be given to such matters as the 'fitness for purpose' of the device, its efficiency, the human and material resources available for the design and manufacture, the properties of the materials and their availability and cost, the energy requirements, safety in manufacture and operation, reliability, life expectancy and the environmental impact. A compromise has then to be achieved between the different constraints. It is difficult to see how these variables could possibly be arranged in hierarchies of meaning as in Polanyi's scheme. He dismisses the complexities of engineering by referring to them as consisting of an interest in 'momentary constellations foreign to the scientist, whose eye is fixed on the inner law of nature'.[23]

In the context of tacit integration the idea of the two levels of subsidiary and focal knowledge works well, but in its extension to hierarchies the idea of multiple levels is not so successful. It seems that Polanyi in his attack on reductionism has left out the personal aspect of the tacit operation. He treats the hierarchies as if they were explicit structures of knowledge and does not take sufficient account of the unspecifiable element in

all perception of meaning. The metaphor of a hierarchy appears to have become disconnected from Polanyi's central theme of personal knowledge. Just as there are no impersonal objective facts, so also there cannot be isolated hierarchies of meaning arranged in levels. The choice of significant features of an entity is, like the recognition of the entity itself, a human choice and indeed Polanyi makes this very explicit in his discussion of the scientist's choice of a scientific problem.

5. Emergent Knowledge

Polanyi uses the idea of operational principles very effectively in his consideration of the nature of living beings. After showing that human persons are actively involved in acquiring knowledge by solving problems, he notes that this leads to the acknowledgement of similar powers in other persons. That acknowledgement implies the recognition of the skilful performances of other persons and so there emerges a correspondence between the structure of comprehension and the structure of the comprehensive entity, which is the object of that comprehension.[24] This involves acts of recognition, which by relying on tacit knowledge enable us to recognise the behaviour of all sorts of comprehensive entities

Polanyi then asserts that human skills can be arranged in hierarchical order and cites again the example of a literary composition. From this, he infers that there is a similar hierarchy of levels in living beings. In particular, living beings are distinguished from inanimate objects by their possession of purposive functional behaviour subject to operational principles. Like the operational principles in machines, these principles in living beings are subject to failure. That shows the impossibility of reducing them to the laws of physics and chemistry. They relate to a higher level that has emerged from inanimate matter.

In the hierarchical structure of levels of being, each level is controlled by a higher one and no level can gain control over its own boundary conditions. Hence it cannot bring a higher level into existence. Thus the existence of higher levels entails the operation of a process of emergence. Polanyi writes, 'If this be vitalism, then vitalism is mere common sense, which can be ignored only by a truculently bigoted mechanistic outlook'.[25]

Polanyi bases his 'vitalism' on the recognition of functional behaviour in living beings. Tacit knowledge is involved both in the recognition of such functions and in the operation of the functions. The essential role played by tacit knowledge distinguishes Polanyi's approach to functional behaviour from Aristotle's belief in 'final causes'. However, when at the end of *Personal Knowledge* he attributes such behaviour to inanimate matter, he does come close to Aristotle. [26]

Polanyi's 'vitalism' and his belief in hierarchical levels of operation lead him to the belief that there is an emergence of higher levels. This is a 'personal' theory of evolution, whereas, in his view, the theory of evolution by natural selection is impersonal and cannot account for the emergence of single individuals of a higher species. Personal emergence is exemplified by the development of the mental powers of human infants and children. Moreover the theory of evolution by natural selection is based entirely on self-preservation and something more is needed to account for the moral sense of human persons and for the human sense of obligation to standards and the reverence due to men greater than oneself..[27]

In the closing pages of *Personal Knowledge*, Polanyi attempts an evolutionary theory that will account for emergence. He suggests that the tacit component of human knowledge is a feature of a more general entity of a 'biological field', which produces emergence.[28] This field is associated with a gradient of potential

achievement and is observed in the heuristic processes preceding human discoveries.

Polanyi uses the terms 'field' and 'gradient' as metaphors relating emergence to physical processes. The usefulness of a metaphor depends on the link it establishes between the normal meaning of an expression with a novel usage in a different context. The term 'field' became prominent in science through the discovery of electromagnetic waves by J C Maxwell (1831-1879). Maxwell replaced the idea of electrical particles acting on each other at a distance by the idea of a contiguous field of distributed energy and momentum in space and time. The subsequent development of relativity theory showed that space and time had to be considered as a single entity of space-time. Strictly speaking there are therefore no static spatial phenomena independent of time. However, for purposes of calculation, the time variation can sometimes be neglected in phenomena in which the motional energy is small. In such approximations the field can be described in terms of its gradient. Polanyi's metaphor of a gradient field therefore carries with it the notion of something unchanging in time. The use of a gradient field in the description of something dynamic like emergence would appear to be highly unsatisfactory. The difficulties in Polanyi's analogies are indeed formidable. In any case physical fields belong to the level of 'the laws of physics and chemistry' that Polanyi frequently calls 'mechanistic' and that he contrasts with the personal features of knowledge operating at a higher level. It is surely unsatisfactory to invoke entities from a lower level to account for those at higher levels and Polanyi has already declared that this is impossible. Thus the field metaphor seems to involve a contradiction. Moreover physical fields can be observed and measured, whereas emergence appears to be indeterminate and unspecifiable like tacit knowledge. A strong further technical objection of the metaphor is that gradient fields are, as already mentioned, static in time, whereas emergence is related to temporal change. All in all it comes as rather a disappointment to find that a book that starts with a ringing declaration of personhood ends by attributing the emergence of personal knowledge to an impersonal and unchanging field.

6. Personal Knowledge and Human Creativity

Polanyi does not often use the word creative. Occasionally, he refers to 'creative imagination',[29] but he fights shy of crediting human beings with creativity. It may well be that he was afraid that creativity was too close to the limitless aspirations of totalitarian systems with their repudiation of traditional values. Polanyi's essays 'Beyond Nihilism'[30] and 'The Two Cultures'[31] with their analysis of the malign influence of Rousseau and the French *philosophes* is important in this context. He relates Rousseau's assertion of intrinsic human rights of creative spontaneity to the glorification of the noble savage. These views contrast sharply with the work of Polanyi's friend Arthur Koestler, whose book *The Act of Creation*[32] was published six years after *Personal Knowledge* and nine years before *Meaning*. For Koestler, personal knowledge is invariably an act of creation. This difference in emphasis of two writers who shared similar ideals is no doubt largely due to the fact that Polanyi was a scientist before turning to philosophy, whereas Koestler had a literary background. Polanyi was aware of the divergence of the 'Two Cultures'. In his essay with this title, written in answer to C P Snow's original essay, [33] he suggests that Snow's analysis does not go far enough. [34] The perceived gulf between the literary and the scientific cultures is not merely due to the ignorance of science by workers in the humanities, as suggested by Snow, but is due to the mistake of accepting scientism as representing true science. Polanyi contends that literary culture is being destroyed by its acceptance of scientism into its own system.

Although Koestler's work lacks the careful analysis undertaken by Polanyi, the stress on human creativity supplies a gap that exists in Polanyi's work. With scientific knowledge as the paradigm of all human

knowledge, Polanyi speaks of discovery and problem solving rather than creativity and novelty. Polanyi's terms stress the universal pole of human knowledge, but they do not give full weight to the personal pole. He is dismissive about 'inventions', because their importance depends on external economic constraints, whereas 'the validity of a scientific observation cannot be affected by changes in the value of goods'.[35] Elsewhere, he writes that invention is a kind of 'trick learning', while scientific discovery is an 'act of interpretation'.[36] Technology is therefore an ephemeral activity compared with scientific research.

Underlying these reflections is Polanyi's conviction that science is a bulwark for truth and that 'The Republic of Science'[37] is the guardian of 'The Free Society'.[38] In their pursuit of scientific truth, scientists combine what is best in traditional beliefs and values with the liberty to question and explore. They 'indwell' the scientific tradition and by means of this tacit knowledge are enabled to 'break out'[39] into new insights.

There is much to be said for this vision of reality in a relativistic age such as ours. Unhappily, Polanyi's ideal scientific community of committed scientists no longer exists and perhaps it never existed, although his account of the scientific community in Berlin in the years before Hitler comes close to the ideal.[40] However, the disaster that overtook that community and scattered its members shows that scientific research cannot operate in isolation, nor can universities sustain the load of acting as isolated bulwarks of free enquiry. Even more serious for Polanyi's visionary scheme is the objection that scientific research is too narrow in its scope, because it omits vast areas of human activity. In particular, it overlooks human creativity in the fashioning of tools and the construction of useful devices and systems.

Creativity is more than discovery or problem solving, although it plays a part in those activities. Engineering design, for example, is concerned with the creation of entities that do not yet exist. An electric distribution system is not something that can be discovered, nor is it a problem that can be solved, but it is a newly created entity, creating value for society.[42] Similarly, musical composition and the visual arts do not easily fit into Polanyi's scheme of discovery. Probably even scientific discovery has a stronger component of creation than he admits. There is a difference between the discovery of America, which is a favourite analogy used by Polanyi, and the discovery of relativity theory. The discovery of America is an example of the anthropocentrism of the human senses, whereas the discovery of relativity theory is an example of the anthropocentrism of the human reason. In both examples, the underlying phenomena were observed, shaped and interpreted by human beings, but the discovery of relativity theory required greater creativity.

The omission of creativity in Polanyi's otherwise masterly exposition of human knowledge is related to his treatment of time. Polanyi uses a so-called 'tenseless' approach to time, which distinguishes between earlier and later but which does not account for the direction of time and for causality.[41] His vitalism describes the functional behaviour of living beings, but stops short of crediting them with powers of independent causation. Alongside and behind the personal activity of human beings he posits the action of a cosmic field. In spite of his brilliant insight into the tacit component of knowledge, Polanyi's world does not make allowance for the creation of new entities.

Polanyi's legacy is manifold. He set himself the task of defending freedom of thought and in doing so, he rediscovered that thoughts require thinkers and that truth requires persons committed to truth. In particular he reacted against the corrosive influence of scientism, which as a practising scientist he knew to be mistaken both in its methods and its conclusions. This fight against scientism is still necessary for the defence of freedom because, as Polanyi saw clearly, scientism inevitably leads to nihilism and to the destruction of society. However,

Polanyi's concentration on scientific knowledge restricted his vision and did not allow him to affirm human creativity as strongly as personal knowledge. Such an affirmation and elucidation await the arrival of his successors.

Endnotes

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1 Michael Polanyi, *Personal Knowledg*e, Routledge & Kegan Paul 1962

2*PK,* pp. 4-5.

3 Michael Polanyi and Harry Prosch, *Meaning,* University of Chicago Press 1975, p. 3.

4 Drusilla Scott, *Everyman Revived- The Common Sense of Michael Polanyi*, The Book Guild 1985.

5 *Everyman Revived,* p.16.

6 *PK,* p. 5.

7 Michael Polanyi, *The Tacit Dimension*, Doubleday 1966, p. 48.

8 *PK,* p. 146.

9*PK,* pp. 306-308.

10 *TD*, Chapter 3.

11 Michael Polanyi, *Knowing and Being* (edited by Marjorie Grene), University of Chicago Press 1969. See especially the essay 'The Republic of Science' (1962) and the autobiographical essay 'The Potential Theory of Adsorption' (1963).

12 *PK,* pp. 53 & 182

13*PK,* 'Part Two: The Tacit Component', *TD* chapter 1, and *KB*, which has four essays under the general title of 'Tacit Knowing'. Of particular interest are 'The Logic of Tacit Inference' (1964), 'Tacit Knowing: Its Bearing on Some Problems of Philosophy' (1962), and 'Sense Giving and Sense Reading' (1967).

14*PK*, 'The Structure of Commitment', pp. 308-316.

15*PK,* pp. 262-264

16 *PK,* pp. 139-142.

17*KB,* p. 236.

18*TD,* pp. 38-40, *KB,* pp. 175-176, 217-219, 226-227.

19 *TD,* p. 41, *KB,* pp. 154-155, 233.

20A R Peacocke, *Creation and the World of Scienc*e, Oxford University Press 1979, pp. 113-115.

21*KB,* pp. 233-238.

22 The idea of a single hierarchy of knowledge is a type of 'nomological monism' and is part of the quest for 'grand unified theories (GUT)', which in the words of Stephen Hawking would enable us to 'know the mind of God'. It is part of the belief system of popular scientism.

23*PK,* p. 178.

24*PK,* pp. 347-354.

25 *PK,* p390.

26 Philip Clayton, 'Emergence, Supervenience and Personal Knowledge', *Tradition And Discovery*, Vol. 29, 3, pp. 8- 19. Clayton does not make this distinction.

27*PK,* p. 396.

28 *PK,* pp.398-400.

29See, for example, Polanyi's paper with this title in *Chemical and Engineering News*, Vol. 44, April 1966, pp. 85-93. This paper is included in the collection edited by R T Allen: *Society, Economics and Philosophy – Selected Papers by Michael Polanyi*, Transaction Publishers, New Brunswick, New Jersey 1997.

30*KB,* pp. 3-23.

31*KB,* pp. 40- 46.

[32]Arthur Koestler, *The Act of Creation*, Hutchinson 1964.

[33]C P Snow, *The Two Cultures and the Scientific Revolution*, The Rede Lecture, Cambridge University Press 1959.

[34]'Two Cultures Revisited: Polanyi on the Continuity Between the Natural Sciences and the Study of Man', *Tradition And Discovery,* Vol. 28, 3, pp. 6-19. Yu argues that the theory of tacit knowing establishes a continuous transition from the study of the natural sciences to that of the humanities.

[35] *PK, p. 177.*

[36]*PK,* p. 76.

[37]*KB,* pp. 49-72.

[38]*Meaning,* pp. 198-216.

[39]*PK,* pp. 195-202..

[40]*KB,* pp. 97-104.

[41]K K Schwarz, *Design and Wealth Creation*, Peter Peregrinus 1990.

[42]Michael Tooley, *Time, Tense and Causation*, Oxford University Press1997. It is interesting to note that the equations of science do not embody the direction of time, although the phenomena described by the equations do so. A view of the world based on equations is therefore essentially static in the sense that both the future and the past are real. Causation is a feature of a dynamic world, in which the future is open and not real. Laplacian views assume a static universe. Polanyi's tacit knowing could fit into the structure of a dynamic universe, but Polanyi did not discuss this aspect. This needs further investigation.

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