Science and Anarchism: Kropotkin Revisited

A commonplace assumption is that anarchism and natural science are distinct. Anarchism is assumed to belong to the social realm of historically contingent and intersubjective political ideology—based on human choices and actions—whereas natural science is assumed to reveal an objective reality that pre-exists and transcends society. Anarchism is taken to be a political ideal, theory, or stance, available as an object of study for social science, whereas natural science is taken to be an activity concerned with explaining and discovering facts about the natural world. When anarchism and natural science are related, one approach is to interpret the theories and discoveries of natural science as demonstrating the feasibility or necessity of basing society on the principles of anarchism, once the sciences have given us particular facts about human nature and the human condition. Peter Kropotkin's *Modern Science and Anarchism* was a work based on this approach.[1] One philosophical problem with this approach is that it assumes naïve scientific realism—which often neglects to account for the social and historical nature of scientific research and its results—and an overly generalised conception of the scientific method. Another approach is to show that scientific activity and progress are inherently anarchic and that there is not any underlying scientific method at all. Paul Feyerabend's *Against Method* exemplified this tendency with his "anything goes" slogan.[2] One philosophical problem with this approach is that it tends towards a level of relativism and subjectivism that makes any notion of either scientific or social progress quite implausible. This tendency is the inevitable consequence of an overly individualistic conception of scientific activity, reasoning, and creativity. How can we proceed to relate natural science and anarchism in a way that embraces these approaches but avoids these philosophical problems?

In this chapter, I shall show how a social libertarian conception of anarchism reveals an anarchistic core to natural science, without degenerating into relativism and subjectivism, which is compatible with a notion of scientific progress. I shall make this step by rejecting, from the outset, the overly individualistic conception of scientific activity, reasoning, and creativity made by Feyerabend, and revisiting Kropotkin's *Modern Science and Anarchism* in the light of Michael Polanyi's social philosophy of science. The first section will present a summary of Kropotkin's ideas about the scientific basis for a social libertarian conception of anarchism. The second section will discuss how Polanyi's philosophy of science underwrites a social libertarian conception of scientific activity and progress. The third section will sketch some implications this has for our understanding of the relations between anarchism, society, and science.

[1] First published (in French) in 1913; translated and reproduced in Kropotkin, P., *Anarchism: A Collection of Revolutionary Writings* (NY: Dover, 2002), pp. 145-91

[2] Feyerabend, P.K., *Against Method* (London: Verso, 1988)

Anarchism and Modern Science:

Kropotkin's aim was to give anarchism a scientific foundation by basing it upon the methods of the natural sciences and the scientific world-view. He considered it to be essential to reject all metaphysics and, instead, only develop anarchism in relation to scientific theories and methods. Nature and society were to be scientifically explained in terms of material causes, while anarchism was to be justified and developed in accordance with unified natural and social science, understood as "a synthetic philosophy comprehending in one generalization all the phenomena of nature – and therefore also the life of societies."[3] As Kropotkin put it,

"…man is a part of nature, and since the life of his 'spirit', personal as well as social, is just as much a phenomenon of nature as is the growth of a flower or the evolution of social life amongst the ants and the bees, there is no cause for suddenly changing our method of investigation when we pass from the flower to man, or from the settlement of beavers to a human town."[4]

Although he acknowledged that the social sciences remained inexact in comparison with the natural sciences, and cannot exactly explain social change in purely mechanistic terms, he argued that we should reject all metaphysical notions and, instead, we should only explain social phenomena in accordance with the scientific method of observation, induction, deduction, and observation. For Kropotkin it was self-evident that the scientific method involved testing quantifiable deductions about relations and laws by comparing them with quantified measurements of observable phenomena. Once we recognise that "man is a part of nature", social and personal development are just as much natural phenomena as are "the growth of a flower or the evolution of social life amongst the ants and the bees", the results of the social sciences should be compatible with the natural sciences, and both kinds of science should use the same methods. Social sciences become subdivisions of the natural sciences. By basing the methods of social science on those of the natural sciences, Kropotkin hoped that a unified general theory of human nature and social evolution would be developed, alongside the development of modern techniques and inventions of benefit to humanity, and these developments would form the basis of the development of society in accordance with the principles of a social libertarian conception of anarchism. He termed this unified philosophy to be *scientific anarchism*.

Kropotkin adopted a Baconian philosophy of science and considered the ultimate end of every science to be "prediction and practical application to the demands of life, it should concern itself with the discovery of means *for the satisfaction of these needs with the smallest possible waste of labour and with the greatest benefit to mankind in general.*"[5] The scientific study of political economy should be a study of "the physiology of society" (an analogous science to the physiology of animals and plants), and its object would be the needs of society and the (scientific and technical) means of their satisfaction. Based on scientific

[3] Kropotkin, *Anarchism*, p. 150
[4] *Ibid* p. 152
[5] *Ibid* p. 180

anarchism, by a process of revolution and gradual evolution, the new economic and political organisation of society must emerge and be developed together, in accordance with a scientific world-view that discloses "the road to liberty, equality, and fraternity, with a view to realising the greatest sun of happiness for every unit of human society."[6] However, Kropotkin rejected any notion that anarchism could be *derived* from the sciences, given that contemporary sciences *qua* human activity possess the class privileges of society and are often in the service of governments. He argued that the *creative power* of scientific anarchism depends on its connection with the general population and the demands of practical life. This creative power does not originate within universities or intellectuals, but is the outcome, on the part of the majority, of a struggle against a powerful minority who would enslave the majority. The creative power of scientific anarchism resolves this struggle by creating institutions and associations in such a way as to insure a free evolution of society based on equality, non-coercive and cooperative labour, and on the self-government of each person in accordance with their individual conscience.

For Kropotkin, the fundamental question was: which forms of social life promote the greatest growth of happiness and vitality? – This question formed the basis for his conception of *progress* in terms of the evolution of a greater capacity for growth and further evolution. A society based on social libertarian principles of scientific anarchism must be one that promoted the social evolution of a greater potential for happiness and creative power, leading to "increased vitality, vigour, sense of oneness with mankind and all its vital forces."[7] In this respect, scientific anarchism must be historically developed in order to provide a theoretical understanding in response to the lessons learned from a historical understanding of "the practical tendencies of events" for increasing or decreasing human happiness and vitality. He argued that such a historical understanding shows how the State cannot form the basis for social revolution and progress. Citing Godwin's (*Inquiry Concerning Political Justice*, 1793) arguments for the rejection of government, courts, and laws, Kropotkin argued that the French Revolution 1789-1793 provided an example of how governmental authority, as set up during the revolution, retarded the revolutionary movement. Governmental authority may start out as a revolutionary institution, but the State finds its origin "as a society for the mutual insurance of the land lord, the warrior, the judge, and the priest, constituted in order to enable every one of them to assert his respective authority over the people and to exploit the poor." [8] It rapidly becomes an obstacle to emancipation in virtue of its function as the means to protect the privileges of a powerful minority. Once history reveals the origin and development of the State is an instrument of exploitation and preserving inequality, it is therefore an error to hold the State to be the means of abolishing privilege and establishing equality. Hence Kropotkin noted that Proudhon (in *A General Idea of Social Revolution and Confessions of a Revolutionist*) advocated the abolition of the State and proclaimed anarchism based on *mutualism* (itself based on Robert Owen's system of labour), as a result of his experiences of the Revolution of 1848 and the crimes perpetrated by the revolutionary government and the failures of state socialism. In reference to Bakunin and the movement within the

[6] *Ibid* p. 192
[7] *Ibid* p. 154
[8] *Ibid* p. 181

International Working Men's Association to develop as an economic organisation and reject all forms of governmental authority, after the failure of the Paris Commune of 1871, Kropotkin showed how anarchist movements in Spain, Italy, and Switzerland grew out of the rejection of the IWA London General Council's turn to parliamentarism and political reform. It was on the basis of his rejection of any form of governmental authority and his call for the abolition of the State, which is an instrument for the preservation of privileges and monopolies, that Bakunin and others established the social libertarian principles of modern anarchism.

A social libertarian conception of a free society is one based on mutual agreements, conventions, and social habits between members of society, each being freely developed and reformed in accordance with individual conscience and the practical requirements of life, stimulated by scientific progress, technological innovation, and "the steady growth of higher ideals." All ruling authorities are rejected. The revolutionary struggle against exploitation, inequality, and the State *must* take the form of *an economic struggle of labour.* Every means of production, communication, and consumption must be transferred to the producers/workers through syndicalist and trade union movements directed towards the emancipation of labour and the equitable distribution of produce. The revolutionary form of this movement must shape the whole popular constructive process of the revolution. It is an error to propose some "dictatorship of the proletariat" as the means to move from a pre- to post- revolutionary society. Kropotkin argued that a historical understanding of revolutions shows that all revolutions began by small rebellious – local revolts that spread without any centralised authority – and it is essential that any revolution retains this popular, decentralised form. It is simply absurd to think that a successful social revolution could be handed to the people "as a birthday present", without the free participation the majority of people in the process of revolution, each in accordance with their own individual conscience. The abolition of the State is necessary to prevent the exploitation of labour and to allow the growth and development of free associations and societies, wherein the conventions and social customs required are decided by all, in accordance with their individual conscience and through voluntary agreement, for the benefit of all.

Kropotkin argued in favour of the social revolution (political, economic) taking form from within the development of *the self-governing commune,* the members of which decide to communalise the production, distribution, and consumption of commodities, and realise this for and among themselves. Hence the first concern of the revolution must be economic: to provide food, clothing, and shelter for all. Any social revolution based on social libertarian principles must involve the abolition of exploitation of labour; rejection of capitalism and wage-labour systems (including state-capitalism and coercive collectivisation). This would require a new form of economic organisation based on a new form of political organisation. In describing these new forms of organisation, Kropotkin considered anarchism and communism[9] to complete one another, converging through self-

[9] It is important to note that Kropotkin's idea of communism was very different from that of Marxists in general and particularly Marxists of the Marxism-Leninism variant (of which we can include Stalinism, Maoism, and the Yugoslav and Cuban experiments as further variations). For Kropotkin, communism was the entirely scientific and voluntary outcome of social evolution, which could not be

government based on popular and decentralised political organisation, if based on scientific anarchism.[10] He argued that, by organising economic and political activity through a *free federation of self-governing communes*, the State would become obsolete and be abolished. In order to maximise human happiness, the free federation of self-governing communes must increase personal initiative and coordinate cooperative action, the possibility of which requires shared aims and mutual confidence. Hence Kropotkin rejected individualistic conceptions of libertarianism. He argued that, within an individualistic anarchist society, political and economic inequalities would, ultimately, naturally reoccur simply due to biological inequalities. If the privileged minority wanted to remain so, it would need to reproduce the State as the means of protecting itself – as a privileged class – from the majority. Such a State would ultimately restrict and contradict individualistic conceptions of anarchism and personal freedom. It is thereby necessary for each individual to understand that they are only free in direct proportion to the freedom of all other individuals. Society must be based on egalitarian and cooperative principles of mutual aid and solidarity, if it is to remain a libertarian society. Such a society must guarantee to all its members a minimum level of well being produced in common, which must be provided by equally shared labour. The affairs of each member will concern other members and require cooperative actions and agreements to solve shared concerns and problems. The agreement between individuals to live as equals, *within a society of equals*, is sufficient to prevent unsociable and harmful actions. Within such a society, individuals could act freely, without fear of punishment or coercion.

Kropotkin's conception of social revolution was based upon a conception of society as continually evolving. Even though a social libertarian society has not been achieved – remaining an idealisation or vision – it is not utopian. It is an evolving tendency within the development of existing society and life itself. The drive towards complete liberty is the goal of all life and the revolutionary principle should be connected with the natural process of growth. The natural growth of society is disrupted and distorted by powerful minorities who hold it in bonds made for their advantage, and the task of anarchists is to liberate the natural growth of society from these bonds by arousing workers to unify, seize the means of production and distribution, and establish the free federation of communes as an economic basis for social revolution. Scientific anarchism is a practical and natural philosophy aimed at liberating constrained processes of life that are already immanent in society, which can be advanced or retarded. Hence he advocated an evolutionary theory of social change, wherein the natural growth of society is one of changing between states of equilibrium, rather than a form presupposed and fixed in accordance with eternal laws or providence. Social revolution takes place through violent changes in the established equilibrium, followed by new adaptations, each aimed at achieving a new state of equilibrium, and, consequently, a newly established equilibrium evolves from out of the collapse of the old.

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achieved by the coercive and centralized methods of the State, a "dictatorship of the proletariat" lead by the Party acting as a "revolutionary vanguard". Kropotkin remained an outspoken critic of both Marxism and the Bolsheviks until his death.

[10] See also *Mutual Aid* and *The Conquest of Bread.*

Kropotkin developed his argument through a series of analogies with the scientific world-view. While he accepted that the human understanding of the universe has changed throughout history, he took it quite for granted that this understanding progressively converged on the true understanding of the natural world, human nature, and the human condition. It has been an evolutionary trajectory, wherein ideas and assumptions taken for granted, such as the geocentric view of the universe, were replaced by a new world-view, such as the post-sixteenth century Copernican heliocentric view of the universe, and subsequent developments and refinements wherein the Sun is seen as only one star among countless starts in the Milky Way galaxy, and, subsequently, the Milky Way is seems as only one galaxy among countless ones. The scientific world-view has changed from one that considered matter to have been created in fixed forms in accordance with a preordained, universal and eternal law, to one which results from the random and mechanistic movements of matter, evolving through countless interactions into and through states of equilibrium.[11] Changes and increases in complexity are the outcomes of periods of destabilisation of the state of equilibrium followed by the establishment of a new state of equilibrium – "harmony in Nature" is the result of states of equilibrium, each perhaps evolved over hundreds, thousands, or millions of years, between the chance collisions and encounters of matter in motion. So-called "natural law" is an internal relation between phenomena, wherein any causal relation between phenomena is a property of the relationship, rather than something externally governed and planned. Nothing is preconceived or preordained. The stability of the solar system represents a state of equilibrium between millions of blind forces that has taken millions of centuries to establish.[12] The continents on Earth have formed after thousands of centuries of volcanic shocks, shifts, erosion, and accumulation. Harmony is an adaptation. It is the provisional and temporary adjusted state between all the forces acting in a particular region. Equilibrium is the resultant of all conflicting actions. Forces are not destroyed by being hindered, but continue to exercise their effects, which, should some other modification of the arrangement of conflicting forces occur, may well prove sufficient to destabilise the state of equilibrium, destroying harmony, until a new state of equilibrium occurs. As human beings and societies are also part of Nature, the revolutionary changes in sciences and society are also examples of the motion of matter, the conflict of blind forces, and the evolution of states of equilibria, disequilibria, and new states of equilibria.

Kropotkin's conception of social revolution, as analogous to scientific revolution, anticipated and surpassed Kuhn's conception of a scientific revolution and paradigm shift.[13] Using an analogy between a study of political economy and a study of plant and animal physiology, Kropotkin argued that scientific anarchism, when based on a physiology of human societies, forms a new philosophy – a new view of knowledge taken as a whole – upon which a new vision of society can be advanced. Thus, for Kropotkin, scientific anarchism is necessarily and progressively connected with the natural and social sciences, which in turn are necessarily and progressively connected with social evolution. If directed in accordance with the

[11] *Op cit* p. 118
[12] *Ibid* p. 120-1
[13] Kuhn, T.S., *The Structure of Scientific Revolutions* (University of Chicago Press, 1962)

principles of scientific anarchism, the new directions of scientific research are such that the interpretation of history is done in the same manner as natural sciences interpret the phenomena of nature, given that human beings and societies are phenomena of nature, which increasingly liberates evolutionary forces and potential within society, in accordance with the aim of benefiting humanity as a whole. Scientific anarchism promotes a vision of society wherein all members of society are included in the societal use of its resources, knowledge, skills, in the interest of all, without reproducing minority rule: a society comprised of "an infinite variety of capacities, temperaments, and individual energies." People within such a society would not attempt to establish uniformity, but, instead urge each other "to develop free initiative, free action, free association."[14] Within such a society, voluntary association, individuality, and the diversity of aims are all developed to the highest degree possible. The task facing scientific anarchism is one of discovering and liberating those forces that promote "the energies which are favourable to their march towards progress, towards liberty of developing in broad daylight and counterbalancing one another."[15]

Kropotkin argued that the tendency towards a social libertarian conception of society has been inherent to social organisation throughout history – in popular institutions such as the clan, the village community, the guild, and the commune – but this tendency is opposed and suppressed by domineering minorities to enslave the majority. Poverty prevents liberty – the historical product of exploitation by a minority, using the power of the state to secure their right to exploit. Even though contemporary scientific knowledge and technical power could provide society with abundance for all, capitalism and the State systems *secures* a monopoly ownership over the necessities of life (housing, food, land, water, etc.) and the means of production *by maintaining poverty and scarcity*. Exploitation is an unavoidable consequence of profiting from another person's labour by paying them wages less than the value of the product of their labour. After all, who would work for less than he produces if he were not threatened with unemployment, starvation, and homelessness? The ability of capitalism to profit from labour depends on denying the majority of people access to the means of production and basic necessities. Kropotkin argued that communism would be the necessary political and economic organisation within a free and egalitarian society basic on scientific anarchism. Communism is the necessary form of economic and political organisation, given the social nature of production, the social libertarian principles of an equal right to life and liberty, and the need to share labour and its products to satisfy common human needs.

Scientific anarchism, unifying the natural and social sciences, needs to analyse the *tendencies*, at any given moment, of social evolution towards communism, by providing revolutionary anarchists with the means of acting in accordance with those tendencies, working for the destruction of institutions and prejudices the impede these tendencies, and connecting revolutionary movements with social evolution. Kropotkin related "revolution" and "evolution" in two ways: revolution is essential to liberate evolutionary forces and tendencies from social

[14] *Op cit* p. 123
[15] *Ibid* p. 124

constraints and inertia; he also considered social evolution to be a special kind of natural evolution, which develops through periods of gradual evolution, followed by periods of accelerated evolution – these latter periods are what he termed as revolutions. For Kropotkin, social revolution was not a coup d'etat in the name of some utopian vision of a future society, but was necessary due to the fetters upon the social character of production, distribution, and consumption within exploitative class based capitalist society. The social revolution liberates the constraints upon social evolution, leading to the social creation of new values, along with the drive towards political liberation and economic growth. He argued that one only needs to reflect on the terrible waste within class based capitalist society to gain a glimpse of what could be achieved if the workers/producers seized the means of production, everyone had access to the basic necessities of life, and everyone took a share in the labour needs of society. Such a society is only possible if it is the outcome of social evolution – as an organic, natural growth – is generated by all human beings, for the benefit of themselves and each other, through cooperative and voluntary labour. It cannot be built by organs of the State (parliaments, bureaucracies, municipal or communal councils), or any coercive and authoritarian system. The political organisation of such a society must be based upon decentralised free-associations, dealing with all social needs and exchanges, based upon voluntary agreement and enrolment to deal with problems and concerns, moving from the local to the global, in accordance with the extent of the sharedness of the problems and concerns. It is the whole that evolves as a result of the "multitude of millions of which it is comprised" – it cannot be *lead* by an intelligentsia or so-called revolutionary vanguard, working in accordance with planned and calculated stages of history. It is a spontaneous and uncontrollable change in the nature of social organisation. Any genuine economic revolution must be based on the *initiative and free actions* of all workers (the producers) through confederations of free-communes and unions, decentralised and local free-associations. Authoritarian socialism (Party based control over the State) is premised on pseudo-scientific conceptions of history and economics when it presupposes that a centralised authority can guide or lead social revolution towards social uniformity, equality, and stability. Centralised control suppresses the levels diversity and mass participation that are essential for social evolution. Centralised authority leads to stagnation and collapse.

Kropotkin viewed science as being something that should benefit all humanity, and research and innovation should be disseminated to all. It is essential that scientific knowledge is treated as social property, evaluated in relation to the task of understanding and aiding social evolution for the benefit of humanity. To this end, scientific education should be considered as a basic human right and should be universally available. Scientific research and technological innovation should be implemented and developed in a way that alleviates the conditions of humanity in general, increases productivity, and improves the capacity of labour. This liberates human beings from toil and allows for a greater cultural development and growth of higher ideals. It is inherent to Kropotkin's vision of the future society, based on scientific anarchism, that it is a post-scarcity and technological society, tending towards the automation of production and the liberation of humanity from material hardship, toil, and suffering. Given the above, we can see how, for Kropotkin, science could benefit the development of anarchism. However, now we must turn to

the question of how anarchism can benefit the development of science. In the next part of this chapter, I shall discuss Michael Polanyi's social philosophy of science and how it relates to Kropotkin's social libertarian conception of anarchism.

Science, Individual Conscience, and Authority:

Polanyi's social philosophy of science advocated a realist philosophy of science, but acknowledged that scientific realism is based on a cultural faith in the methods and practices of science as being means to disclose underlying reality.[16] From the outset, he accepted that all realist claims about the objectivity of scientific knowledge of natural laws are based upon a personal commitment to a belief in the existence of natural laws as a real feature of Nature that exist beyond human control, independently of scientific knowledge of them, and that these laws can cause an indeterminate range of effects, some of which will be unknowable and unthinkable. He argued that a commitment to scientific realism is necessary for scientific research to be intelligible as a mode of discovery. Without this commitment, it would be impossible to sustain the idea that scientific knowledge of "the general nature of things" is universally applicable to explain the experiences of all human beings, in similar circumstances, and corresponds to the underlying realty that is independent from human experience. However, if the purpose of scientific observation and experimentation is to disclose the underlying causal structure of reality, it does so through trained and educated human interventions and interpretations of ordinary perception. Polanyi rejected the notion that purely empirical criteria (descriptive exactness or predictive accuracy) determine the aims and methods of scientific research. For example, on purely empirical criteria there would have been little reason to choose the Copernican heliocentric system over the Ptolemaic geocentric system of astronomy. The selection and interpretation of evidence and the facts are based on historically conditioned and contingent choices involving general assumptions regarding the requirements of naturalistic explanations. This includes criteria for intelligibility and plausibility, such as simplicity, practicality, and whether or not they lead to a more unified conception of underlying causal reality.[17] Hence, even though there is not any empirical basis for considering the motion of the moon across the sky and the constant acceleration of a falling object towards the ground to be instances of the same underlying force – gravity – it is the conception unification of these otherwise disparate phenomena as instances of the same laws or principles that gives science explanatory force.

General assumptions about the nature of the underlying causal structure of reality are implicit in the scientific understanding of which questions are reasonable and interesting, what would constitute acceptable and plausible answers to these

[16] Polanyi, M., *Science, Faith, and Society: A Searching Examination of the Meaning and Nature of Scientific Inquiry* (University of Chicago Press, 1964), first published in 1946.

[17] Polanyi's philosophy of science anticipated the scientific realist critiques of empiricist philosophies of science made by Roy Bhaskar in *A Realist Theory of Science* (Leeds Books, 1975), *Scientific Realism and Human Emancipation* (London: Verso, 1986), *The Possibility of Naturalism* (Harvester Wheatsheaf, 1989); Rom Harré in *Causal Powers* (with E.H. Madden, Oxford: Blackwell, 1977), *Varieties of Realism* (Oxford: Basil Blackwood, 1986); and Nicholas Maxwell in *From Knowledge to Wisdom* (Oxford University Press, 1984), *The Comprehensibility of the Universe* (Oxford University Press, 1998)

questions, what would constitute evidence that would allow scientists to selection between, verify, or refute possible answers, and, also, what kind of theoretical concepts, representations, and relations can and should be applied to human experiences to disclose "tokens" (intuitions, clues) about the underlying causal reality. Concepts, representations, and relations are brought to particular experiences in order to unify these experiences as experiences of an underlying force, mechanism, or causal structure, e.g. the motion of the moon across the night sky or an object falling to the ground under constant acceleration as both being the effect of gravitation. Science also involves making particular assumptions to explain particular observations or experiments, and remains creative, conjectural, and tentative about both the structure of the universe and the methods to explore and explain that structure. It is an inherently social process of communication, critically articulating and demonstrating its own truths to the satisfaction the members of the scientific community, in order to provide an intelligible understanding or representation of reality.[18] The scientific process of discovery is the social and personal culmination of participatory and communicative acts directed towards understanding and demonstrating truth about the causal structures of reality, over and above any instrumental value or political expediency. As such, the process of discovery does not occur in accordance with an *a priori* set of epistemological principles. Nor can the path to discovery be determined in advance. The methods, conjectures, experiments, and efforts made by scientists prepare the way for the possibility of discovery, but discovery itself is a "process of spontaneous mental organisation uncontrolled by conscious effort."[19] This process should be constrained only by the limits of our "faculty to guess the nature of things in the outer world" to the satisfaction of our peers and our own intellectual conscience.[20]

Polanyi rejected abstract notions of any unified scientific methodology. He argued that the epistemology of science was based on psychological processes of intuitively interpreting experiences of phenomena to discern those aspects of reality that are not controlled by the observer but can be inferred or imagined as being involved in the shaping of perception. We need to understand how these psychological processes are acquired and developed, if we wish to understand the nature of science. These psychological processes are tacitly learnt and developed during scientific education and training, by imitating the discursive and material practices of established scientists. The student leams heuristic guides to action and interpretation, within the contexts of particular scientific research projects and problems, rather than learning any unified scientific methodology applicable to all sciences. By learning these heuristic guides, along with particular methods and sets of standards, scientific intuition, interpretation, and perception are shaped, while the selection and evaluation of evidence and facts remain ultimately matters of the educated and personal judgements of the scientists working upon particular research projects. It is not the task of the scientist to follow any universal epistemology, but, rather, through appeal to particular methods and interpretations, proposed as being the best available means to establish contact with underlying reality, the individual scientist attempts to make a contribution to a field of scientific research, *in*

[18] Cf. David Gooding , *Experiment and the Making of Meaning* (Dordrecht: Kluwer, 1990)
[19] *Science, Faith, and Society* pp. 31-4
[20] *Ibid* p. 38

accordance with the dictates of his or her education, training, and intellectual conscience, from within a scientific community of already established scientists.[21]

Hence, although there are similarities, in many important respects Polanyi's social philosophy of science radically differed from Popper's philosophy of science, which proposed a principle of falsification as the demarcation criterion between scientific and non-scientific research.[22] As Polanyi argued, the history of science shows many examples of scientific propositions not being falsified by conflicting observations, but instead suggesting a new mechanism to account for the discrepancy, such as Galileo's use of friction to explain the discrepancy between the motion of a ball on a plane and his theory of motion. Polanyi went further than this and rejected the notion that there is any "logic of scientific discovery" at all. Instead, he argued, it is an art, transmitted by examples of the practice that embodies it, without any precisely defined methodology or underlying epistemological principle(s). The scientific practitioner becomes such by being immersed within and being an exponent of a scientific tradition. While this tradition is embodied by the scientific community of already established scientists, the determination of whether one is being faithful to the scientific tradition is based on the personal judgement and intellectual conscience of individual scientists. Learning how to practice science involves accepting this tradition and becoming a representative of it. The principle of falsification does have a role in scientific practice, but it acts as a heuristic guide to action rather than an epistemological principle. Scientific discovery is a tacit and social process of making decisions and personal judgements, involving intuition, creativity, and heuristics, balanced by critical restraint, learned from within a scientific tradition of historically developed and refined training and practice, without any clear epistemological understanding of how discovery occurs, from within a community of practitioners. The possibility of science – as an ongoing activity directed towards the discovery of objective truth – depends on the faith that the scientific tradition and its methods are progressive, and this runs much deeper, psychologically and culturally speaking, than falsifying the conjectures and theories of others. As Polanyi put it,

"To understand science is to penetrate to the reality described by science; it represents an intuition of reality, for which the established practice and doctrine of science serve as clues. Apprenticeship in science may be regarded as a much simplified repetition of the whole series of discoveries by which the existing body of science was originally established."[23]

Like Kuhn, Polanyi identified the disciplinary framework of science in sociological terms. The standards and norms inherent to the scientific tradition are embodied in the working practices of scientists, periodicals and books, the priorities of research institutes and funding bodies, and the curricula of university science departments. Authority in science – "a hierarchy of influence" as Polanyi termed it – is more attached to persons (exemplars) than it is to offices or institutions.[24] It is

[21] *Ibid* p. 40
[22] Popper, K.R., *The Logic of Scientific Discovery* (London: Hutchinson, 1959)
[23] *Op cit* p. 45
[24] *Ibid* p. 48

established in terms of reputation, recognised experience and expertise, and the unity of science is dependent on scientists knowing who are the experts in neighbouring fields, rather than the maintenance of the same minimum epistemological standards in all the fields of scientific activity. On this account, science is itself a social network of experts and interconnected areas of activity, wherein authority is established through interpersonal evaluations of credibility, trustworthiness, and respect between scientists.[25] This kind of authority is established independently of any centralised institutions, ideology, or doctrine. It is established through the decentralised and local consent between scientists about who is to be considered to be a colleague, a peer, and an expert within the scientific community. In this sense, the demarcation criterion between science and non-science is based upon decisions made by already established members of the scientific community, regarding what is of relevance or use to them, as scientific practitioners, for the continuation and further development of scientific research. If there is a principle involved it is a principle of free-association, rather than any universal epistemological principle. Scientific authority is dispersed in an evolving and decentralised way, throughout the social network (the scientific community), and the student freely submits to the authority of the exemplary scientists, whom are taken to embody the scientific tradition in virtue of their credibility, trustworthiness, and the respect that others have for their expertise, knowledge, and skills.

For Polanyi, the progressive aspect of the scientific tradition is the demand that each generation is to critically reinterpret the nature of this tradition in order to better represent it and further develop scientific practices. Dissent and criticism are major aspects of the scientific tradition, alongside intellectual virtues such as honesty, discipline, independence, and originality. It is by embodying the scientific tradition that the student learns how to dissent, while also utilising the traditional practices and interpretations, and how to competently criticise scientific authority, while also maintaining a firm conviction in the soundness of the scientific tradition. By embodying this tradition through training and education, from within an already established scientific community, the student learns how to develop personal judgements, rather than rely on appeals to the authority of others, and, once the tradition has been fully embodied, the student can reject authority, assume full responsibility before their own conscience, and become a scientist in their own right. It is this shared conviction that not only unites scientists in their faith in science, as a community, each freely founding their relationships upon trust in each others' shared commitment to the same intellectual virtues, while also forming the basis for their dissent from the current consensus, which is the driving force for creativity and progress. Dissent does not occur in a vacuum. When scientists dissent from the current consensus, they actually appeal to the scientific tradition in order to convince other scientists that they are right to dissent. This appeal is based upon the claim that their dissent is more in line with – better expresses – the scientific tradition than does

[25] Polanyi preempted sociological accounts of science, such as David Bloor's *Knowledge and Social Imagery* (Oxford: Routledge, 1976); Bruno Latour & Steve Woolgar's *Laboratory Life: The Social Construction of Scientific Facts* (Beverly Hills, Cal: Sage, 1979); Harry Collin's *Changing Order: Replication and Induction in Scientific Practice* (London: Sage, 1985); Karin Knorr-Cetina's *The Manufacture of Knowledge* (Pergamon Press, 1981), and Steve Shapin's *A Social History of Science* (University of Chicago Press, 1994).

the current consensus. It is in this sense that we can describe the heuristic premises of the scientific tradition as normative values rather than epistemological axioms, while the progressive core of science is in how the scientific tradition is continually refined and better understood. The normative values of science are intellectual virtues and ideals cultivated by the scientific community, regarding the character of good science, as a matter of personal judgement according to individual conscience. Science is in a state of permanent revolution in the sense that the *status quo* is constantly being challenged to better express and live up to the scientific tradition. The scientific community is periodically called upon to restore itself, as each generation of scientists applies their personal judgement and conscience to the task of reinterpreting and renewing the scientific tradition. In this way, each generation of scientists dissents from and challenges the current consensus about how the scientific tradition is to be respected by showing the scientific community how they ought to respect it better.

It is at this point that we can see the social libertarian philosophy underlying Polanyi's social philosophy of science. He originally developed it as a counter to Marxist theories of science developed in the Soviet Union during the assertion of Lysenko's theories of genetics and biology.[26] He argued against the possibility of the centralised social planning of scientific research and discovery. While he acknowledged that, at bottom, his argument involved little more than a partisan defence of Western science against Soviet science, appealing to faith (or trust) in the former and scepticism (or distrust) in the latter, he also argued that the choice between these kinds of science comes down to a choice between kinds of society. The possibility of scientific discovery depends on a devotion to science as the best means to discover the truth about a reality that exists independently of our efforts to learn about it, and this possibility crucially depends on the freedom to pursue scientific knowledge and explanation to the satisfaction of one's own intellectual conscience from within a scientific community, wherein dissent from authority and consensus is considered essential for scientific progress. Whereas the rationality of science cannot be demonstrated to someone who does not already share a devotion to science, it can become known in terms of the value of the free society, within which the continued pursuit of a open and free intellectual process is practiced, whereby individuals are able to openly and freely interpret science in accordance with their intellectual conscience and subject their interpretation to the scrutiny of their fellows. Polanyi's faith in Western science was premised upon his faith in its value for the further development and subsequent continuation of an open and free society. When a government asserts the premises of inquiry, taking upon itself the decision about what constitutes sound methods to discover moral or scientific truths, or to justify ideological assertions, as well as taking upon itself the responsibility to direct that inquiry and control when and how its results are disseminated to the public, then, even when it does so in the name of the public good, totalitarianism and poor science are the inevitable results. Hence, Polanyi asserted that

[26] For interesting and detailed studies of Lysenko and the suppression of geneticists in the Soviet Union see Roll-Hansen, N., *The Lysenko Effect: The Politics of Science* (New York: Humanity Books, 2005), and, Joravsky, D., *The Lysenko Affair* (University of Chicago Press, 1970).

"Whether a free nation endures, and in what form it survives, must ultimately rest with the outcome of individual decisions made in as much faith and insight as may be everyone's share. Any power authorised to overrule these decisions would of necessity destroy this freedom."[27]

Similarly, when big business (multinational corporations) control the aims of science, subordinating the directions of scientific research and the dissemination of its results in accordance with profitability and marketability criteria, the intellectual freedom upon which science depends is suppressed and distorted. This damages the creativity and progressive nature of science.

It is necessary for dissent within science that it occurs within a scientific community committed to open and free discussion between scientists sharing a common devotion, capacity, and obligation to pursue, discover, and communicate scientific truth. It is through this open and free discussion that scientists can preserve their spirit of independence and exercise critical reason, when and where their intellectual conscience dictates how to best to interpret the scientific tradition. Polanyi appealed to the intellectual conscience of citizens in a free and open society, guided by the principles of free discussion, fairness, and tolerance freely transmitted by a tradition of civic liberties, personal freedom, and free-association, each embodied in the institutions and practices of enlightened democracy.[28] The possibility of scientific progress depends on the enlightened democratic participation of scientists to best interpret the scientific tradition, wherein democratic virtues are also intellectual virtues. Arguably, for Polanyi, the scientific community constitutes Rousseau's ideal democratic community within which each "succeeding generation is sovereign in reinterpreting the tradition of science" and, through their democratic participation, "the independence of its active members in the service of values jointly upheld and mutually enforced by all" is preserved and guaranteed.[29] Unless every generation of scientists takes on a commitment to interpret the scientific tradition in order to best serve it, science would be a meaningless pursuit, except in so far is it would provide technological innovations and propaganda in service of the status quo. However, as Polanyi pointed out, ever should scientists take on this commitment, it does not provide any reason for anyone outside the scientific community to share that commitment. The commitment to the scientific tradition must be made freely, only constrained by the individual's intellectual conscience and their understanding of how best to interpret the scientific tradition. It is this appeal to the sovereignty of the individual intellectual conscience that is important for connecting Polanyi's social philosophy of science, in terms of a social libertarian conception of society, with Kropotkin's scientific anarchism. As Polanyi argued, it is essential that discussion about the truth, meaning, and value of science must remain open and free within wider society, just as how to best interpret the scientific tradition should remain open and free within the scientific community. It is essential for the health of science that it remains open to challenge from rival and alternative interpretations of Nature and how we understand the human condition. The dissent and criticism of a "judicious public with a quick ear for insincerity of argument is therefore an essential partner in

[27] *Op Cit* p. 73
[28] *Ibid* p. 67
[29] *Ibid* pp. 16-17

the practice of free controversy."[30] The "democratic spirit" of any people is dependent on their respect for intellectual freedom of conscience, their commitment to truth and honesty, the belief that truth can be learned and conveyed, and the common value and shared practice of communication and education. Playfulness, cooperativeness, commitment, and trustworthiness are as important for scientific research as they are for democratic participation. This crucially depends on the existence of diversity and pluralism in media; the existence and activities of heterogeneous political, cultural, scientific, and humanitarian organisations; the constitutional embodiment of fairness and tolerance in law and custom; and, the public dedication to ideals, such as truth, justice, and charity. Thus the possibility of the development of society into free and open society, upon which the health of science and the democratic spirit of the general citizenry both depend, itself depends of the social evolution of the same social libertarian institutions, practices, and customs upon which Kropotkin's vision of scientific anarchism depended.

However, before we can hope to adequately revisit Kropotkin's scientific anarchism in terms of Polanyi's social philosophy of science, we need to understand Polanyi's conception of scientific authority and how it relates to the individual intellectual conscience. Polanyi distinguished between "the General Authority" of precepts and prepositions and "the Specific Authority" of doctrine and conclusions.[31] The former is essential for the establishment of common standards and norms upon which science depends, whereas the latter would destroy science completely. The former leaves the decisions for interpreting scientific tradition to numerous individual scientists within a community of scientists dedicated to science, whereas the latter centralises the decisions into a hierarchy that acts on behalf of the community, to which all individuals are to conform to as law. This conception of the General Authority of science can be understood in terms of Rousseau's concept of "the General Will", as being formed through the reasoned and conscientious commitment of individuals to the scientific tradition, as the best expression of their intellectual efforts and aspirations as scientists. In this regard, we can understand the scientific tradition in terms of a social contract between scientists, wherein each individual scientist has the intellectual freedom to interpret how best to uphold the scientific tradition in accordance with their own intellectual conscience, while all scientists freely agree to do so to the best of their ability, constrained only by the dictates of critical reason and intellectual conscience. Each scientist takes upon themselves the sovereign power to dissent from consensus and challenge the interests of fellow scientists. Based upon a shared commitment to science as a whole, scientists are obliged to conform to the General Authority, constrained only by critical reason and intellectual conscience, but reject any and all appeals to any Specific Authority. This obligation is none other than the commitment of all scientists to the ideals, values, and standards of the scientific tradition – a devotion to science as a whole – but, under the General Authority of the scientific tradition, all scientists have the freedom to interpret how the ideals, values, and standards of that tradition are to be understood and how they ought to be respected.[32] The competence of each generation of scientists to make decisions for the whole of science is in direct

[30] *Ibid* p. 68
[31] *Ibid* p. 57
[32] *Ibid* pp. 64-5

proportion to their conscientious commitment to science as being the best means to discover objective truth. Hence, as Polanyi argued, should any Specific Authority attempted to impose any intellectual standards or procedural safeguards to prevent errors of judgement being made by individual scientists, such a Specific Authority would destroy science. Questions of correctness or competency must be left to individual scientists to answer for themselves, acting in accordance with their individual consciences, which are "inherently sovereign because it is in the nature of science that no authority is conceivable which could competently overrule their verdict."[33] It is on this basis that we can understand science as having a social libertarian core that is essential for the possibility of scientific progress.

Anarchism, society, and science:

Both Kropotkin and Polanyi assumed scientific realism. Due to this assumption, both rested content with overly abstract and generalised conceptions of scientific methodology. Although both acknowledged that science existed in a wider social context, neither discussed how this context effected the nature of scientific research and how that research shaped society. They did not discuss the technological context within which scientific research is conceived, developed, and implemented. They did not discuss how scientific conjectures and theories are explored, developed, and tested within this technological context, wherein only those features of phenomena that are capable of being selected, measured, explored, and manipulated through technological means can be considered as objective and natural. Only those aspects of experience that are accessible to technological mediation can be considered as having any contact with underlying material reality. Even when any scientific hypothesis or knowledge does not have any immediate practical application, these propositions are only considered as hypotheses or knowledge if and only if they can be "tested" in terms of their instrumental consequences for the further refinement and development of techniques and instruments in future scientific research. Even though scientists may well consider themselves to be working in the context of pure research and discovery, their work is emergent from and situated within a historically conditioned and contingent technological framework, socially bounded by human interests, ambitions, and expectations, made possible and dialectically developed and differentiated as technological innovation transcends prior conceptual limitations and brings new possibilities into the world. Scientific methods are considered as being objective if and only if they occur within an ongoing project of the further refinement and development of the technological framework within which all scientific researches are shaped and structured. Scientific discovery occurs within this technological framework, as an ongoing process of mapping out the contours of the interactions between human interventions and machine performances, and theoretically representing and explaining these interactions in terms of underlying natural mechanisms. Through education and training, it is within this technological framework of the theoretical representation and explanation of techniques and devices, that the intuitions, personal judgements, and technological activities of individual scientists are connected with the historically developed tradition, conventions, standards, and expectations of the scientific community. Kropotkin and

[33] *Ibid* p. 60

Polanyi's naïve realism and intuitionism were premised upon an act of faith in the historically developed, metaphysical assumption of mechanical realism that underlies and unifies the scientific understanding of both technology and the natural world.[34]

We exist in a world within which we are subject and vulnerable to forces beyond our control, such as extremes of weather, earthquakes, volcanoes, disease, birth defects, accidents, decay, and, ultimately, death. Science and technology are driven by the human desire to achieve certainty and control in an often chaotic world that seems indifferent and is frequently hostile to human life. Since their origin in the sixteenth and seventeenth century, modern science and technology have been conceptually implicated in a societal struggle to pacify existence by using our knowledge of natural mechanisms to develop devices and techniques to alleviate humanity from the limitations of our material conditions. This societal struggle to overcome our sense of vulnerability to natural forces beyond our control has taken the form of a societal project to construct an artificial world – a technological society – which promises to liberate and protect us from the destructive power of Nature. [35] This societal project is premised upon a societal gamble upon the rationality and goodness of the technological society, as a substitute for the natural world, which confronts and appropriates Nature in order to transform it into a more intelligible and controllable world of our own making. The objectivity of science is thus related to its practical value for controlling and manipulating natural phenomena as the means of achieving certainty and power to mould and pacify a recalcitrant and capricious Nature. Hence, the societal project of constructing the technological society is implicit to the Baconian dream of utilising human reason, knowledge of causal principles of Nature, and the practical arts to construct a paradise on Earth to liberate human beings from toil, scarcity, and suffering, and prevail over the natural world. The Enlightenment project of constructing a rational society was premised upon the societal gamble upon the possibility of achieving human freedom by using our natural faculty of reason augmented by the knowledge, experiences, and powers discovered through mathematics, the practical arts, and natural sciences. This project was intensified during the nineteenth century, within which the Industrial Revolution led to the rapid development of science and technology into highly organised social structures inextricably integrated into the development of society as a whole. Taking the societal gamble for granted allowed the positivistic reduction of the conception of progress and rationality to that of instrumental reason and its application to the enhancement of efficiency, technique, innovation, and power. During the twentieth century, science and technology were applied to nearly every human activity, including agriculture, education, information, labour, medicine, politics, sexual reproduction, and warfare. Scientific research increasingly requires large teams of scientists and technicians, high levels of funding, which are integrated within the so-called university-industrial-military complex.[36] Under advanced capitalism, the

[34] Rogers, K., *On the Metaphysics of Experimental Physics* (Basingstoke & New York: Palgrave Macmillan, 2005)

[35] Rogers, K., *Modern Science and the Capriciousness of Nature* (Basingstoke & New York: Palgrave Macmillan, 2006)

[36] In 1961, in his farewell presidential address, Dwight Eisenhower warned that the state supported industrial-military complex could have damaging consequences for the US economy and democracy. For detailed discussions of these damaging consequences see Mumford, L., *Pentagon of Power: The Myth of the Machine* (New York: Harcourt Brace Jovanovich, 1970); Melman, S., *Pentagon*

trajectories of scientific research and technological innovation have become further integrated into technosciences directed to provide new devices and techniques to satisfy the demands of production and consumption. Biotechnologies, such as genetic screening, selection, modification, and cloning, are the latest technoscientific manifestations of the societal gamble, promising to create a brave new world free from birth defects, hunger, and disease, within which human beings attempt to improve upon farming, medicine, and even upon how life begets life.

One of the often envisioned goals of the technological society is that of its transformation into a *post-scarcity society*, within which the trajectory of technological innovation is towards the satisfaction of all human needs and complete automation, thereby also liberating human beings from labour, freeing up human time for creative activities, education, and political participation. The idea of a post-scarcity society developed through scientific research and technological innovation, as inherently emancipatory forces, was central to the ideas of the future society sketched by Proudhon, Bakunin, and Marx (especially his early writings). As stated above, this idea was also central to Kropotkin's vision of how the future society would be a post-scarcity technological society developed in accordance with the social libertarian principles of "scientific anarchism". This vision has underwritten much of contemporary anarchist thinking from Rudolf Rocker to Daniel Guerin, Murray Bookchin, Noam Chomsky, and Colin Ward. It was also presupposed by radical Marxist thinkers such as Rosa Luxemburg, Antonio Gramsci, and Anton Pannekoek. It was also figured frequently in the writings of the Bolshevik theorist Nikolai Bukharin and a leitmotif in the speeches of Lenin and Trotsky, as well as being quite central to the rationale of Khrushchev's proposed economic and political reforms.[37] It was this notion of science and technology as emancipatory forces tending towards the transformation of society into a post-scarcity technological society that permitted all these thinkers to claim that capitalism distorted or perverted the essence of scientific research and technological innovation. Instead of developing science and technology as emancipatory forces, leading towards the post-scarcity society, capitalists suppress this tendency in favour of maintaining scarcity through waste, using obsolete technologies, suppressing patents, and intensifying labour in order to prioritise profitability at the expense of technical efficiency. Lewis Mumford characterised this contradiction in the development of the technological society, which he termed as the technical civilization, in terms of distinct aspects or phases of technical development, which he termed as *eotechnic*, *paleotechnic*, and *neotechnic* phases, which co-exist at any stage of the technical development of society.[38] The eotechnic phase is the tendency to develop science in accordance with the kind of Baconian ambition that I have termed the societal gamble. The paleotechnic phase is characterised by the technologies of the Industrial Revolution, wasteful of resources, polluting, indifferent to human well being, and labour intensive, which are built and

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Capitalism: The Political Economy of War (San Francisco: McGraw-Hill, 1970) and *The Permanent War Economy: American Capitalism in Decline* (New York: Simon and Schuster, 1985); Chomsky, N., *Failed States: The Abuse of Power and the Assault on Democracy* (New York: Metropolitan Books, 2006).

[37] For my criticisms of Marxism and Soviet Marxism see *Modern Science and the Capriciousness of Nature*, chapter 4.

[38] Mumford, L., *Technics and Civilization* (New York: Harcourt Brace, 1934)

maintained to maximise profits. The neotechnic phase is characterised in terms of technologies developed in accordance with modern science to be highly efficient and tending towards automation. He considered the progressive tendencies inherent to the technological society involved the recovery of the eotechnic ambition (the societal gamble) leading the movement from the paleotechnic to the neotechnic, in accordance with need to place it at the service of life rather than merely at the disposal of the opportunistic schemes of capitalism. He argued that society needed to develop an organic transformation of technology, within the natural environment, to transform society into a post-scarcity technological society comprised of harmonious and intimate connections between the aesthetic, architectural, social, economic, and ecological aspects of the construction of civilization. It was this later aspect that Thomas Hughes characterised as the ecotechnological phase of technical civilization, wherein the technical, aesthetic, and ecological aspects of the world are closely connected and mutually beneficial.[39] This vision of the post-scarcity ecotechnological society has considerable commonality with Bookchin's social libertarian vision of social ecology.[40]

However, as Jacque Ellul warned us, the technological society has a tendency to develop as a totalitarian society, wherein technical efficiency comes to dominate all aspects of human activity, while simultaneous eroding our ability to critically reflect upon the meaning and purpose of human life.[41] The ongoing development of increasingly powerful and sophisticated means has become so dominant to human thinking and public policy that the question of ends is hardly considered at all. Such a technocratic society would develop antithetically to the social libertarian principles of Kropotkin's "scientific anarchism", and also, as I have argued elsewhere, repress and distort the evolutionary potential and adaptability of society, reducing its ability to deal with unforeseen social and natural changes that can occur in an open ended, complex, and changing world that does not conform to our intentions.[42] It is essential for the hope and possibility of developing the technological society into a sustainable and adaptable society that the diverse and pluralistic knowledge, experience, skills, ideals, and values of society are creatively utilised in the ongoing development and evolution of the open society. This involves the recognition that the maximisation of decentralised democratic participation based on social libertarian principles is the best means of achieving the levels of creativity, dissent, experimentation, and cooperation needs to maximise the potential for the long term sustainability and adaptability of society and human existence on Earth. Overcoming the current inequalities and hierarchies inherent to how the technological society is being envisioned, planned, and constructed, and the possibility of developing it as an open society all depend upon the democratisation of how scientific research and technological innovation are developed and implemented within society. Kropotkin's conception of "scientific anarchism" can help us understand how to achieve this, but we need to revisit this conception by carefully and critically exploring how maximised and decentralised democratic participation should relate to science and

[39] Hughes, T.P., *Human-Built World* (University of Chicago Press, 2004)
[40] Bookchin, M., *The Philosophy of Social Ecology* (New York: Black Rose Books, 1996)
[41] Ellul, J., *The Technological Society* (New York: Alfred Knopf, 1964)
[42] Cf. *Modern Science and the Capriciousness of Nature*, especially Chapter 6

technology, which, after all, are often taken to be activities requiring technical expertise, specialised knowledge, and advanced education.

Such a careful and critical exploration is beyond the scope of this chapter. Elsewhere I have raised and tackled questions regarding how the development of science and technology could be democratised within the technological society.[43] However, in the remainder of this chapter, I would like to raise some general features of a democratised technological society that would be required for any possibility of the development of the technological society into an open society of the kind envisioned by Kropotkin and Polanyi. The development of the technological society into the open society, which is a condition for the flourishing of scientific research and the critical refinement of the scientific tradition, is a social process of "scientific anarchism", as conceived by Kropotkin, consciously directed as a political process of enrolment of people into maximally inclusive democratic participation, alongside the ongoing removal of anti-democratic obstacles and opposing forces. However, we need to carefully examine the following question: how should we envision maximally inclusive democratic participation in a way that is beneficial to scientific research and technological innovation?

We need to consider the relationship between the lay citizenry and technical experts (including scientists in their specialised fields). How can citizens without specialised knowledge and experience hope to decide on questions of how science and technology should be developed and implemented within society? It would seem that such questions are simply beyond the ken of the lay citizenry and their interference could be damaging to science and technology. The commonplace assumption is that technical questions should be left to technical experts, while questions of policy should be left to political/administrative experts, and, if the lay citizenry are involved at all, it should be at the level of the expression of values and concerns, as measured by opinion polls and the outcome of elections. The received wisdom is that questions regarding how science and technology should be developed and implemented are just too complicated for the lay citizenry. However, we can turn this received wisdom on its head by asking the question of whether there are any experts in the overall development and implementation of science and technology. Are there experts in how to construct the technological society? Or is it done in a piecemeal, *ad hoc*, and experimental fashion? Modern science and technical professions are highly specialised. Scientific and technical expertise is limited to highly narrow fields of knowledge, activities, and experiences. Highly skilled scientists and technical professionals are as much lay citizens outside their field of expertise as any other lay citizen. The complexity of the development and implementation of science and technology in society is such that even modestly ambitious technical projects involve experts from a wide variety of fields. It is quite impossible for any one person or group of people to have acquired the expertise in all these fields. It may well be the case that it is quite impossible for most people to judge the complexities and implications involved in the research and development of nanotechnology, biotechnology, medical science, space exploration, computer science, and nuclear fusion, but, it is quite impossible for any scientists working in

[43] Rogers, K., *Participatory Democracy, Science and Technology* (Basingstoke & New York: Palgrave Macmillan, 2008)

any of these brave new technosciences to judge the complexities and implications either. As the current scientific debates about global warming have shown, there are widespread disagreements between scientists about the consequences of the ancient techniques of deforestation and burning fossil fuels for the future evolution of the climate, human existence, and for life on Earth. Why should narrowly specialised scientists be any better placed to understand the complexities and implications of cloning, for example, than any other citizen? I would argue that they are not. Being an expert in a narrow technical specialisation does provide anyone with any greater deal of foresight than anyone else, all other things being equal, in an open ended, complex, and changing world that does not conform to our intentions. Nor does it provide anyone with a greater understanding of how to envision social progress and plan how the technological society should be constructed. It is a complex aggregation of experimental processes, retaining the character of a societal gamble. The evaluation of whether this gamble is paying off involves conceptions of what a good society is and what public goods are. Technical expertise does not impart anyone with a greater capacity to critically evaluate the nature of a good society or public goods. We are all on a par in this respect.

Of course, it is at this point that some people will argue that this is why we need political/administrative experts to liaise between the technical experts and the lay citizenry. Unfortunately, there is insufficient space here to point out the many flaws in this assertion.[44] However, here I shall merely point out that such an assertion assumes that elected professional politicians and legislators are better educated in the sciences and more scientifically and technically literate than their constituents. This is an implausible assertion, at best. The skills that are required to win elections and gain political power—skills more bound up with gaining wealthy backing and appealing to the electorate via mass media—do not convey scientific or technical expertise. All other things being equal, professional politicians are no better placed to evaluate the question of how science and technology should be developed than are any members of the lay citizenry, including scientists and technical professionals. Nor are political/administrative experts—including political scientists, lawyers, social scientists, and bureaucrats—any better placed to evaluate the nature of a good society or public goods. Again, we are all on a par in this respect. Rather than providing an *a priori* basis for the exclusion of the public, the complexities of science and technology actually provide good reasons for the inclusion of the public in deliberating and deciding the directions of scientific research and technological innovation. What is required is an improved level of general education within the citizenry, including scientists and technical professionals, on wider problems about how to evaluate critically values and goals, to explore and debate questions of social progress and the nature of a good society, and how to participate in the democratisation of society. Given that there is an absence of any expertise in these areas, this kind of education must be conducted in a decentralised, experimental, participatory, and pluralistic manner. This absence of any universal agreement on questions of values is further complicated by the problem of our limited foresight and knowledge of the consequences of scientific research and technological innovation in the world. Hence, the aim of such an education should be more one of improving

[44] See *Participatory Democracy, Science and Technology*, especially chapters 1 and 5, for detailed discussion and arguments.

critical thinking, powers of articulation, and learning skills, helping people learn how to democratically participate and gain the knowledge and skills that they decide upon as valuable, for themselves, rather than geared towards the dissemination of facts and techniques in accordance with some core curriculum. In this way, education would pave the way a broader public understanding of science among scientists and lay citizens alike, while also providing citizens with the intellectual skills to become more involved with science and technology more at the preparatory and design stages, and scientists would understand that there are broader concerns and issues at stake and not just a set of technically specialised problems and their solutions.

It is important to emphasise here that this is not merely a question of the lack of a general education in the sciences among the citizenry. Of course, widespread scientific education would help citizens better participate in decision-making process and critically engage with scientists and technical professionals. This would lead to greater transparency and accountability, as well as improve the ability of the citizenry to raise questions, to dissent, and also to challenge the claims that scientists often make about the social value and implications of their proposals. I do not deny that a better informed citizenry is better able to participate in the democratic process, however construed, and better able to articulate public concerns to scientists. However, we can understand that the problem is much deeper than this, once we recognise that we do not have any expertise in how to evaluate questions of values, goals, public goods, and the nature of a good society. It is not simply a question of improving levels of scientific education and literacy so as to improve the capacity of the citizenry *to be better informed* about science in general. Even if the citizenry were to be well educated in the sciences, unless they were also able to challenge scientists about the development and implementation of science and technology in society, the public debate would not be a democratic process of decision making at all. It would be nothing more than a more complicated process by which the citizenry came to understand what it was that scientists were trying to inform them. While the quality of the public debate would be improved, the citizenry would still remain in a passive and receptive relationship with scientists. Even though informed public debate would increase levels of accountability and transparency in the decision-making process, it would still leave scientists and technical professions in a position of leadership and governance over the development of the technological society. As Bakunin argued, even if the most learned scientists, inspired only by the love of truth, were to govern the development of society by framing laws and policies only in accordance with the best available scientific knowledge, still this would inevitably result in a monstrous and totalitarian regime rather than a free and enlightened society.[45]

The problem, argued Bakunin, is that if the majority of people do not understand the best available science (otherwise what need would citizens have for the scientists as framers of laws and policies?), then any such laws or policies developed by scientists (no matter how well meaning) would have to be applied without the majority of people understanding how and why they were framed thus. Any such laws or policies would have to be imposed upon a largely ignorant

[45] Bakunin, M., *God and the State* (New York: Dover Publications, 1970), first published 1882.

majority. Given that the best available science is always imperfect (or incomplete), and it was also deemed necessary to frame them as biding laws, then the imposition of any laws or policies based on science would require that the majority ignorantly conformed to these laws or policies *as if they were dictates based on the absolute truth*. Bakunin argued that this would result in a mass society of passive and irrational citizens – mindless brutes – and would tend towards an authoritarian (technocratic) society *based on the absolute authority of scientists*, wherein scientists were compelled to resort to propaganda techniques to instruct the citizenry. Science in such a society would ultimately become doctrinarian and knowledge would be disseminated through a hierarchy, which leads to the form of authoritarianism and suppression of dissent that would destroy the critical and revolutionary nature of science. Bakunin's argument pre-empted Polanyi's on this important point. Bakunin's argument also agreed with Polanyi's on the crucial point that if scientists are to attempt to change public policy they must do so *as equals* with their fellow citizens through persuasion and discussion. Citizens come to learn about the science involved and judge its truth for themselves, while scientists learn the concerns of the fellow citizens and also develop a broader understanding of the relationship between science and society. This would open up the debate in such a way that all citizens would be able to develop an active and free relation with science, only constrained by their own intellectual conscience and education. This would allow all citizens to develop a critical relationship with science and truth, better able to debate about the value of science, its implications, and how best to implement its discoveries in society. For Bakunin, as also for Kropotkin and Polanyi, science should retain its universal and abstract character, but it should be subordinate to considerations of the particularities and practicalities of life. Scientific knowledge and education should be distributed freely throughout the population, while each person remains free to act on that knowledge and education as their intellectual and moral conscience dictates.

Democratic participation is an ongoing, experimental, and incomplete process of learning how better to develop society and integrate scientific research and technological innovation into already existent structures of the world, in order to increase the individual and societal potential for creativity, adaptability, and understanding. Democratic participation is a movement of social evolution and broadening it to be maximally inclusive liberates evolutionary potential within that movement. Once we broaden democratic participation in how science and technology are developed and implemented in society, and recognise that democratic participation needs the time and resources required for careful deliberation and decision making, as well as address the assumptions and structures which reinforce social inequality, then we have good reasons to believe that citizens are capable of learning how to communicate effectively their concerns to scientists, as well as understanding the complexities of science and technology in a way that will lead to better science and technology. We also have good reasons to believe that scientists are capable of learning how to communicate effectively their concerns to their fellow citizens, as well as better understanding the complexities of the implementation and development of science and technology in the wider world outside of the laboratory or a computer simulator, through a broader philosophical, historical, sociological, and political understanding of science and technology. Such an understanding would arise as a result of broad democratic deliberation, involving pluralistic and diverse

ideals, values, standards, and perspectives, as well as involving critical and dissenting voices.

Once we understand the need for a broader understanding of science and technology, as well as a broader understanding of maximally inclusive democratic participation as having practical value in helping society better develop science and technology, we need to address the enduring problem of the inequalities that exist within society, such as inequalities in access to education, ability to participate, access to scientific and technical knowledge, and access to the results of scientific research and technological innovations. Among other things, this requires that we rethink how we conceive intellectual property rights and patents. The WTO Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) has imposed global standards of patent and copyright protections for the benefit of multinational corporations. This has had a detrimental effect on poor countries by restricting their access to affordable pharmaceuticals, for example, as well as other copyrighted materials. It has also disrupted the international free flow and exchange of scientific research and technological innovations. The argument in favour of TRIPS largely boils down to what has been termed as "the free-rider problem": the use of scientific knowledge and technological innovations without contributing to the research and development costs. TRIPS was designed to provide international standards and regulations that protect patents and intellectual property rights from "free-riders" and, thereby, preserve the motivation for private investment in research and development. However, TRIPS is based on the assumption that private investors and the market are the main providers of resources for research and development. This assumption is largely based on an ideological faith in the "invisible hand" of the market. In fact, taxpayers have provided the funding to educate scientists and cover the high risk and investment stages of most advanced technologies, including microelectronics, computing, and telecommunications, as well as educating the public to the benefits of such technologies, subsidising distribution, training, and providing public access.[46] It is also the case that taxpayers also fund the measures to deal with any social costs and problems that arise after the implementation of new technologies, such as unemployment, pollution, waste disposal, and new crimes, for example. It is clearly the case that a great deal of "private" enterprise in new technologies simply would not be profitable unless the taxpayers carried a great deal of the costs burden. It is open to question: who exactly is the "free-rider" here? Furthermore, TRIPS, by effectively criminalising one group of "free-riders" to protect the profits of another group of "free-riders" is, arguably, suppressing the economic benefits of a liberalised market by restricting the dissemination of knowledge, decreasing competition, increasing costs, and allowing monopoly control over knowledge (including the suppression of patents). However, it is in the public

[46] Rosenberg, N., *Inside the Black Box: Technology and Economics* (Cambridge, Mass: MIT Press, 1982); Flamin, K., *Targeting the Computer* (Washington, DC.: Brookings Institution, 1987); Smith, M.R. *Military Enterprise and Industrial Technology* (Cambridge, Mass: MIT Press, 1987); Henderson, J., *The Globalization of High Technology* (London: Routledge, 1989); Lockeretz, W., & Anderson, M.D., *Agricultural Research Alternatives* (Lincoln: University of Nebraska Press, 1993); Bonanno, A., Busch, L., Friedland, W., Gouveia, L., & Mingione, E., eds., *From Columbus to ConAgra: The Globalization of Agriculture and Food* (Lawrence: University Press of Kansas, 1994); Forman, P., and Sanchez-Ron, J.M., eds., *National Military Establishments and the Advancement of Science and Technology: Studies in 20th Century Science* (Dordrecht: Kluwer Academic, 1996).

interest to tolerate “free-riders”, providing that the public also accepts the burden of research and development investment costs by publicly organising and funding science and technology.

After all, if we look at the problem from the perspective of economic self-interest, why should the public accept the burden of the costs of policing and regulating systems to protect private intellectual property rights? Why should the public shoulder the costs of protecting private monopoly control over supply and pricing, only then to pay for the private research and development costs anyway, once they have been figured into the market price of the product? It would be more cost effective for the public to directly fund research and development at public universities and research institutes and then allow knowledge and innovations to be freely available to the market. This not only would provide the benefits of a competitive market and afford public transparency and accountability, but it would also remove unnecessary burdens upon the taxpayer to fund bureaucratic systems of regulation and their enforcement. It would also remove the obstacles to the free flow and exchange of knowledge and innovation that is a condition for scientific creativity and equitable opportunities for international and social development. Providing that public universities and research institutions were democratically controlled at the local level, this would both decentralise and socialise scientific research and technological innovation, without requiring a centralised bureaucratic administration, and further liberalise the market. There is not any evidence to suggest that profit is the primary motivation of scientists and inventors, so providing that such individuals were given the intellectual credit for their labours, there would be little in the way of moral objection to allowing free access to the products of those labours, especially if they were funded by public sources, once they enter the public realm outside of the laboratory walls. This would not prohibit private research, but it would not afford it any public protections, at public expense. Once private research enters the public realm, with its concomitant public effects, then it would become public property, freely available to all. Once we recognise that all knowledge in the public realm has public effects, we can argue that the public has a reasonable claim to the right to legislate and administrate public effects, which includes the dissemination and application of knowledge and innovation. By treating scientific knowledge and technological innovation as public goods and risks, then we acknowledge that it is in the public interest to take responsibility for research and development costs, as well as social costs, rather than relying on private enterprise, which, understandably, demands profits and ownership when it has to bear the burden of investment. Once the burden of research and development costs is shouldered by the public, making all scientific knowledge and technological innovation available freely to anyone, then the public will be able to benefit from market competition between “free-riding” producers, while also being able to subject scientific research and technological development to public scrutiny.

Furthermore, commercial secrecy and the ability to suppress patents are not compatible with either democratic oversight or an open society. The success of scientific research and technological development are more likely in an open society, wherein researchers can share knowledge and skills, leading to cross-fertilisation between scientific fields and receiving critical evaluation at all stages of the research.

It is of benefit to scientists that their research should be made public as soon as possible, and, when research impacts upon the public then it is fairly obvious that, in a democracy, it should be under public scrutiny. Of course, scientists need a working environment that is free from interference and distractions, but the public should be involved in the choices of research funding, the location of research laboratories, and the implementation and development of research outside the laboratory. There are also benefits to scientists that arise from public involvement. By increasing the stock of values, knowledge, experience, imagination, creativity, and lateral thinking available to the researchers, many future problems and their solution can be anticipated. Education and communication are crucial for the democratisation of science, creating the conditions for an open society, and they are also essential for the flourishing of the sciences. A close relation between communities, schools, colleges, and universities, would facilitate democratic participation in the choices of studies and research that should be promoted and encouraged, as well as helping ordinary citizens improve their level of education and capacities to effectively communicate. School children should be involved, from an early age, in discussions about their visions for the future development of their communities, which must include their own education, scientific research, and technological innovation. The public should fund the further education of college and school teachers through local university programmes studying the relations between science, technology, and democracy. Universities should research and teach the wider historical, sociological, and anthropological uses and adoptions of sciences and technologies in other communities, societies, and cultures; researching in detail the ways that sciences and social structures transform one another. Universities should also focus on researching public concerns and interests about the wider issues of education and communication. Moreover, through education, an increased public awareness of the history of the choices made during the ongoing construction of the technological society will increase the public awareness of the contingency of those choices and raise awareness of possible alternatives. This will not only increase the public confidence in the value of democratic participation, but will also help people anticipate the challenges, difficulties, and resistances that may well result from their choices. It will aid the maturation of society into a fully democratic and open society based on “scientific anarchism”, which will maximise the evolutionary potential of that society and enhance civic virtues throughout society. Hence, it is central for the possibility of an open society and flourishing sciences that education and the access to scientific knowledge must be a public universal right, funded through public resources, and the results of scientific research and technological innovation must be public property, again funded through public resources. However, we cannot rest there. The problems with the inequalities in the access to science and technology, as well as the general inequalities in the access to education, are themselves consequences of the deeper political, social, and economic inequalities that pervade advanced capitalist society. This, from the outset, “scientific anarchism” must be directed to identifying and removing those inequalities.

Karl Rogers, January 2010