Marxism and Science

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Contents

ICC Introduction

We are publishing here a contribution sent to us by the anthropologist Chris Knight on the relationship between marxism and science. Chris was invited to the 19th congress of the ICC, held in May, in order to participate in the debate on this same topic, which we have been developing within the organisation for some time. This debate has been reflected in articles we have published on Freud, Darwin, and indeed on Chris' own theory of the origins of human culture[1]; at the same time we intend to publish some of the internal discussion texts that have been produced to take this debate forward. We will also be writing in more detail about the work of the congress.

Our aim in this debate, which followed logically from prior discussions about ethics, human nature and primitive communism, is not to arrive at a single, homogeneous view of the relationship between marxism and science, or to make adherence to a particular psychological or anthropological theory the equivalent of a point in our platform. Neither does our interest in engaging in discussion with scientists like Chris Knight, or the linguist Jean-Louis Desalles who spoke at our previous congress, require that we share with them a high level of agreement on the political positions that our organisation exists to defend. Rather we are seeking to continue a tradition in the workers' movement which consists of being open to all authentic developments of scientific inquiry, particularly when they focus on the origins and evolution of human society. This is essentially what motivated Marx and Engels' enthusiasm about the theories of Charles Darwin and LH Morgan, Trotsky's recognition of the importance of Freud's ideas, and so on. And despite the decadence of capitalism and the profoundly negative impact it has had on the advance and utilisation of science, scientific thought has by no means come to a complete halt in the last century or so. At the congress itself, as well as taking part in the general discussion about marxism and science, Chris also made a succinct but extremely well-argued presentation of the anthropological theories he has elaborated in the book *Blood Relations* and other works. This presentation and the discussion that ensued from it provided a concrete demonstration that fruitful scientific research and reflection about the origins of humanity and the reality of 'original communism' is certainly still going on today.

The text that follows is not directly about anthropology, but about the more general relationship between marxism and science. It offers a way of approaching the relationship between the two which is fundamentally revolutionary, affirming the essential internationalism of real science, the dialectical manner in which it moves forward, and

[1] See for example:

its necessary opposition to all forms of ideology. We invite our readers to make use of the discussion forum on this website to send us their views on Chris Knight's text, and indeed on his anthropological theories. Chris has said that he would be very willing to take part in any discussions that his contributions may generate on this site.

ICC, June 2011

Marxism and Science

Part I

"*Science,*" according to Trotsky, "*is knowledge that endows us with power.*"[1] In the natural sciences, Trotsky continued, the search has been for power over natural forces and processes. Astronomy made possible the earliest calendars, predictions of eclipses, accurate marine navigation. The development of medical science permitted an increasing freedom from and conquest of disease. The modern advances of physics, chemistry and the other natural sciences have today given humanity an immense power to harness natural forces of all kinds and have utterly transformed the world in which we live.

Potentially at least, the resulting power belongs to all of us – the entire human species. Science is the self-knowledge and power of humanity at this stage of our evolution on this planet – and not merely the political power of one group of human beings over others. To Trotsky, as for Marx before him, it is this intrinsic internationalism of science – the global, species-wide nature of the power it represents – which is its strength, and which distinguishes science from mere local, national, territorial or class-based (i.e. religious, political, etc) forms of consciousness. Ideologies express only the power of certain sections of society; science belongs to the human species as such.

By this yardstick, social science has always been a paradox: on the one hand, supposedly scientific, on the other, funded by the bourgeoisie in the hope of buttressing its political and social control. Even the development of natural science itself – although intrinsically international and of value to humanity – has necessarily taken place within this limited and limiting social context. It has always been torn between two conflicting demands – between human needs on the one hand and those of particular corporations, business interests and ruling elites on the other.

Sectional interests and species interests – science has always oscillated between these conflicting forces. Between the two extremes, the various forms of knowledge have formed a continuum. At one end have been the sciences least directly concerned with social issues – mathematics, astronomy and physics, for example. At the other have been fields such as history, politics and (relatively recently) sociology – fields whose social implications have been immediate and direct. The more direct the social

[1] "*An individual scientist may not at all be concerned with the practical applications of his research. The wider his scope, the bolder his flight, the greater his freedom in his mental operations from practical daily necessity, the better. But science is not a function of individual scientists; it is a social function. The social evaluation of science, its historical evaluation, is determined by its capacity to increase man's power to foresee events and master nature.*" L D Trotsky, 'Dialectical materialism and science' in I Deutscher (ed) *The Age of Permanent Revolution: a Trotsky Anthology.* New York 1964, p. 344.

implications of a field, the more direct and inescapable have been the political pressures upon it. And, wherever such pressures have prevailed, knowledge has been distorted and blown off course.

Social conditions of scientific objectivity

Is Marxism ideology? Or is it science? In an intense attack penned at the height of the Cold War, Karl Wittfogel – author of *Oriental Despotism* – denounced Marx as an ideologist. He conceded that Marx would have indignantly rejected that description of himself, and would have been outraged at the use made of his work by Stalin and his followers. The Soviet authorities, wrote Wittfogel in 1953, always cited Lenin's concept of "partisanship" (*partiinost*) to justify 'bending' science – even to the point of falsifying data – in order to render it more suitable for political use. This idea of "utility" or "manipulation" seemed to follow naturally, according to Wittfogel, from Marx's initial premise that all knowledge was socially conditioned – produced by social classes only to suit their economic and political needs. To the Soviet authorities, scientific truth was always something to be manipulated for political ends. But Wittfogel continues:

> "*Marx, however, did not hold this view. He not only emphasised that a member of a given class might espouse ideas that were disadvantageous to his class – this is not denied by Lenin and his followers – but he also demanded that a genuine scholar be oriented toward the interests of mankind as a whole and seek the truth in accordance with the immanent needs of science, no matter how this affected the fate of any particular class, capitalists, landowners or workers. Marx praised Ricardo for taking this attitude, which he called 'not only scientifically honest, but scientifically required'. For the same reason, he condemned as 'mean' a person who subordinated scientific objectivity to extraneous purposes: '... a man who tries to accommodate science to a standpoint which is not derived from its own interests, however erroneous, but from outside, alien and extraneous interests, I call mean* ***(gemein)****'.*
>
> *Marx was entirely consistent when he called the refusal to accommodate science to the interests of any class – the workers included – 'stoic, objective, scientific'. And he was equally consistent when he branded the reverse behaviour a 'sin against science'.*
>
> *These are strong words. They show Marx determined to maintain the proud tradition which characterised independent scholarship throughout the ages. True, the author of* ***Das Capital*** *did not always – and particularly not in his political writings – live up to his scientific standards. His attitude, nevertheless, remains extremely significant. The camp followers of 'partisan'*

science can hardly be blamed for disregarding principles of scientific objectivity which they do not profess. But Marx, who accepted these principles without reservation, may be legitimately criticised for violating them."[2]

Karl Marx, writes Wittfogel, played two mutually incompatible roles. He was a great scientist, but he was also a political revolutionary. He championed – as every scientist must do – "*the interests of mankind as a whole",* but he also championed the interests of the international working class. The self-evident incompatibility (as Wittfogel sees it) of these two activities meant that *"Marx's own theories ... are, at decisive points, affected by what he himself called 'extraneous interests'"*.[3]

Wittfogel is cited by the social anthropologist Marvin Harris, whose views on this issue appear to be quite similar. Harris counterposes Marxism's "scientific" component against its "dialectical and revolutionary" aspect, his aim being to render the former serviceable by decontaminating it of all traces of the latter. According to Harris, *"Marx himself took pains to elevate scientific responsibility over class interests.*" But this was only in his scientific work. Much of Marx's work was political, and here, science was subordinated to political ends – and therefore misused. If science is championed for political reasons, this *must* lead to the betrayal of science's own objectivity and aims, says Harris: "*If the point is to change the world, rather than to interpret it, the Marxist sociologist ought not to hesitate to falsify data in order to make it more useful.*"[4]

Wittfogel's point that Marx tried to base his science on "*the interests of mankind as a whole*" is a valuable one. We may also agree with Harris that Marx "*took pains to elevate scientific responsibility over class interests*" – if by "class interests" we mean sectional, as opposed to universal human, interests. But the difficulty lies precisely here. Like Einstein, and like all great scientists down through the ages, Marx believed that it was his responsibility as a scientist to place before all sectional interests the general interests of humanity. The question he faced is the one which still faces us today: in what concrete form, in the modern world, are these general interests expressed?

Marx came to the conclusion, on the basis of his scientific studies, that the general interests of humanity were not represented by the various ruling classes of 19th century Europe. These interests conflicted not only with one another, but also with those of the human species as such. They could not, therefore, form the social basis for a genuinely objective social science.

The weakness in the position of both Wittfogel and Harris is that they have nothing to say on this issue. They are in the peculiar position of both agreeing with Marx's basic premises and yet refusing even to discuss the possibility that his conclusions might have been correct. They fully agree that science must base itself upon general human interests. Marx, basing himself on this idea, reached the conclusions (a) that

[2] K Wittfogel, 'The ruling bureaucracy of oriental despotism: a phenomenon that paralysed Marx'. *The Review of Politics* No. 15, 1953, pp. 355–56. Wittfogel cites Marx's *Theorien über den Mehrwert,*

[3] Wittfogel, p. 356n.

[4] M Harris, *The Rise of Anthropological Theory* London 1969, pp. 4–5; 220–21.

science was itself politically revolutionary to the extent that it was genuinely true to itself and universal; (b) that it was this kind of 'politics' (i.e. the politics of science itself) that the modern revolutionary movement required; and (c) that the only possible social basis for such a science-inspired politics was the one class in society which was itself a product of science, which was already as intrinsically international as scientific development and whose interests countered all existing sectional interests. But neither Wittfogel nor Harris mount any argument on all this. They simply take it as self-evident that the interests of humankind are one thing, whereas working class interests are another.

Karl Marx knew – and every Marxist worthy of the name knows – that it is not worth committing oneself to a social force unless it genuinely does represent by its own very existence the wider interests of humanity. And every Marxist worthy of the name knows that it is only real science – the real discoveries of scientists working independently and for science's own autonomous ends – which can be utilised by humanity as a means to self-enlightenment and emancipation. From this standpoint we can see the absurdity of Harris's argument that if the point is to change the world the Marxist sociologist "*ought not to hesitate to falsify data in order to make it more useful*". How can 'falsified data' conceivably be of value to humankind? How can it be useful to anyone interested in changing the world?

Harris is right to insist that when a sectional political interest – be it 'Marxist' or not – takes hold of scientific work, science itself will suffer. A particular **national** and therefore **limited** political party or a **particular** group ruling a particular state (as, for example, the Soviet bureaucracy and 'communist' apparatus during the cold war) may well feel itself to have particular interests of its own, which it sets above the wider interests it claims to represent. In that case, to the extent that scientists are involved, science will certainly be distorted. But a distortion of science (i.e. its partial transformation into ideology) can only involve a limitation of its long-term ultimate appeal and human usefulness. Wherever such things happen, therefore, the particular group concerned reduces rather than enhances its power to "change the world".

All distortions, falsifications or mystifications express the power only of sectional social interests in opposition to wider ones. Marx at no time advocated tailoring science to suit the felt needs of this, that or the other sectional interest – whether working class or not:

> "*It is not a matter of knowing what this or that proletarian, or even the proletariat as a whole, conceives as its aims at any particular moment. It is a question of knowing what the proletariat is, and what it must historically accomplish in accordance with its nature".*[5]

For Marx, to know "what the proletariat is" constituted a scientific question, which could only be given a scientific answer in complete independence of any immediate

[5] K Marx and F Engels, *The Holy Family* (1845). In T B Bottomore and M Rubel (eds) *Karl Marx: Selected writings in sociology and social philosophy.* Harmondsworth 1963, p. 84.

political pressures or concerns. Far from arguing for the subordination of science to politics, Marx insisted on **the subordination of politics to science**.

Autonomy and class interest

Engels wrote: *"... the more ruthlessly and disinterestedly science proceeds, the more it finds itself in harmony with the interests of the workers."*[6] We can be confident that this accurately expressed Marx's own views. Science, as humanity's only universal, international, species-unifying form of knowledge, had to come first. If it had to be rooted in the interests of the working class, this was only in the sense that all science has to be rooted in the interests of the human species as a whole, the international working class embodying these interests in the modern epoch just as the requirements of production have always embodied these interests in previous periods.

There was no question here of any subordination to sectional needs. In being placed first, science was destined to cut across sectional divisions and become the medium of expression for a new form of political consciousness. In this sense, science was even destined to **create**'the international working class' itself. Without science, there can only be sectional working class political movements; only through scientific analysis can the **general**interests of the class be laid bare.

Admittedly, science – as itself a social product — cannot (in Marx's view) add anything to the strength of the working class which is not already there. It cannot impose itself upon the workers' movement as if from outside.[7] It is in and through science alone that workers internationally can become aware of the global, species-wide strength which is already theirs. And it is only in becoming aware of its own power that the 'international working class' can politically exist.[8] There is no question, therefore, of science being subordinated to a pre-existing political force. The political force is science's own and cannot exist without it. The previously prevailing relationships between science and politics are reversed.

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[6] F Engels, 'Ludwig Feuerbach and the end of classical German philosophy'. In K Marx and F Engels, *On Religion.* Moscow 1957, p. 266.

[7] As long as the working class is weak, wrote Marx, the theoreticians aiming to help it "*improvise systems and pursue a regenerative science*". But, once the working class is strong, its theoreticians "*have no further need to look for a science in their own minds; they have only to observe what is happening before their eyes and to make themselves its vehicle of expression ... from this moment, the science produced by the historical movement, and which consciously associates itself with this movement, has ceased to be doctrinaire and has become revolutionary*" (K Marx, *The Poverty of Philosophy*; in Bottomore and Rubel, p. 81).

[8] As Trotsky puts it, *"... the consciousness of strength is the most important element of actual strength*" (L D Trotsky *Whither France?* New York 1968, p116). Marx had the same idea in mind when he wrote: *"... we must force these petrified relationships to dance by playing their own tune to them! So as to give them courage, we must teach the people to be shocked by themselves"* ('Towards a Critique of Hegel's *Philosophy of Right';* quoted in D McLellan (ed) *Karl Marx: Early Texts.* Oxford 1972, p. 118).

For Marx, social science – including his own — is as much a product of class relationships as any other form of social consciousness. His general formulation is well-known:

> "*The ideas of the ruling class are, in every age, the ruling ideas: i.e., the class which is the dominant material force in society is at the same time its dominant intellectual force. The class which has the means of material action at its disposal has control at the same time over the means of mental production, so that in consequence the ideas of those who lack the means of mental production are, in general, subject to it. The dominant ideas are nothing more than the ideal expression of the dominant material relationships, the dominant relationships grasped as ideas, and thus of the relationships which make one class the ruling one; they are consequently the ideas of its dominance."*[9]

For this reason, Marx did not consider it possible to change the prevailing ideas of society – or to produce a universally agreed science of society – without breaking the material power of those forces which distorted science. It was because Marx saw social contradictions as the source of mythological and ideological contradictions that he was able to insist that only the removal of the social contradictions themselves could remove their expressions in ideology and science.

This is what Marx meant when he wrote:

> "*All social life is essentially practical. All the mysteries which lead theory towards mysticism find their rational solution in human practice and in the comprehension of this practice".*[10] Or again: "*The resolution of theoretical contradictions is possible only through practical means, only through the practical energy of man. Their resolution is by no means, therefore, the task only of the understanding, but is a real task of life, a task which philosophy was unable to accomplish precisely because it saw there a purely theoretical problem."*[11]

So from the standpoint of Marx and Engels it was in order to remain true to the interests of science – to solve its internal theoretical contradictions – that they felt obliged, as scientists, (a) to identify with a material social force which could remove the "extraneous interests" distorting the objectivity of science and (b) to take up the leadership of this material force themselves. Their idea was not that science is inadequate, and that politics must be added to it.[12] Their idea was that science – when true

[9] K Marx, *The German Ideology; in Bottomore and Rubel, p. 93.*

[10] K Marx, 'Theses on Feuerbach'; in Bottomore and Rubel, p. 84.

[11] K Marx, 'The Economic and Philosophic Manuscripts'; in Bottomore and Rubel, p. 87.

[12] Actually, Marx had a very low opinion of 'political thought' in general precisely because of its inevitably subjective, unscientific bias: "Political intelligence is political just because it thinks inside the

to itself – is intrinsically revolutionary, and that it must recognise no political project but its own.

Marx and Engels believed science could acquire this unprecedented political autonomy for a social reason: there had come into existence within society for the first time – and as a direct result of scientific development itself – a 'class' which was not really a class at all, which had no traditional status or vested interests to protect, no power to dispense patronage, no power to divide man from man and therefore no power to distort science in any way. "*Here,*" wrote Engels of the working class, "*there is no concern for careers, for profit-making or for gracious patronage from above.*"[13] Only here could science be true to itself, for only here was a social force of a truly universal kind, capable of uniting the species as a whole.

This was the condition for a truly independent, truly autonomous, truly universal science of humankind – the existence of

> "*a class in civil society which is not a class of civil society, a class which is the dissolution of all classes, a sphere of society which has a universal character because its sufferings are universal, and which does not claim a particular redress because the wrong which is done to it is not a political wrong, but wrong in general*". "*There must be formed*", Marx continued, "*a sphere of society which claims no traditional status but only a human status, a sphere which is not opposed to particular consequences but is totally opposed to the assumptions of the ... political system, a sphere finally which cannot emancipate itself without emancipating itself from all other spheres of society, without therefore emancipating all these other spheres, which is, in short, a total loss of humanity and which can only redeem itself by* ***a total redemption of humanity.***"[14]

limits of politics. The sharper and livelier it is, the less capable it is of comprehending social evils ... the principle of politics is the will. The more one-sided and thus the more perfect political intelligence is, the more it believes in the omnipotence of the will, and thus the more incapable it is of discovering the sources of social evils" (K Marx 'The King of Prussia and Social Reform'; McLellan, p. 214). If Marx believed in the necessity for political struggle, it was because he understood the political nature of the obstacles to human emancipation and to the autonomy of science. It was not because of anything intrinsically political about this emancipation or its science. Socialism when realised is not political: "Revolution in general – the overthrow of the existing power and dissolution of previous relationships – is a political act. Socialism cannot be realised without a revolution. But when its organising activity begins, when its peculiar aims, its soul, comes forward, then socialism casts aside its political cloak" (McLellan, p. 221).

[13] F Engels, 'Ludwig Feuerbach and the end of classical German philosophy', K Marx and F Engels, On Religion Moscow 1957, p. 266.

[14] K Marx, 'Towards a Critique of Hegel's Philosophy of Right'; in Bottomore and Rubel, p. 190.

Validation of Marxism

Much of the preceding argument may itself seem tendentious. Almost any political or social philosopher will claim, after all, that their theory expresses general human interests rather than narrow sectional ones. To use 'fidelity to the interests of humanity' as a yardstick by which to measure the scientific value of a conceptual system is therefore not possible – unless some objective test for this can be found. But what kind of test could this possibly be? In the final analysis, no doubt, the proof of the pudding is in the eating. What happens when we try out a new hypothesis? Does it prove to be empowering? Does it lessen mental effort in solving intellectual problems? In other words, does the hypothesis add to the power – be it purely intellectual or practical as well – of scientists in the relevant field?

If it does, then everyone should ultimately come to recognise the fact. Assuming intellectual efficiency to be our criterion (and we will not be scientists otherwise), support for the theory will spread. Internal coherence (agreement between the theory's parts) will find expression in widespread social agreement. Such a capacity to produce agreement is the ultimate social test of science.[15]

In the long term, for Marxism or for social science, a similar test must be undergone. Science differs from mere ad hoc knowledge, technique or common sense by virtue of its abstract, symbolic, formal characteristics. Science is a **symbolic system**. Like any such system, its meaning depends on **agreement.**The figure '2' means 'two' only because we all say it does. It could equally well mean 'nine'. All symbolic systems – including myths and ideologies – depend in this sense upon social agreement. But, in the case of myths and ideologies, the scope of agreement extends only so far. A point is reached at which disagreement arises – a disagreement rooted in social contradictions. And, when this happens, the need to reconcile **incompatible**meanings leads to contradictions of an internal kind – within the symbolic system itself.

Mythology and ideology are expressions of social division. This is the essential feature which distinguishes these forms of knowledge from science. Science expresses the power and the unity of the human species – a power which, in class-divided societies, human beings have increasingly possessed in relation to nature even though not in relation to their own social world. A science of society, in order to prove itself as

[15] See T S Kuhn, 'The Structure of Scientific Revolutions' International Encyclopaedia of Unified Science Vol 2, No. 2, Chicago 1970, p. viii. Marx probably derived this idea at least in part from Feuerbach, although it is also a powerful theme in Hegel's writings. Feuerbach writes: "That is true in which another agrees with me – agreement is the first criterion of truth; but only because the species is the ultimate measure of truth. That which I think only according to the standard of my individuality is not binding on another: it can be conceived otherwise; it is an accidental, merely subjective, view. But that which I think according to the standard of the species, I think as man in general only can think, and consequently as every individual must think if he thinks normally ... That is true which agrees with the nature of the species; that is false which contradicts it. There is no other rule of truth" (L Feuerbach, The Essence of Christianity. Quoted in E Kamenka The Philosophy of Ludwig Feuerbach. London 1970, pp. 101–02).

science, would have to prove that it was without internal contradictions, and that it was consistent with natural science and with science as a whole. In the long term, it could only prove this practically. It would have to demonstrate its internal consistency by demonstrating its roots in social agreement of a kind uniting the human race. It would have to demonstrate in practice, in other words, that it formed part of a symbolic system – a global 'language' woven out of the concepts of science – which was capable in practice of embracing and ultimately politically unifying the globe.[16]

Yet this is not the only test. In the case of every scientific advance, the first test is theoretical. Copernicus knew that the earth moved. And he knew it long before this fact had been proven to the satisfaction of others and universally agreed. Einstein knew that light was subject to gravitational laws. And he knew this long before it was demonstrated in 1919 during an eclipse watched from observatories in Cambridge and Greenwich (when it was shown that lightrays from a star were deflected by the gravitational pull of the sun). In scientific discovery it has always been the same. A scientific revolution is validated on the level of pure theory long before passing the final test of practice.

The only ultimate validation of Marxism as science would be the demonstration of its power to produce agreement on a global scale – its power to unify humanity. But if Marxism is genuine science, it ought to be possible to demonstrate this potential in purely theoretical terms in advance. The question arises: how? I shall examine this problem in the second part of this article.

[16] For this idea as it was expressed during the Russian Revolution see C Knight Past, future and the problem of communication in the work of V V Khlebnikov (unpublished M Phil thesis, University of Sussex, 1976).

Part II: The Structure of Scientific Revolutions

In Part I, I showed how Marx and Engels viewed science. They saw it as humanity's only genuinely internationalist form of knowledge. The idea of subordinating science to a political party – even to a party calling itself 'communist' – would have been anathema to them. It is not that science must be subordinated to the Communist Party. On the contrary, the Communist Party must be subordinated to science. It would not be a Communist Party otherwise.

Thomas Kuhn

One of the most important achievements of 20th century historical scholarship was Thomas Kuhn's book, *The structure of scientific revolutions*.[1] It would be difficult to overstate Kuhn's influence on the sociology and philosophy of science.

Predictably, postmodernist cynics have used Kuhn to justify their claim that there is no such thing as science – that everything boils down to politics and power. In fact, Kuhn's work leads us to the opposite conclusion: real science is possible only where scientists are in a position to resist external political pressure. The struggle for such autonomy, if this logic is pursued, turns out to involve simultaneously the struggle for human liberation from inequality and class rule.

In his great book, Kuhn's focus is not the relationship between scientific development and social or political events. His work concerns the internal structure of science. Nor does Kuhn accept any absolute distinction between science, on the one hand, and myth or ideology, on the other. For him, this distinction is always a relative one – a matter of the degree to which one conceptual system can produce agreement and prove fruitful in comparison with alternatives.

His main point is that a form of knowledge only acquires the status of 'science' by demonstrating that it can produce very fundamental levels of agreement between thinkers which are beyond the scope of rival systems of knowledge. Schools of thought which prove to be incapable of producing enduring levels of agreement – in scientific communities which cut across local or national barriers – tend not to be accorded the

[1] Kuhn, T S. 1970. The Structure of Scientific Revolutions. 2nd edition. International Encyclopaedia of Unified Science, Vol. 2, No. 2, Chicago.

status of science. It is for this reason that 'social science' is so suspect. It seems to be incapable of producing any real agreement at all.

Setting the paradigm

In explaining how he came to work on the subject matter of his book, Kuhn writes: *"... I was struck by the number and extent of the overt disagreements between social scientists about the nature of legitimate scientific problems and methods. Both history and acquaintance made me doubt that practitioners of the natural sciences possess firmer or more permanent answers to such questions than their colleagues in social science. Yet, somehow, the practice of astronomy, physics, chemistry or biology normally fails to evoke the controversies over fundamentals that today often seem endemic among, say, psychologists or sociologists."*[2]

Kuhn's point is that in the social sciences thinkers not only cannot reach agreement with each other on fundamental issues – they cannot even find a common language of rules or concepts through which to communicate with each other in a rational way. There is a point at which rational debate breaks down and the opposing schools seem to each other to be breaking the rules and resorting to illegitimate techniques of persuasion, including even material inducements or force. In fact, it is not just that the rules are broken – it turns out that there are no rules. Each camp only obeys its own rules. This is in stark contrast to the normal situation among, say, nuclear physicists, who, even when they do disagree with each other on fundamental issues, nevertheless possess a shared language – a set of agreed rules of procedure, concepts, traditions and ideas through which fruitful communication can be achieved.

But Kuhn's most significant point is that the natural sciences themselves were once in a position similar in essentials to that of the social sciences today. They, too, in their early stages of development, were incapable of producing any enduring agreement or language on the basis of which a unified scientific community could form. And they, too – like the social sciences today – were divided by disagreements over fundamentals; disagreements which often seemed to be of a political or even violent kind.

On June 21 1633, Galileo de Galilei was interrogated by the pope and by a tribunal made up of cardinals and high officials of the Catholic church who threatened him with torture unless he withdrew his allegation that the earth circled the sun. In those times, the conflict between the Ptolemaic and Copernican systems of astronomy was a political one and anyone supporting Copernicus risked persecution, imprisonment or even death by being burned at the stake. If this example seems historically remote, we should remember that Charles Darwin was considered to be putting forward a theologically dangerous and politically subversive theory when he argued that humanity was descended from a kind of ape.

[2] Kuhn p. viii.

In the case of both Galileo and Darwin, it was only the political and ideological defeat of the church on the issues concerned – defeats which formed part of a wider process of social and political change – which eventually lifted science from the realm of political controversy. But, conversely, it is only once its initial political coloration has faded away that science produces sufficient general agreement for it to be recognised simply as science. Borrowing from Marx, we might say that science has to "conquer politically" before it can "shed its political cloak".

Achievements such as those of Copernicus and Darwin are termed by Kuhn "paradigms". Paradigms are *"universally recognised scientific achievements that for a time provide model problems and solutions to a community of practitioners".*[3] Such achievements are products of scientific revolutions. A revolution of this kind is not simply an addition to pre-existing knowledge. It is, within any given field, "*a reconstruction of the field from new fundamentals ..."*[4] It is a complete demolition of an old theoretical and conceptual structure and its replacement by a new one based on entirely different interests, aims and premises.

During the course of a scientific revolution, nothing is agreed, there are no common rules of procedure, everything seems to be ideological and political, and other issues are decided by 'unconstitutional' means. The old paradigm is not defeated on the basis of its own rules, but is attacked from outside. It cannot be defeated on the basis of its own rules, for these rules are not only inadequate to solve the new problems which have begun to arise – they actually preclude any discussion of these problems at all.

For Kuhn, the parallelism with political and social revolutions was profound. He explains:

> "*Political revolutions aim to change political institutions in ways that those institutions themselves prohibit. Their success therefore necessitates the partial relinquishment of one set of institutions in favour of another, and in the interim, society is not fully governed by institutions at all. Initially it is crisis alone that attenuates the role of political institutions ... In increasing numbers individuals become increasingly estranged from political life and behave more and more eccentrically within it.*
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> *Then, as the crisis deepens, many of those individuals commit themselves to some concrete proposal for the reconstruction of society in a new institutional framework. At that point the society is divided into competing camps or parties: one seeking to defend the old institutional constellation; the others seeking to institute some new one. And, once that polarisation has occurred, political recourse fails. Because they differ about the institutional matrix within which political change is to be achieved and evaluated, because they acknowledge no supra-institutional framework for the adjudication of revolutionary differences, the parties to a revolutionary conflict*

[3] Kuhn p. viii.
[4] Kuhn p. 85.

must finally resort to the techniques of mass persuasion, often including force. Though revolutions have had a vital role in the evolution of political institutions, that role depends upon their being partially extra-political or extra-institutional events."[5]

It is just the same, writes Kuhn, when, in the course of a scientific revolution, scientists polarise into opposite camps. The opposing camps cannot communicate. They talk 'past' each other, questioning each other's most elementary premises and refusing to submit to each other's logical or procedural rules. In periods of 'normal science' – ie, in periods of consolidation which follow scientific revolutions, and during which all scientists in the field concerned accept the paradigm of the victorious party – everything can seem 'rational'. Because a community exists which bases itself on a set of shared assumptions and traditions, scientists can appeal to certain written or unwritten agreements as to what constitutes 'correct' or 'rational' procedure and what does not. Disputes internal to a single paradigm can be settled in an orderly way, on the basis of the rules laid down by that paradigm itself. This is what 'normal science' is all about.

But when an entire paradigm is being challenged from outside, there is no purely logical way to proceed. The supporters of the new paradigm may feel that their own framework is far more powerful, far simpler, more elegant and more logical than the old one of their opponents. But they cannot convince their adversaries on the basis of those opponents' own rules. If the old guard are to be won over, they must make a leap in abandoning their former conceptions as to what constituted 'proper' procedure:

"Like the choice between competing political institutions, that between competing paradigms proves to be a choice between incompatible modes of community life. Because it has that character, the choice is not and cannot be determined merely by the evaluative procedures characteristic of normal science, for these depend in part upon a particular paradigm, and that paradigm is at issue. When paradigms enter, as they must, into a debate about paradigm choice, their role is necessarily circular. Each group uses its own paradigm to argue in that paradigm's defence.

"The resulting circularity does not, of course, make the arguments wrong or even ineffectual. The man who premises a paradigm when arguing in its defence can nonetheless provide a clear exhibit of what scientific practice will be like for those who adopt the new view of nature. That exhibit can be immensely persuasive, often compellingly so. Yet, whatever its force, the status of the circular argument is only that of persuasion. It cannot be made logically or even probabilistically compelling for those who refuse to step into the circle. The premises and values shared by the two parties to a

[5] Kuhn pp. 93–4.

debate over paradigms are not sufficiently extensive for that. As in political revolutions, so in paradigm choice – there is no standard higher than the assent of the relevant community."[6]

Normal science and anomaly

It is not until a paradigm has been generally accepted that 'scientific research' in the normal sense can get underway. As Kuhn puts it,

"*Effective research scarcely begins before a scientific community thinks it has acquired firm answers to questions like the following: What are the fundamental entities of which the universe is composed? How do these interact with each other and with the senses? What questions may legitimately be asked about such entities and what techniques employed in seeking solutions?*"[7]

Once – following a scientific revolution – a paradigm has become accepted, a period of conservatism sets in. This is a period of "mopping-up operations"– a period in which, over and over again, the validity of the new paradigm is 'proven'. Kuhn writes:

"*Mopping-up operations are what engage most scientists throughout their careers. They constitute what I am here calling normal science. Closely examined, whether historically or in the contemporary laboratory, that enterprise seems an attempt to force nature into the preformed and relatively inflexible box that the paradigm supplies. No part of the aim of normal science is to call forth new phenomena; indeed those that will not fit the box are often not seen at all. Nor do scientists normally aim to invent new theories, and they are often intolerant of those invented by others.*"[8]

The paradigm validates itself again and again, in ever greater detail, by in effect forbidding scientists to investigate any problems other than those for which the paradigm offers a solution. Only problems whose solutions, like those of a crossword puzzle, are already "*built in by their method of formulation are allowed*". Other problems, as Kuhn writes, "*including many that had previously been standard, are rejected as metaphysical, as the concern of another discipline, or sometimes as just too problematic to be worth the time.*"[9]

[6] Kuhn p. 94.

[7] Kuhn pp. 4–5.

[8] Kuhn p. 24.

[9] Kuhn pp. 36–7. The author adds: "*It is no criterion of goodness in a puzzle that its outcome be intrinsically interesting or important. On the contrary, the really pressing problems – e.g., a cure for cancer or the design of a lasting peace – are often not puzzles at all, largely because they may not have a solution ... A paradigm can, for that matter, even insulate the community from those socially important problems that are not reducible to the puzzle form, because they cannot be stated in terms of the conceptual and instrumental tools the paradigm supplies*".

After about 1630, for example, and particularly after the appearance of Descartes' scientific writings, most physical scientists assumed that the universe was composed of microscopic corpuscles and that all natural phenomena could be explained in terms of corpuscular shape, size, motion and interaction. Hence the solar system was believed to function mechanically, like a clock. The same applied to all other systems, including living ones, such as animals. This paradigm was extremely powerful and led to immense advances of scientific knowledge, but it was also extremely narrow and limiting.

Anyone in Descartes' time who had drawn attention to, say, such phenomena as are nowadays associated with radioactivity simply could not have communicated in a coherent way. In that time, all the problems which today form the subject matter of nuclear physics would have seemed irrelevant, illegitimate, metaphysical and unscientific even to discuss. And, of course, none of these problems **was**discussed or even seen as a problem at all. Among scientists, it was 'known' what the universe was composed of. It was composed not of curved space-time nor electromagnetic fields, but very small, hard objects colliding in accordance with mechanical laws.

However, it is not for us simply to condemn the rigid, conservative paradigms which scientific revolutions eventually produce. Kuhn presents instead a subtle, dialectical argument, showing that it is precisely through such conservatism that new scientific revolutions themselves are prepared. Only a rigid, conservative, but extremely detailed and precise theoretical structure can be disturbed by some small finding which seems 'wrong'. It is only a community of scientists who confidently expect to find everything 'normal' who will genuinely know what an 'abnormality' or 'novelty' is – and who will be thrown into a crisis by it. A more easygoing, open-minded community which never expected precise regularities in the first place would not let themselves be bothered by such things. The precious anomaly in that case would be missed and science would not be in a position to learn from it or advance.

Just as state rigidity can build up pressure for social revolution, so normal science in its predictability and rigidity tends to stoke up pressure for scientific revolution. Every historian knows that a social revolution is often sparked by some apparently trivial incident in the workplace or street. In much the same way, some officially forbidden yet persistent laboratory result can trigger an explosion demolishing an entire scientific paradigm.

As Kuhn explains,

> "*Without the special apparatus that is constructed mainly for anticipated functions, the results that lead ultimately to novelty could not occur. And even when the apparatus exists, novelty ordinarily emerges only for the man who, knowing with precision what he should expect, is able to recognise that something has gone wrong. Anomaly appears only against the background provided by the paradigm. The more precise and far-reaching that paradigm is, the more sensitive an indicator it provides of anomaly and hence of an occasion for paradigm change.*

In the normal mode of discovery, even resistance to change has a use … By ensuring that the paradigm will not be too easily surrendered, resistance guarantees that scientists will not be lightly distracted and that the anomalies that lead to paradigm change will penetrate existing knowledge to the core."[10]

All scientific revolutions are precipitated by anomalies. A planet is in the wrong part of the sky. A photographic plate is clouded when it should not be. A fundamental law of nature is suddenly found to be wrong. A piece of laboratory equipment designed and constructed merely to add precision to a familiar finding behaves in a wholly unexpected way. To normal science, such anomalies are merely an irritation or a nuisance. In attempts to defend the old paradigm, efforts are made to suppress, obliterate or ignore the bothersome findings or events. New observations are made, new experiments are set up – with the sole intention of eliminating the anomaly concerned.

But it is precisely these attempts to defend the old paradigm which now begin to shake it to its foundations. Had the old, rigid paradigm not had its ardent defenders, the anomaly concerned would probably not even have been noticed. Now, however, an entire community of scientists begins to feel challenged by it, and more and more attention is focused upon it. Attempts are made to explain it away. But, the more such attempts are made, the more inconsistent and inadequate the old paradigm appears, the more strange the anomaly seems, and the more dissatisfied a section of the old scientific community becomes.

It is the internal inconsistencies now apparently permeating the old theoretical structure which convince some scientists – at first only a small number – that something is fundamentally wrong. Writing of astronomical observations, Copernicus complained that in his day astronomers were so "*inconsistent in these investigations … that they cannot even explain or observe the constant length of the seasonal year".* He continued: "*it is as though an artist were to gather the hands, feet, head and other members for his images from diverse models, each part excellently drawn, but not related to a single body, and, since they in no way match each other, the result would be a monster rather than man.*"[11]

In the period immediately preceding every scientific revolution, similar complaints are made. There is no neat, logical proof that the old paradigm is wrong. Rather there arises a general sense of dissatisfaction, a feeling – on the part of some – that absolutely everything is wrong, and a gradual splintering of the scientific community into schools and factions between whom communication is difficult or even impossible. Few things – not even the most elementary principles – seem to be agreed upon any more. Everything is questioned, anything is allowed.

"*The proliferation of competing articulations*," writes Kuhn, *"the willingness to try anything, the expression of explicit discontent, the recourse to*

[10] Kuhn pp. 64–65.
[11] Kuhn p. 83.

philosophy and to debate over fundamentals – all these are symptoms of a transition from normal to extraordinary research."[12]

All these are signs that the old theoretical edifice is crumbling and that a new one is about to take its place.

'Madness' of the new

But how does the new paradigm arise? Kuhn argues that it cannot arise logically out of the premises of the old one, because logic is a matter of symbolism – of the meaning of figures, equations and terms – whereas what is required is a complete restructuring of the semantic field itself. In fact, at first, logically it is unquestionably the old paradigm's defenders who are right:

> *"The laymen who scoffed at Einstein's general theory of relativity because space could not be 'curved' – it was not that sort of thing – were not simply wrong or mistaken. Nor were the mathematicians, physicists and philosophers who tried to develop a Euclidean version of Einstein's theory. What had previously been meant by space was necessarily flat, homogenous, isotropic and unaffected by the presence of matter. If it had not been, Newtonian physics would not have worked. To make the transition to Einstein's universe, the whole conceptual web whose strands are space, time, matter, force and motion had to be shifted and laid down again on nature whole. Only men who had together undergone or failed to undergo that transformation would be able to discover precisely what they agreed or disagreed about.*
>
> *Communication across the revolutionary divide is inevitably partial. Consider, for another example, the men who called Copernicus mad because he proclaimed that the earth moved. They were not either just wrong or quite wrong. Part of what they meant by 'earth' was fixed position. Their earth, at least, could not be moved. Correspondingly, Copernicus's innovation was not simply to move the earth. Rather it was a whole new way of regarding the problems of physics and astronomy, one that necessarily changed the meaning of both 'earth' and 'motion'. Without those changes the concept of a moving earth* ***was*** *mad."*[13]

So it is only in a sort of 'madness' – by the old standards – that a new paradigm can be conceived. It is not logically constructed, step by step. It is unusual for the new structure of thought to be consciously anticipated or viewed in advance:

[12] Kuhn p. 91.
[13] Kuhn pp. 149–50.

> "*Instead, the new paradigm, or a sufficient hint to permit later articulation, emerges all at once, sometimes in the middle of the night, in the mind of a man deeply immersed in crisis. What the nature of that final stage is – how an individual invents (or finds he has invented) a new way of giving order to data now all assembled – must here remain inscrutable and may be permanently so.*
>
> *Let us here note only one thing about it. Almost always the men who achieve these fundamental inventions of a new paradigm have been either very young or very new to the field whose paradigm they change. And perhaps that point need not have been made explicit, for obviously these are the men who, being little committed by prior practice to the traditional rules of normal science, are particularly likely to see that those rules no longer define a playable game and to conceive another set that can replace them."*[14]

In other words, even on the level of individuals and personalities, according to Kuhn, the attack on the old paradigm is an external one. Certain individuals or groups from outside the field manage to penetrate it and set about undermining and demolishing the structure around them, using the experience and the materials gained in doing so to build a more stable structure on new foundations in its place. The development is not a gradual or evolutionary one; the 'revolutionaries' possess, right from the beginning, a firm conviction of the necessity of what they are doing and a firm plan – however intuitive or embryonic – of the essentials of the structure they are about to build.

> And they themselves have been converted not gradually, "*but by a relatively sudden and unstructured event like the gestalt switch. Scientists then often speak of 'scales falling from the eyes' or of the 'lightning flash' that 'inundates' a previously obscure puzzle, enabling its components to be seen in a new way that for the first time permits its solution".*[15]

The same applies to the gradual conquest, by the revolutionaries, of the scientific field. Before the scientists can talk to each other again, every scientist in the old camp who is capable of it must undergo the same 'sudden' conversion as that experienced by the revolutionaries themselves:

> *"... before they can hope to communicate fully, one group or the other must experience the conversion that we have been calling a paradigm shift. Just because it is a transition between incommensurables, the transition cannot be made a step at a time, forced by logic and neutral experience. Like the gestalt switch, it must occur all at once (though not necessarily in an instant) or not at all."*[16]

[14] Kuhn pp. 89–90.
[15] Kuhn p. 122.
[16] Kuhn p. 150.

In this, as in all other respects, scientific development is dialectical and revolutionary to the core.

Conclusion

Kuhn correctly sees all human knowledge as socially constructed. To work within a branch of science, he points out, is to help reproduce and define the identity of a particular community – the community of specialists concerned.

In addition to the obvious practical tests of a scientific theory, there is also an internal test. It is this: how much consensus can the theory generate? A theory which can get only this or that sectional interest to mobilise behind it is not likely to be as influential in the long run as one which can cut across sectional interests, building a community of truly universal scope.

Marx and Engels were interested in assembling the big picture – uniting the natural and social sciences to form a single science. Theirs was a revolutionary new scientific paradigm which failed only in the sense that its natural constituency – the working class – was materially defeated on each occasion when it attempted to bring freedom and reason to the world.

Today, rampant and unrestrained capitalism threatens not only freedom and reason, but the very existence of a habitable planet. Meanwhile scientists aware of the dangers of climate change are struggling against heavy odds to defend their intellectual autonomy, threatened as they are by corporate interests bent on concealing and distorting the facts.

In a world currently dominated by grotesquely wealthy state terrorists politically in league with religious fundamentalists, humanity needs autonomous, free-thinking, self-organised science as never before. Our survival as a species depends on it. Across the world, scientists – and that must include all marxists – need to get politically active precisely in order to defend the autonomy of science. For the scientific community to link up and overcome its internal divisions, it must realise where the true source of disunity lies.

In climate research, for example, it is only scientists in the pay of Exxon-Mobil or other such oil corporations (building on techniques developed previously by the tobacco companies) who make it appear that there are 'two sides' on the issues which matter. There are not two sides. Instead, there is science on the one hand; corruption and irrationality on the other. Following the example of the vast majority of climate scientists, scholars in other areas of research may begin to question their political allegiances, learning to speak out against the very corporate interests which stifle inconvenient truths, yet which unfortunately provide the bulk of funding for scientific research.

In order to find the necessary moral courage and social support, the scientific community will have no choice but to identify with the only truly internationalist, truly

incorruptible, truly revolutionary political alternative to market insanity and corporate power. Science will have no choice but to align itself with our class. A Communist Party which did not represent this intellectual and social force would not be worthy of the name.

en.internationalism.org/ir/2009/137/pannekoek-darwinism-01; en.internationalism.org/ir/2009/137/pannekoek-darwinism-02; en.internationalism.org/icconline/2009/04/darwin-and-the-descent-of-man; en.internationalism.org/ir/140/the-legacy-of-freud; en.internationalism.org/2008/10/Chris-Knight.

Chris Knight
Marxism and Science
Submitted by ICConline on 21 June, 2011

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