

ANTONIO GRAMSCI REVISITED: HISTORIANS OF SCIENCE, INTELLECTUALS, AND THE STRUGGLE FOR HEGEMONY

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INTRODUCTION

In 2001, Steven Fuller analysed the successful enterprise of Thomas S. Kuhn's *Structure of scientific revolutions* as a two-sided story.¹ In spite of its public image of neutrality and objectivity, the *Structure*, like all other products of academic research in the history of science, carried a political load. As chairman of the Anti-Communist Committee in the 1950s, and designer of science education policies, James B. Conant, Kuhn's mentor, strongly supported an uncontroversial, neutral science, which was to be transmitted to the younger generations as a taken-for-granted worldview far from any critical reflection on the material conditions of thought. The *Structure* reinforced the idea that the scientific process remains essentially the same whenever and however it occurs.² The Conant-Kuhn case has been widely discussed and has raised much controversy, but it would not be hard to find other examples in which, under the rhetoric of neutrality and objectivity, historians of science have tacitly shared the hegemonic values of the élites of their time.

In spite of the longstanding perception of modern science as value-free knowledge of the external world,³ the new social and cultural history of science has contributed substantially in recent decades to the blurring of the old boundaries between a supposed ideology-free history of ideas and an ideology-loaded social history of science.⁴ As Dominique Pestre stated in a recent essay,⁵ professional scientists are progressively becoming experts in the service of political and economic power, and the old image of defenders of 'truth' seems to be fading quickly. We are today witnesses of the progressive disappearance of the old ideology-free rhetoric, which supposedly has allowed scientists to develop their careers successfully, detached from moral values, being socially and politically neutral. In the same vein, Sheila Jasanoff has pointed out that the dynamics of our contemporary politics, culture and power is intimately linked to the dynamics of science and technology. Through the study of the natural world and its transformations, politics today defines and refines the meaning of citizenship and civic responsibility, rivalry and solidarity, the boundaries between public and private, and the tensions between freedom and social control.⁶

At the 2001 annual meeting of the Society for Social Studies of Science, Wiebe Bijker called for science and technology studies (STS) scholars to be more involved in the political debate. In his view:

... STS needs to make a further step ... to show to a broad array of audiences (politicians, engineers, scientists and the general public) that science and

technology are *value-laden*, that all aspects of modern culture are infused with science and technology, that science and technology do play key roles in keeping society together, and that they are equally central in all events that threaten its stability. It is therefore necessary that science and technology, in their explicit and implicit forms, be subject to *political debate*.⁷

Bijker's manifesto was probably reflecting on the uneven political load of recent scholarship. In spite of former powerful statements by Pestre, Jasanoff and others, a good number of academic products issued from the sociological turn of the 1980s, while illuminating on how science has actually been produced in specific times and cultures, are lacking in deep political analysis. As Gary Werskey has pointed out recently, in our present day of 'political correctness', historians of science and STS scholars rarely acknowledge for instance the influences of old Marxist ideas.⁸ Although Werskey's work is inevitably tinged by an important dose of autobiography,⁹ he is probably right in emphasizing how the old 'scientific lefts', the so called 'popular front' of the 1930s and the 'radical science' movement of the 1960s, have provided a very rich and complex intellectual heritage, which is still available to the younger generations of scholars and deserves further attention from historians of science today.¹⁰

As is widely acknowledged, the famous International Congress of the History of Science held in London in 1931 (and the subsequent impact of the controversial Saturday evening session with the Soviet delegation) was one of the key landmarks in this history.¹¹ It led many to express their indignation, yet to some it was a turning point in their views about science and its history. Gordon Childe, Hyman Levy, Lancelot Hogben, J. B. S. Haldane, Joseph Needham, and John Desmond Bernal are usually known as the six main British historians influenced by the papers of the Soviet delegation. They were to become the first wave of Marxist historians of science, to whom other names such as Benjamin Farrington, Edgar Zilsel, Leo Olschki, Stephen Mason, and Sam Lilley should also be added.¹²

Even those fiercely opposing any attempt to link material conditions to intellectual production were forced to react and made public statements against the Marxist influence, especially in the early period of the Cold War. As Anna K. Mayer has aptly emphasized in a recent paper: "Anti-Marxism formed a defining feature of the process by which the image of scientific work as a disinterested journey of the mind came to be institutionalized."¹³

In this context, it was the image of the development of science as an elitist, autonomous intellectual activity, sealed off from society, that reinforced the relevant and politically 'safe' role of the history of science as an emerging academic discipline, as a useful ally to professional scientists and educational reformers. Since Bernal's *Science and history* (1954) epitomized a version of Marxism, which overemphasized economic determinism, naïve externalism and uncritical scientism,¹⁴ in the 1960s and 1970s, a new emphasis on cultural aspects of Marxism contributed to further analysis on the links between culture, knowledge (science) and power, on the use of science as a cultural tool for domination and social control. The *Radical science journal* reflected a good part of the new concerns, but it was largely ignored and

counterbalanced by more ‘politically correct’ research and teaching programmes in emergent STS and Science Studies Departments.¹⁵

Robert Young’s impressive intellectual career is a good example of the potentialities of the radical science movement. In the 1960s and 1970s, Young worked on the history of concepts concerning human nature, mind and brain at King’s College, Cambridge. He later went on to become professor of Psychotherapy and Psychoanalytic studies at the University of Sheffield in the late 1990s. His *Changing perspectives in the history of science*, edited in conjunction with Mikuláš Teich in 1973, is a good example of the mark he made on the historiographical debates of the discipline some decades ago. Young’s thoughts were rooted in the context of the New Left movement, which gave priority to cultural issues of domination and social control in relation to the old economic determinism of the 1930s.¹⁶

In the late 1980s, Young was asked to contribute two chapters to the collective enterprise of the *Companion for the history of modern science* (1990), a landmark for the discipline at the end of the twentieth century. In his “Marxism and the history of science”, Young strikingly pointed out that, in his view, the work of the Italian thinker Antonio Gramsci (1891–1937) would become a very useful reference for future historians of science.¹⁷ However, if the main names of the scientific lefts, from Bernal to Young, have had a limited impact in the historiography of science in the last thirty years, Gramsci’s name seems to be an even more remote reference, especially among the English speaking community. Although names such as Theodor W. Adorno and Max Horkheimer, Jürgen Habermas, and Michel Foucault, with their strong criticisms of the supposed autonomy and neutrality of modern science, have permeated more or less explicitly into the sociological turn,¹⁸ Gramsci seems to have been diluted by the more powerful force of the so-called postmodernist approaches. His main intellectual production dates back to the 1930s, but his ideas seem to have been used much later only by ‘radical’ historians of science such as Robert Young and some of his pupils.

How can we place Gramsci’s thoughts accurately within this framework? To what extent was there a real break between the old generations of ‘scientific lefts’ and our present times? Which elements of continuity from the old Marxist ideas lay behind public discourses and academic programmes in our present times? In response to these questions, this paper tries to place Gramsci’s stamp in the twentieth-century historiography of science, even for those, such as the anti-Marxists of the 1950s, who feel distant from his intellectual programme. In fact, a revision of Gramsci’s ideas might become a useful tool for endorsing Bijker’s focus on the political dimension of our *métier*. To do this, the article analyses how Gramscian specific concepts such as *hegemony* and *intellectuals* might help us to revisit, more critically, processes of science communication, such as teaching and popularization, but also to rethink our role as academic experts and the value of historiographical plurality. However, for that purpose, we shall first summarize Gramsci’s life and work.

THE GRAMSCIAN LEGACY

Beyond the specialist area of history of science, there has been an enormous amount of scholarly interest in the life and works of Antonio Gramsci in the second half of the twentieth century,¹⁹ in particular his extraordinary intellectual output while detained in Mussolini's prisons from 1926 until his death in 1937. In that period, Gramsci wrote 32 notebooks containing more than 3,000 handwritten pages: the famous *Quaderni dei carcere* (*Prison notebooks*), which were to have a deep impact on Italy, and, later, internationally.²⁰ The dramatic circumstances of his writing, Gramsci's political relevance — elected MP for the Italian Communist Party (PCI) in 1924 — and the thoughtfulness of his work conferred on Gramsci a deserved place in the history of Western political thought. Throughout the pages of the *Quaderni*, Gramsci worked out concepts such as *hegemony* and *consent*, *political and civil society*, *popular literature*, *folklore*, *subaltern social groups*, etc., together with a considerable effort devoted to the definition and analysis of *intellectuals* and their role in society.

Hegemony is probably the most central Gramscian concept to which his other ideas are intimately linked.²¹ Hegemony was the result of Gramsci's reluctance towards deterministic explanations for social inequalities, and the limitations of any socio-economic reductionism to explain the political character of Western Europe. In his view, in a particular historical context, social control of the state — the so-called *political society* — through law, police, army, prisons, i.e. mainly through 'official' force and violence, is insufficient to understand social stability. This political stability had to be explained by other factors, further physical coercion and repression. Therefore, *hegemony* brought to the fore how the so called *civil society*,²² with its institutions ranging from education, religion, and family to the microstructures of everyday practices, contributed to the production of meaning and values, which direct and maintain the spontaneous *consent* of the various strata of society. Civil society was the sphere in which a dominant social group organized hegemony, but also the sphere for the counter-hegemony of a dominated group. Hegemony was a ruling tool for any class or group, an instrument for cultural, moral, ideological leadership over subordinated groups, a prestige language, for example, that reinforced cultural influence and control over weaker linguistic communities. It was conceived as a dynamic force, a continuous process of formation. Therefore, hegemony changed in different times and places and was historically contingent.²³

But subtleties of definition went even further. As Raymond Williams, one of the leaders of the New Left, stated: "hegemony is not simply the crude defense of the dominant opinions, nor the simple manipulation of things from above. It is much more than this: it embraces the whole of our reality, all our habits and hopes; it is our own perception of reality."²⁴ Therefore, it was hegemony, and its acceptance and *consent* by the lower, *subaltern* classes that explained social stability. For Gramsci, only a progressive construction of cultural *counter hegemony* could act as a cultural weapon against that *subaltern* tacit and passive consent. Gramsci associated hegemonic values with the dominant industrial bourgeois class, and its *counter hegemony* had to grow up from the popular culture of the working class, through an ambitious

process of democratization of knowledge.

Since Young had worked in the 1960s on the history of the mind and brain, in particular on the work of the famous medical doctor Franz Joseph Gall,²⁵ it is not a coincidence that his pupil, Roger Cooter, became particularly interested in the role of phrenology — the new ‘science’ founded by Gall — as a strategy of social control in nineteenth-century Britain, and more generally, within a cultural Marxist framework, in the specific relations between knowledge and power through the practice of this controversial science. Jack Morrell reviewed Cooter’s work in the following terms:

In analyzing the uses of phrenology by different groups, Cooter systematically deploys the ideas of Antonio Gramsci.... Gramsci developed the concept of hegemony, by which he meant the way in which a ruling group or class exerted its own moral, political and cultural values by a mixture of force, fraud or persuasion.... Gramsci realized that, in the nineteenth-century liberal regimes, persuasion, not force or corruption, was often the means preferred by ruling groups.... Moreover, given the importance of persuasion and education in the struggle for power, it followed for Gramsci that *knowledge and the intellectuals who produce and diffuse it are not ornamental butterflies but central ideological agents*. For the social historian of popular science in a nineteenth-century liberal parliamentary democracy, the heuristic attractiveness of Gramsci’s approach is obvious yet strangely unexploited.²⁶

A crucial issue was the problem of *intellectuals* who, in Gramsci’s view, conceptualized the direct reproduction of an effective hegemony. In the rural, pre-industrial and feudal world of the Ancien Regime, *traditional* intellectuals such as clergymen would have monopolized the construction of a specific hegemony, but in spite of their continuing influence, in the capitalist industrial world, other kinds of intellectuals became progressively more influential: new professionals, judges, experts, teachers, civil servants, and scientists. Thus, *organic* intellectuals emerge from these groups. In Gramsci’s words:

Every social group, coming into existence on the original terrain of an essential function in the world of economic production, creates together with itself, *organically*, one or more strata of *intellectuals*, which give it homogeneity and an awareness of its function, not only in the economic but also in the social and political fields.²⁷

For Gramsci, the only hope of real social change was the progressive emergence of new intellectuals from the most modest social classes, who would be capable of slowly subverting the élites’ hegemony. These new intellectuals had to create a new culture that, in theory, could challenge the power of a modern capitalist state like Italy in the early decades of the twentieth century. In his utopian view, any person was a potential intellectual who could fight against passive consent and acceptance of a specific cultural hegemony. As a result of this process, the more people engaged in mental tasks of organization, deliberation and leadership, the higher the level of democratization in a specific group or society as a whole.²⁸

Although intellectuals were traditionally associated with certain rhetoric of independence and freedom of thought, they continued to contribute, in a more or less conscious way, to the construction of a specific hegemony, serving specific élites.²⁹ The meaning of the word might vary substantially in different cultural contexts, but it is worth noting that, in 1928, the French writer Julien Brenda (1867–1956) defined intellectuals as a tiny band of super-gifted and morally endowed philosopher-kings who were supposed to constitute the conscience of mankind. In his idealistic approach, intellectuals had to denounce corruption and oppressive authority and be in permanent opposition to the status quo. However, in Brenda's view, they used to sell themselves too often to political and economic interests. Influenced by the Dreyfus Affair and later by the tragic events of the First and Second World Wars, Brenda systematically criticized any collaboration between intellectuals and Nazism and Communism.³⁰ In opposition to this approach, Gramsci preferred a more pragmatic definition of intellectual. His *organic intellectuals* were connected to the interests of specific groups, which aimed to obtain acceptance and consent from larger sections of society. They were constantly struggling, therefore, to change minds.

In 1981, and following his Gramscian influence, Edward Said denounced the lack of autonomy of intellectuals from universities, political parties, think tanks, and private firms. He pointed out the never ending tensions between free discussion and freedom of thought and opinion and the constant worries about pleasing an audience or an employer. Said identified some dangers of professionalism, which can be also easily applied to professional scientists, and, why not, to professional historians of science: (1) specialization; (2) expertise certified by the proper authority; (3) political correctness; (4) submission to power and authorities; and (5) centralized powers and decisions. Said described critically the role of academic intellectuals with the following words:

Today's intellectual is ... a ... professor, with a secure income, and not interested in dealing with the world outside the classroom.... All that we have now ... is a missing generation which has been replaced by buttoned-up, impossible to understand classroom technician, hired by committee, anxious to please various patrons and agencies, bristling with academic credentials and a social authority that does not promote debate but establishes reputations and intimidates non-experts.³¹

This critical statement seems to be far from the public image of, for instance, Albert Einstein (1879–1955): a twentieth-century luminary beyond the laboratory walls, discussing topical issues such as Nazi power, the 'Jewish problem', and the use of nuclear power in war and peace.³² It also seems far from the great achievements of Linus Pauling (1901–94), which included two Nobel Prizes — Chemistry and Peace — and a deep commitment to pacifism. Beyond these great luminaries, who struggled for freedom of thought from privileged positions, the broader situation can seem bleak. If we take, for instance, chemistry, the profession as a whole is often linked to a public image of pollution, environmental problems and artificiality. It is seen as an agent of the destruction of nature, with subaltern alliances to big corporations

that often prioritize economic profits over human welfare.³³

In the constant tension between hegemony and consent, elite and subaltern, popular and high culture, between experts and lay people, intellectuals emerge as epistemologically and ideologically active figures, whose detailed analysis can benefit several fields of research. In this context, political ideology is significant in debates about scientific authority, and controversies in the classroom, the laboratory, industry and the public sphere. It becomes embedded within everyday communication practices among experts and society as a whole. It tinges any process of knowledge in transit — teaching, popularization, cultural transfer — which obviously cannot be taken as ideologically free. Moreover, by extrapolation, it influences the way in which historians of science, as a community of experts, struggle for authority, power and social recognition. There is no doubt that concepts such as *hegemony* and *intellectual* constantly raise questions and stimulate debates, as the following sections in this article will try to demonstrate.

SCIENCE, TECHNOLOGY, AND THE *UNITARY* SCHOOL

At the beginning of the twentieth century, Italy suffered a very high illiteracy rate and a dramatic lack of economic support for education. This fact clashed with Gramsci's dream of converting each member of the working class into an autonomous intellectual, able to think critically. In spite of these enormous difficulties, he sketched some guidelines for the country's short- and long-term educational policies. Since the school played a crucial role in reproducing hegemonic values of industrial capitalism, in his view, important changes in its goals and organization were needed. Although Gramsci's educational programme has been discussed extensively from different angles, it is worth noting his idea of breaking the cultural hegemony of the élites in the school system by approaching students as epistemologically active agents. Gramsci was in favour of an active pedagogy that stimulated creativity and the wish to learn from below, instead of a vertical, cumulative transmission of descriptive, encyclopaedic knowledge. He emphasized critical self-awareness, and critical social awareness, as well as the role of teachers as intellectuals, transforming education, against a fixed status quo.³⁴ Borrowing some values from the liberal education tradition, Gramsci's model of *unitary* school involved providing a comprehensive training on humanities, and rejected specialization.

In the context of the second industrial revolution and the science-based industry of the early decades of the twentieth century, Gramsci's programme probably sounds too utopian, but it questioned specialization and discipline formation, and placed the concept of cultural hegemony at the core of the educational debate. For Gramsci, if the educational system of a country surrenders docilely to industrial demands, to the utilitarian rhetoric of immediate applicability, then we risk transforming our young students' greatest potential into grey automata, handmaiden of private interests. To avoid this, future professional training had to be open to the talent of each individual and not be limited to mechanically serving the interests of the market.

In the *Prison notebooks*, Gramsci was even critical of the University Extension movement, which spread across Europe in the early twentieth century. He was also reluctant to accept the teaching programmes of numerous working class groups and athenaea, which he considered too paternalistic in their socialist inspiration. The working class had to become intellectually autonomous, and the *learner* became the main subject of interest, as a new epistemologically active actor in the teaching process. Education had to contribute to self-knowledge and self-mastery, instead of accepting passively the main contents and values of the hegemonic élites.

In order to achieve independence from the élites' interests, a new public education system was required, since the perpetuation of the private school system represented the perpetuation of intellectual and social fragmentation. That is, each private school became a factory producing new *organic intellectuals* in the service of a specific hegemony, supporting obviously the values and interests of those who established it. The new *unitary* school had to reject the mimetic application of educational programmes, which in fact were foreign to the values and cultural interests of the lower classes. Which history, which literature, which mathematics, which natural sciences were to be taught? And with what educational purpose? Who had the last word on designing the curricula? This was, and still is, a crucial battle for hegemony, to which, through the rhetoric of technocracy and political neutrality, the subaltern classes too often consent when faced with the rarely questioned authority of the educational experts.

Although there is no explicit reference to Gramsci in the majority of the historical work on the Mechanics' Institutes (MI) in nineteenth-century Britain, it might be helpful to illustrate to historians of science some useful aspects of the Gramscian programme.³⁵ In spite of the later revisions of their main thesis, Steven Shapin and Barry Barnes's seminal paper of 1977 on the use of science for social control in early nineteenth century in the MI is still valuable.³⁶ Throughout the nineteenth century, the MI aimed to provide scientific education to the British working class through three main strategies: utilitarianism, natural theology, and Baconian empiricism. They attempted to spread a good part of the bourgeois moral values to the lower classes, as well as divert their attention from subversive political readings that denounced the injustice of the social order. In Shapin and Barnes's own words: "the foundation of the MI, like the majority of British educational policies in the beginnings of the nineteenth century, was fundamentally based on the interest in the social control."³⁷ The MI original plan was to convert workers into a more docile, less problematic social group, capable of accepting the values of the emergent industrial society.

A good part of the MI's programme lay behind the idea that scientific education of the lower classes had to revert eventually to their moral education. Alcoholism, promiscuity and the uncontrolled exaltation of passions could be 'disciplined' through the habits that scientific knowledge would impose. Therefore scientific education reinforced the kind of social control already exerted by religion — the natural theology tradition, and the *Bridgewater treatises* being a good example.³⁸ In addition, since deep, abstract, rational, comprehensive knowledge was automatically associated with

the upper classes, the MIs had to deal with superficial, concrete, sensual, fragmented content, in tune with the ‘inferior’ epistemology of their students. Geometry and practical mathematics were preferable to abstract demonstrations; observation and description of concrete facts (minerals, machines, chemical substances, diagrams, etc) were always preferable to algebraic equations, metaphysical principles. As Ann Firth clearly stated, also making reference to the MIs: “scientific education was a means by which labour in society could be normalized and individualized, while simultaneously labour as a commodity could be made more productive.”³⁹

Historians still have doubts about the real efficiency of the MIs in their attempt to shape the working class culture. But, in spite of the controversy, the case of the MIs helps us to become aware of the strategies of the ruling classes to impose moral, political and cultural values through subtle mechanisms of persuasion. Even assuming a detailed historical reconstruction of the material culture of the classroom, a renewed approach to science education should go further than the standard concept of education as a process of acculturation for the sake of reproducing a specific paradigm. Under Gramsci’s influence, Raymond Williams analysed how, during the nineteenth century, politics was systematically excluded from British educational plans. In fact, abstract judgements and moral values had to be preserved for the élites, whereas a technocratic ‘neutral’ science was conceived for the lower classes.⁴⁰

Similarly, in 1978, Morris Berman’s work on the Royal Institution (RI) considered that the success of that scientific institution and its educational programme could be understood only through the analysis of science as a system of moral and social values, as a tool to control tensions and contradictions of an industrial society.⁴¹ Berman’s work provides a critical, less naïve version of the role of science in its spectacular version. Equally, some years later, in 1995, Tony Bennett considered museums in general, but science museums in particular, as spaces for entertaining but also for discipline and control, in which the visitors’ manners and behaviour were carefully standardized and shaped, by analogy to exhibitions, shopping malls, and fairs.⁴² Not by chance, Bennett made extensive use of Gramsci in his work, and was very much concerned about the cultural mechanisms that legitimized museums in the past. He integrated Gramsci’s concept of hegemony to analyse the rhetorical strategies of every display.⁴³

New research on the history of science education has shown how students become an active part in the process of knowledge making. Katherine Olesko has studied in detail how nineteenth-century physics seminars in Germany stimulated a culture of precision and measurement, which resulted from very active interactions between professors and students.⁴⁴ David Kaiser’s work on student participation in the making and dissemination of Feynman’s diagrams is another excellent example of education from the perspective of the *learner*.⁴⁵ Kaiser’s more recent book on pedagogy and the practice of science concludes that scientists and engineers are trained through complex learning processes involving constant feedback between students and teachers. The process is full of tacit rules, values, and hegemonic models of behaviour for the future professionals.⁴⁶ In a similar way, relying on the work of Ludwik Fleck,⁴⁷ Olesko

argues that the training process in scientific education should be carefully analysed according to specific sites and times.⁴⁸ John Rudolph has also recently highlighted the need to overcome the old institutional history of scientific education — too often full of fruitless erudition and quantitative data — to develop a new history that confronts teachers' hidden intentions and values, as well as students' reactions. It approaches the 'material culture of the school': the reconstruction of communication practices in the classroom. Beyond the study of official programmes and standard textbooks, students' notebooks, examination answers and laboratory notebooks are now being used as the new primary sources for a new history of education.⁴⁹

These are only a few seminal examples, but more research is needed to integrate political and ideological factors in the analysis of science education. A further exploration of Gramsci's idea of hegemony in the context of scientific education would probably enrich the analysis of the hidden intentions of teachers and students in communication practices, as well as the connection between those everyday practices and the broad political frameworks on which educational scientific institutions were founded and legitimized in the past. A Gramscian approach to scientific education would help us to better understand how science teaching has contributed to the formation of specific moral values, and played a crucial role in the battle for cultural hegemony by different social groups. It would place teachers and professors as intellectuals, as key individual actors appropriating values and ideas from their own élites and transmitting them through complex filtering processes to the younger generations, the members of which, at the same time, would play an active role in the feedback learning process.

If we turn to technology and technical education, it is worth mentioning that Gramsci was deeply impressed by the new systems of chain production of cars in the North American factory of Henry Ford (1863–1947) — the founding father of the utilitarian car — and by the great international impact of Frederick W. Taylor's *Principles of scientific management* (1911).⁵⁰ Gramsci appropriated Fordism and Taylorism from different perspectives. On the one hand he realized their potential as mechanisms of domination and materialization of the élite hegemony, as well as the serious challenge they presented to the influence of trade unions and craftsman traditions in the production system. On the other hand, their capacity to optimize production attracted his interest, especially in the post-First World War context, in which the lack of labour force and the incorporation of women to the factories became a serious challenge, even in the Soviet Union.⁵¹ Gramsci was deeply concerned by the economic and mechanical reductionism of Fordism, and attempted to introduce political, cultural and ideological factors in the analysis of the production process in the factory.

In relation to technical education, Gramsci assimilated the training of a new active and creative student with the training of a creative worker in the modern factories. The latter had to become new intellectuals to fight against the excessive mechanization of objects but also against the cruel mechanization of knowledge.⁵² This was just a piece of a more general trend, in which intellectuals' minds "had been taylorized

just as the body of the working class has been taylorized in industrial production”.⁵³ Gramsci was for a new relation between the intellectual and the industrial work, and defended a humanistic training as prior to blind applied knowledge as the only way to progressively build a counter hegemony of the working classes.⁵⁴ As it was also extensively developed with a different emphasis in the framework of the Frankfurt School by Herbert Marcuse in his *One dimensional man* (1964), and by Habermas in *Science and technology as ideology* (1968),⁵⁵ the apparently unproblematic division between science and technology was perceived as extremely political. It exempted ‘pure’ science and academic scientists from any responsibility in the transformation of nature and society, which was led by technology, and by its ‘organic’ intellectuals.

Historians of technical education have brought to the fore the distinct and often conflicting contributions of educational institutions, industrial employers, national and local governments, professional bodies, and private patrons. They have made it clear that the history of technical education requires more complex explanations than the demand-pull thesis coming from industry. It must be analysed in the framework of the delicate balance between the supply of educated manpower and the capacity of industry to exploit knowledge and skills.⁵⁶ Within this framework, however, there is still room for a more ambitious political analysis. There is still room for instance for a closer look at the contribution of the basic worker to the overall functioning of the factory from their perspective. Resistance to technological change, old guild attitudes in modern factories, the particular perceptions and values of specific corporations and trade unions, and reinterpretations of luddism are research questions that should be explored further. Martin Bauer’s description of the rationale of historical actors, who resisted technological changes — textile mechanization, steam engines, nuclear power and biotechnology — in different historical periods, is a very useful example.⁵⁷

Gramsci’s reflections on Taylorism and Fordism might also help historians of technology to revisit, in more critical terms, some of the standard accounts of the history of labour organization, in the same way that environmental issues have deeply transformed research priorities in the history of technology in recent years.⁵⁸ As discussed recently by the historian of technology, David Edgerton, when exploring the human capacity to transform matter, common readers too often expect a focus on great inventors — Leonardo, Watt, Stephenson, Edison, Marconi, etc. — and on the creative act of invention as a previous and isolated stage, that only later has a social influence. They tend to forget the role of technological objects in our daily lives, and assume that our role as *users* of technology is irrelevant or inferior in relation to the act of invention.⁵⁹ Mechanical ‘repression’ in the assembly line or in technical schools might resemble the negative externalities that technological ‘progress’ inevitably acquires when charged with environmental damage.⁶⁰ The *unitary* schools pattern, the MIs case study, and Taylorism and Fordism clearly show that both working class training and the education of experts and *engineers* — the hegemonic intellectuals in the factory — must be questioned further. Research needs to move beyond explanations of industrial demand-pull, national educational plans or entrepreneurial philanthropy.

In addition, a Gramscian framework might help to escape from commemorative practices and official histories of scientific institutions — universities, technical schools, primary and secondary schools — which too often tempt historians of science to become organic intellectuals, and trap them in more or less explicit hagiographic and presentist accounts.⁶¹ It might also be useful to step back from industrial commemorations that end up as simplistic biographies of the founding fathers of the firm, combined with paternalistic responses to any manifestation of ‘low culture’ in the factory.

REVISITING ‘POPULAR SCIENCE’

During his prison years, Gramsci appealed for the dignity of workers, for their instruction, and their moral and intellectual elevation, to be a substantial part of urban popular culture in Western societies. In his view, the progressive construction of a counter-hegemonic discourse from below was the only possible strategy to fight inequality and exploitation.⁶² In this context, *folklore* became one of Gramsci’s main interests, implying empirical collection, description and classification of local traditions and popular knowledge. Folklore was an inherited worldview, passively or unconsciously accepted, which often reinforced consent and subordination. Since folklore was meant to hold the *sediment* of earlier forms of domination, only after deep analysis could the supposedly ‘genuine’ epistemology of the lower classes be efficiently linked to their education. The crucial point was to establish a connection with some elements of popular culture, in order to progressively overcome it. Folklore did not have to be totally erased nor fully preserved. Some aspects of folklore had to be taken as raw materials for the emergence of a new popular culture, which, in Gramsci’s view, would hopefully link intellectuals to the common people.⁶³

Some decades ago, cultural historians such as Roger Chartier and Robert Darnton criticized the existence of an autonomous ‘popular’ culture. For Chartier, the presumed essence of ‘the popular’ was not in a set of finished texts that only require identification and cataloguing, like a species in the library of the popular culture. In his view, the term ‘popular’ refers to a specific type of relation; a form of actively appropriating knowledge and culture in general; an original way to use cultural products, to legitimate ideas or attitudes. Thus, the popular is not a genuine culture created from above by the people below, neither it as is a genuine culture rooted in the people themselves. It is simply about a determinate relation with specific cultural objects. In Chartier’s own words: “The ‘popular’ cannot be found ready made in a set of texts that merely require to be identified and listed; above all, the popular qualifies a kind of relation, a way of using cultural products such as ideas and attitudes.... What is ‘popular’ is neither culture created for the people nor culture uprooted; it is a kind of specific relation with cultural objects.”⁶⁴

In this framework, historians of science have recently questioned the idea of popular science, as a historiographical category, to defend the existence of dynamic communication processes — ‘knowledge in transit’ — which undergo continuous feedback. Mainly focused on the nineteenth century, and in particular on Victorian

Britain, James Secord, Jon Topham and Bernard Lightman, among others, have distanced themselves from the 'popular' as a genuine way of knowing, and shifted the emphasis to the circulation and transit of scientific knowledge often acting as a commodity in a marketplace. Without referring to Gramsci, they feel more comfortable when the term 'popular' reproduces in its own terms the actors' category, that is to say, the way in which, in the past, books, articles, and public lectures were labelled by the élites to draw the audiences' attention.⁶⁵

In spite of these new trends in the history of scientific communication, there is still a lot to do to recover as many primary sources as possible that speak for those without a voice and put a greater emphasis on the audience rather than the élite's hegemonic strategies. We can accept the transit of knowledge among different social strata, but emphasizing Gramsci's request to give a voice to subaltern actors: students, visitors, artisans, amateurs, users, etc., to the 'little men' [and women] of science, as Sam Lilley, one of the privileged witnesses of the transition between Old and New Left, used to say.⁶⁶

Clifford D. Conner's *People's history of science* (2005) shows, for instance, his determination to give a voice to the unknown actors of the history of science. Inspired by *Science for the people* — a successful periodical of the 1970s and 1980s — Conner borrowed ideas from Marxist historians of science such as Hessen, Zilsel, Bernal and Needham, but also from other relevant historians of science such as William Eamon, Steven Shapin, Adrian Desmond, Stephen Pumfrey, and Roy Porter. He looked at the active role of craftsmen, illiterates, miners, naturalists, mechanics, tradesmen, peasants, farmers, sailors, instrument-makers, phrenologists, apothecaries, and alchemists.⁶⁷ Following Conner's pattern, it is perhaps time to begin to sketch something similar to the *Dictionary of Labour biography*, as a new source for a new 'popular' history of science.⁶⁸

Gramsci's reflections on folklore should stimulate new approaches to 'popular science' as a *historiographical* category. It has often been argued that the lack of appropriated primary sources poses serious problems for historians of science trying to reconstruct the epistemologies of craftsmen, peasants, and industrial workers. But, in their role as intellectuals, historians of science should be keen to find new sources, unless they tacitly accept being trapped in the hegemonic discourse of the élites of a specific historical period. To this end, sources such as personal diaries, private correspondence, visitors' reports, popular pamphlets and oral interviews should be further explored over more traditional 'expert' accounts. And, even among expert sources, those that are more informative on folklore and popular science can be particularly useful.

Take, for instance, the case of an obscure figure in mainstream historiography: Cels Gomis (1841–1915) was a civil engineer who worked on the Catalan rail network in early twentieth-century Spain. Ideologically close to anarchism, he soon focused his interests on lower-class culture, in particular its images of nature and details of its scientific skills. In his free time he interviewed thousands of villagers as part of his folklorist agenda to recover the popular culture.⁶⁹ He also gathered an enormous

amount of data on astronomy, meteorology and botany.⁷⁰ According to Gomis, popular science was conceived as an ancient religion of nature — in agreement with Comte's Law of Three Stages — which had to be overcome to reach modern positive rationality and avoid the control and influence of the Catholic Church. One of Gomis's most popular books was *La lluna segons lo poble* (1884) (*The Moon according to the people*), which collected popular proverbs on our satellite and its influence on the weather, health, etc. Accepting contemporary scientific discourses that denied any influence of the Moon on terrestrial events, Gomis stated that:

We should recover all popular concerns, not to perpetuate them, as some believe, but to destroy them, only keeping some written records to allow people in the future to assess its state of progress as well as the backwardness of its ancestors....⁷¹

He applied the same methodology in *Lo llamp y'ls temporals* (1884) (*Lightning and thunderstorms*) and *Meteorologia y agricultura populars* (1888) (*Meteorology and popular agriculture*) to preserve popular knowledge on meteorology and agriculture as well as hygiene and medicine. In Gomis's view, local data were shaped by particular traditions and local contingencies, as in the eighteenth-century tradition of medical topographies where weather conditions varied in every locality and details had to be carefully scrutinized before the establishment of any general diagnosis. Meteorological data easily linked expert knowledge with popular epistemology on the weather and the mysteries of the atmosphere. Popular traditions and superstitions had to be annotated and classified, to be later overcome. He believed that only the Catholic Church and the upper classes of society were interested in keeping the old traditions alive as a kind of ancient religion of nature.⁷²

These kinds of sources can be very informative and useful for the progressive emergence of a new historiography of popular science. In Cooter's view — as stated in a paper written with Stephen Pumfrey in 1994 — popular scientific knowledge holds its own perception of nature, which might oppose at least partially that of the élite. In addition, and in spite of all the communication efforts, lay scientific knowledge does not necessarily coincide with the élite corpus. Its aims and motives might differ as well.⁷³ It can only be properly understood in specific sites and defined local contexts. In their own words:

The impact of science's popularization upon both men and women remains to be measured, whether commercially or ideologically, whether as education or as entertainment.⁷⁴

Therefore, far from deleting 'popular science' as a historical category, there is still room for revisiting its use under a Gramscian framework.⁷⁵ Accepting part of its autonomy and inevitable divergence from the cultural programmes of the élite, 'popular science' could become a renewed historiographical standpoint. A deeper analysis of the mechanisms of Gramscian hegemony always requires our capacity as historians to rescue the actors' consciousness, in particular that of the supposedly ignorant lay people, as well as their mechanisms of consent.⁷⁶ As some recent

works have clearly shown, there is still a lot to do to reconstruct lay perceptions of science among readers, visitors, spectators, students, patients, etc., and their active epistemological status as the main targets of public health policies, medical research, environmental issues and risk assessment in our contemporary societies.⁷⁷ In post-modern terms, the old regime of knowledge based on academic research and cognitive priorities has now shifted to a new regime with no clear boundaries between pure and applied research, and the increasing participation of lay people.⁷⁸ A Gramscian framework of analysis might help historians of science to analyse the political load of lay participation, to answer questions such as: How do lay perceptions of science and lay participation gain authority in the public arena? Who wins the battle for hegemony in every historical context, how and why?

PLURAL CULTURES AND PLURAL HISTORIOGRAPHIES

In 1978, Edward Said published *Orientalism*, a widely read and translated book. From his privileged position — Said was born in Palestine, but enjoyed a prestigious position in the U.S. academic system — he developed a renewed criticism of the subtle mechanisms of Western colonial and imperial enterprise. Under the heading of ‘Orient’, Said included his own land, Palestine, but the concept could be extended to a much broader framework: the Arab nations, India, China or Japan. Using detailed case studies, Said convincingly showed how, in the context of Western hegemony, the Orient progressively became a purposeful intellectual construction of the West, and also helped to construct the West itself. He explains how the Orient was legitimized through numerous accounts on its supposed superiority in relation to the ‘other’, the distant, the exotic, the irrational, the unknown, in other words, the subordinate. Since the geographical expansion of the Renaissance, Western intellectuals, writers and politicians of all signs had constructed this hegemonic image. *Orientalism* implied, in Said’s view, a set of beliefs and practices expressing the academic legitimization of Western superiority in relation to the East, through merchants, soldiers, missionaries, erudite persons and *scientists*.

After the end of the Second World War, in the decolonization process, that kind of cultural imposition from the West seemed, in theory, untenable. In spite of this, Said regretted that even the scholars most sensitive towards non-Western cultures were still prisoners of that kind of hegemony when focusing their research questions. Far from the rhetoric of neutrality, which he complained was too frequent among his fellow scholars in the academic system, he assumed that they could not escape from a political position, which always places them at a superior level in relation to the East. Said explained how social asymmetries of power and knowledge in a specific society could be extrapolated to other geographical and cultural asymmetries, and he described in detail the culture and the geography of that subaltern knowledge. He discussed how civil society as well as political society must have played an important role in this subtle combination of strategies of domination.⁷⁹ Not by chance, Said made extensive use of Gramsci as one of the main sources of inspiration for his *Orientalism*. In his own words:

To believe that politics in the form of imperialism bears upon the production of literature, scholarship, social theory, and history writing is by no means equivalent to saying that culture is therefore a demeaned or denigrated thing. Quite the contrary: my whole point is to say that we can better understand the persistence and the durability of saturating hegemonic systems like culture when we realize that their internal constraints upon writers and thinkers were productive, not unilaterally inhibiting.⁸⁰

The approaches of Said and Gramsci have provided historians of science with new perspectives, but more research is still required. They have further explored the role of science in the mechanisms of construction of Western hegemony in cultural terms, such as ‘soft power’, further violence, coercion or military force.⁸¹ They have given a voice to previously ignored participants, to pre-colonial science, to still unexploited sources: from indigenous literature to oral interviews.⁸² They have tried to decode worldviews and values of the ‘other’ and attempted to overcome Eurocentrism.⁸³ They have analysed movements of popular resistance to foreign scientific imperialism, and emphasized plurality and contingency instead of prioritizing Western-totalizing schemes.⁸⁴ Judith Carney has shown, for instance, how technological transfer can be analysed from the perspective of the colonized, and how new techniques adopted by the colonizers were deeply rooted in the indigenous cultures existing before European expansion. Her main point is that the slaves themselves brought their technology from Africa to America, to be later appropriated by plantation owners. This is an important contribution to the writing of a counter-hegemonic history of technology in the U.S.⁸⁵

Inspired by a similar framework, other approaches attempt to counter balance and resist Western academic hegemony. This was for instance the case of Ranajit Guha and the ‘Subaltern Studies’ group, which has been also strongly influenced by Gramsci’s works.⁸⁶ In this context, the past is conceived as a “contested and colonized terrain”, in which “indigenous histories have been expropriated, eclipsed, sometimes even wholly eradicated, in the service of imperialist aims...”.⁸⁷ Guha was a member of the Communist Party of India until 1956, the year of the Soviet invasion of Hungary, which marked a starting point for polycentrism in the West. After his academic training in Britain and his work on the history of Indian peasant revolts, he founded a new research group, which strongly opposed the tacit assumptions of Western scholarship and criticized the nationalistic tradition of Indian historiography. Guha was also interested in the role of Western science, in particular metropolitan hygiene and public health campaigns, as powerful tools for the legitimization of imperialist discourse in colonies, but also tried to understand why the indigenous population refused to clean themselves and wash their clothes as a strategy of resistance.⁸⁸ Since 1982, the series *Subaltern studies: Writings on South Asian history and society* has been regularly published in India. The recovery of unknown actors and voices from below, and a genuine indigenous historiography is one of the major aims of that school.⁸⁹ What traces have been left by scientific colonial education in postcolonial societies? How did Western science change existing knowledge systems? What are the emergent forms of postcolonial science after the departure of the colonizers?⁹⁰

Other Indian historians have, however, gone a step further. Vinay Lal, who has conquered the core of the hegemonic Western academy with a professorship at the UCLA, considers, in his excellent book on politics and scholarship in modern India, that Guha was never able to overcome a tacit subalternity in his account of the history of India. In spite of his efforts, Guha could not rid his work of concepts such as incompleteness, failure and tardiness. In Lal's words:

... one wonders what reception, if any, subaltern history would have received in the West had it not so obviously been the carrier of theoretical trajectories that were simultaneously finding a resonance in the Western Academy ... the work of many fine Indian historians ... whose work is less indebted to streams of poststructuralist thinking or postcolonial theory, remains relatively little known outside the Indian academy....⁹¹

The same concerns can be extended to other contexts. Using examples from his own career, in an excellent exercise of reflexivity, Shigeru Nakayama criticized some years ago the marginalization of historians of East Asian Science, and the peripheral position of this community of scholars in the mainstream Western historiography. Nakayama entitles this problem, "Professionalization and relegation to the periphery", later explaining that, "after World War II the history of science rapidly became a professional academic field, particularly in the United States ... without a strong foundation in East Asian languages ... leaving it mainly to East Asian specialists, in fear of stepping outside their own familiar field of expertise".⁹² Nakayama argues convincingly that "objective and value-free scholarship is no more possible in the history of science than in any other field".

In a similar vein, Latin American history of science surely deserves more attention. Also influenced by postcolonial studies, it has addressed important questions such as race, gender, and power in recent years. The economic and political subalternity of the continent, in comparison with Western societies, and particularly the U.S., has probably contributed to a certain marginalization of these works by the international community. However, if analysed from a Gramscian perspective, Latin American history of science could easily be integrated into the mainstream historiography of the discipline. Today, a new generation of Latin American historians of science struggles for a genuine approach to their local contexts, and continues to contrast their results with the Anglophone community. Jorge Cañizares-Esguerra has profusely demonstrated the difficulties of Anglo-American scholars to include the Renaissance empires of Spain and Portugal in their historical accounts of the emergence of modern science, whereas Antonio Barrera-Osorio has emphasized the contribution of Spanish imperial data collection from the New World to the Western Scientific Revolution.⁹³ *Saberes locales* — a book edited recently by Frida Gorbach and Carlos López Beltrán in México — is another good example; it attempts to approach history of science in Latin America from the complex historiographical interplay between North and South, while resisting a passive reception of mainstream scholarship.⁹⁴

Even in Western contexts, groups such as "Science and Technology in the European

Periphery” (STEP) have in recent years called for a new ‘internationalization’ of the historiography of science and for a more generous linguistic pluralism.⁹⁵ Of course, peripheries and centres have dynamic relationships that involve more than simply their geographical or cultural contexts. In this context, a recent paper published by some founding STEP members stated that:

European periphery is also a *historiographical standpoint*. Starting from the periphery (or, better, *standing* on the periphery) might offer a clearer view over the intricate ideological constructs, which accompany the establishment of science and technology, and at the same time, unveil their socio-political dimensions. It is often the case that what appears as a coherent whole of ideas or well articulated practices when it is seen from the point of view of the centre, is entirely disassembled when it reaches the European periphery and becomes an issue of intense philosophical and political debate.⁹⁶

In a similar vein, *Beyond borders*, edited by a group of young STEP members, calls for methodological pluralism. The chief editors, Josep Simón and Néstor Herrán, describe how “the overnationalisation of history of science, while securing a prominent position for American and British culture in history of science, has also contributed to the *obscuration* of the international character of many historical events”.⁹⁷ Through several case studies on topics such as science teaching, science popularization, science and the nation, and the geography of scientific centres and peripheries, a broad range of approaches can be presented with an international perspective, which crosses geographical, linguistic, and methodological boundaries.

CONCLUSION

Returning to the core set of questions established at the beginning of this paper, in particular the problem of *historians of science as intellectuals*, it is worth noting that the same communication practices that have been considered above are not very different from the everyday practices of historians of science as academic experts. They are involved in complex expository processes in which teaching, popularizing, and transferring knowledge are intrinsically linked to the profession.⁹⁸ They play a role in the public arena, for the sake of their scientific authority, academic hegemony and social recognition. The Gramscian framework that has been presented throughout this article might help us to rethink the aims and motives of professional historians of science, and the ethical status of experts and professionals as potential intellectuals at large in our contemporary societies.

As Said rightly emphasized in his impressive introduction to *Orientalism*, a good part of the work of a historian can be explained through his or her own personal biography. At this stage of the paper, I hope the reader will allow me some final words of reflexivity, as a useful tool to analyse my own political ideology and research priorities. Perhaps we should consider more seriously the possibility that the biographical profiles of historians of science might influence their research priorities.

I was born into a working class family from a peripheral neighbourhood of the city

of Barcelona (Spain) in Southern Europe. Thanks to my family's efforts, I was able to go to university and obtain a B.A in chemical engineering, which was followed by some research training in Germany and a job in the German chemical industry. In my twenties, professional chemistry did not seem to be my ideal future, and I moved to a more marginal area, and shifted to the history of science. I undertook a Ph.D. on the use of chemistry in Barcelona in the early nineteenth century, and worked on obscure and marginal actors that were totally unknown in mainstream historiography. Later, in my postdoctoral years in Oxford, I approached other subaltern actors: the skilled artisans who devoted their lives to the art of colouring textiles in the eighteenth and nineteenth centuries.⁹⁹ Once I had settled back home as a professional historian of science, I moved to the problem of science and technology in the European periphery and collaborated with the international group STEP.¹⁰⁰ I am now devoted to the history of the popularization of science in Spain in the nineteenth and twentieth centuries, and I struggle to find new local primary sources which might allow me to reconstruct the epistemology of other 'obscure' local visitors, readers, patients, craftsmen, and amateurs.¹⁰¹ Reading the *Quaderni*, and in spite of my subaltern academic position, the writing of the history of subaltern, peripheral or marginalized science practitioners suddenly seemed dignified.

In 2006, while reading Jack Morrell's review of Roger Cooter's work on phrenology,¹⁰² I came across the potential interest of Gramsci's thoughts. However, I had never heard about Gramsci during my years of training as historian of science. It is also regrettable to note that, in 2007, only a few celebrations took place worldwide for the seventieth anniversary of his death.¹⁰³

The 2006 Conference at Princeton, "Science in the Crossroad: Geopolitics, Marxism and 75 years of Science Studies", marking the seventy-fifth anniversary of the 1931 History of Science Congress, brings us back, however, to revisit some aspects of the old historiography. But this is not just a question of an archaeological reconstruction that goes against the historical amnesia of our present societies. As Werskey recently suggested, those old ideas, especially the radical science tradition, which in my view should include Gramsci's thoughts, can be used today as a source of new inspiration.¹⁰⁴

Gramsci's flexibility and, to some extent, the loose and non-systematic presentation of his arguments, especially in the prison notes, have been criticized by different sources. The Marxist historian Perry Anderson, one of the founders of the *New Left review* stated: "In any event, Gramsci never properly theorized the site of specific mechanisms of bourgeois hegemony, and failed to ground a proper revolutionary strategy as a result."¹⁰⁵ This statement was written in 1976, and clearly reflected the uneasiness among committed Marxists about Gramsci's lack of concrete political strategy. Nevertheless, in 1999, already in the heart of our postmodern era, Eric Hobsbawm stated that: "One of the reasons why historians ... have found [Gramsci] so rewarding is precisely his refusal to leave the terrain of concrete historical, social and cultural realities for abstraction and reductionist theoretical models. It is therefore likely that Gramsci will continue to be read..."¹⁰⁶ In fact, his capacity of adaptation,

his refusal of dogmatic and rigid Marxist tools of analysis, and his emphasis on contingencies and particularities have probably contributed to Gramsci's survival in our post-Marxist age.¹⁰⁷

Gramscians such as Young, Berman, Cooter, Morrell and Bennett, are good examples of the main thesis of this paper. However, I hope to have shown some evidence of the continuity of Gramscian thoughts up to the present, and also to have convinced at least some of my readers that important aspects of the 'old' historiography of science might still be useful to future generations. They shed some light on the meaning of our profession, on our role as intellectuals, and on our capacity to resist and counter-balance the well-established patterns of political, economic and academic hegemony.

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REFERENCES

1. Steve Fuller, *Thomas S. Kuhn: A philosophical history of our times* (Chicago, 2001).
2. Fuller, *Thomas S. Kuhn* (ref. 1), 11.
3. Stanley Aronowitz, *Science as power: Discourse and ideology in modern society* (Minneapolis, 1988).
4. Steven Shapin, "Discipline and bounding: The history and sociology of science as seen through the externalism–internalism debate", *History of science*, xxx (1992), 333–69.
5. Dominique Pestre, *Science, argent et politique: Essai d'intersection* (Paris, 2003).
6. Sheila Jasanoff, *States of knowledge: The coproduction of science and social order* (London, 2004), 14. See also Bernadette Bensaude-Vincent, *Les vertiges de la technoscience* (Paris, 2009).
7. Wiebe E. Bijker, "The need for public intellectuals: A space for STS", *Science, technology and human values*, xxviii (2003), 443–50, p. 444 (my emphasis).
8. Gary Werskey, "The Marxist critique of capitalist science: A history in three movements?", *Science as culture*, xvi (2007), 397–461, p. 442, 446.
9. Werskey's critique of the STS movement, as a whole, has been questioned by some historians of science. See, for instance, Christopher Hamlin, "STS: Where the Marxist critique of capitalist science goes to die?", *Science as culture*, xvi (2007), 467–74.
10. Werskey, "The Marxist critique" (ref. 8), 446.
11. Under the leadership of Nicolai Bukharin, one of the more assertive members of the Central Committee of the Bolshevik Party, who was later executed in 1938 during Stalin's purges, it

- included, among other talks, the even more famous paper by Boris Hessen, himself a victim of the purges in 1936, on “The social and economic roots of Newton’s *Principia*”. The best reference for Hessen’s paper is Gideon Freudenthal and Peter McLaughlin (eds), *The social and economic roots of the Scientific Revolution* (Dordrecht, 2009), with an extensive introduction and biographies of Boris Hessen and Henryk Grossmann. See also: Loren Graham, “The socio-political roots to Boris Hessen: Soviet Marxism and the history of science”, *Social studies of science*, xv (1985), 705–22. For a revisited approach to Hessen’s paper, see: Boris Hessen, *Les racines sociales et économiques des Principia de Newton: Un rencontre entre Newton et Marx à Londres en 1931*, transl. with commentary by Serge Guérout, postscript by Christopher Chilvers (Paris, 2006). For the influence of Marxism on the History of Science and Science Studies, see: Anna K. Mayer “Setting up a discipline, II: British history of science and ‘the end of ideology’, 1931–1948”, *Studies in history and philosophy of science*, xxxv (2004), 41–72; Helena Sheehan, *Marxism and the philosophy of science: A critical history* (Atlantic Highlands, 1985); Helena Sheehan, “Marxism and science studies: A sweep through the decades”, *International studies in the philosophy of science*, xxi (2007), 197–210; and Harold Dorn, “Science, Marx and history: Are there still research frontiers?”, *Perspectives on science*, viii (2000), 223–54.
12. Gary Werskey, *The visible college: The collective biography of British scientific socialists of the 1930s* (London, 1978). Cited by Dorn, “Science, Marx and history” (ref. 11), 237.
 13. Mayer, “Setting up a discipline” (ref. 11), 41.
 14. Jerome R. Ravetz and Richard Westfall, “Marxism and the history of science”, *Isis*, lxxii (1981), 393–405. See also: Jerome R. Ravetz, *Scientific knowledge and its social problems* (New Jersey, 1996 [1971]).
 15. Werskey refers here to authors such as: Joseph Ben-David, Derek Price, Warren Hagstrom, but also to Thomas S. Kuhn. Werskey “The Marxist critique” (ref. 8), 426.
 16. Robert M. Young, “Discussion paper. Evolutionary biology and ideology: Then and now”, *Science studies*, i (1971), 177–206; Mikuláš Teich and Robert M. Young (eds), *Changing perspectives in the history of science* (London, 1973). For details on Robert M. Young’s c.v., see the webpage: <http://www.human-nature.com/rmyoung/>. See also: Helena Sheehan, *Marxism and the philosophy of science* (ref. 11), and Helena Sheehan, “Marxism and science studies (ref. 11). For the New Left, see: Raymond Williams, *Marxism and literature* (Oxford, 1977). The movement founded its own journal: *The New Left review*, which is still being published today. See: <http://newleftreview.org>.
 17. Robert M. Young, “Marxism and the history of science”, in R. C. Olby, G. N. Cantor, J. R. R. Christie and M. J. S. Hodge (eds), *Companion to the history of modern science* (London, 1990), 77–86, p. 85.
 18. See for instance: Jan Golinski, *Making natural knowledge: Constructivism and the history of science* (Cambridge, 1998); Dominique Pestre, “Pour une histoire sociale et culturelle des sciences: Nouvelles définitions, nouveaux objets, nouvelles pratiques”, *Annales histoire, sciences sociales*, May–June 1995, 487–522.
 19. For details on Gramsci’s biographical profile, see references on the International Gramsci Society webpage: <http://www.internationalgramscisociety.org/>.
 20. David Forgacs (ed.), *The Antonio Gramsci reader: Selected writings 1916–1935* (New York, 2000). For a general overview of published primary sources see: Kate Crehan, *Gramsci, cultura y antropología* (Barcelona, 2002). See also: Quintin Hoare and Geoffrey N. Smith (eds), *Selections from the prison notebooks* (London, 1971); Chantal Mouffe (ed.), *Gramsci and Marxist theory* (London, 1979).
 21. For a genealogy of the concept, see Ernesto Laclau and Chantal Mouffe, *Hegemony and socialist strategy: Towards a radical democratic politics* (London, 1985), chap. 1.
 22. Thomas H. Broman, “Introduction: Some preliminary considerations on science and civil society”, *Osiris*, 2nd ser., xvii (2002), 1–21.

23. Forgacs, *The Antonio Gramsci reader* (ref. 20).
24. Renate Holub, *Antonio Gramsci: Beyond Marxism and postmodernism* (London, 1992), 6.
25. Young published a paper on Gall: Robert M. Young, "The functions of the brain: Gall to Ferrier (1808–1886)", *Isis*, lix (1968), 251–68, and he is the author of Gall's biography in the *DSB*.
26. Jack Morrell, "Brains of Britain", *Social studies of science*, xvi (1986), 735–45, p. 736–7 (my emphasis). See also: Roger Cooter, *The cultural meaning of popular science: Phrenology and the organization of consent in 19th century Britain* (Cambridge, 1984).
27. Quoted in: Forgacs, *The Antonio Gramsci reader* (ref. 20), 301.
28. Forgacs, *The Antonio Gramsci reader* (ref. 20).
29. For STS references on intellectuals see: William M. Epstein, "The obligation of intellectuals", *Science, technology and human values*, xv (1990), 244–7; Bijker, "The need for public intellectuals" (ref. 7); Sharon McKenzie Stevens, "Speaking out: Toward an institutional agenda for refashioning STS scholars as public intellectuals", *Science, technology and human values*, xxxiii (2008), 730–53.
30. Edward W. Said, *Representations of the intellectual* (New York, 1996).
31. *Ibid.*, 70–1.
32. Fred Jerome systematically analyses Einstein's anti-racism. Fred Jerome, "Einstein, race, and the myth of the cultural icon", *Isis*, xcvi (2004), 627–39.
33. In 1983, Seymour Mauskopf pointed out that: "Chemistry did not participate directly in the great and dramatic transformative scientific revolutions of the beginning of the twentieth century, associated with such celebrated names as Einstein, Bohr and Freud. And in contrast to physics, biology, and the behavioural sciences, chemistry has not seemed to have much import from the great philosophical or existential issues of our time. Hence it has not been integrated in cultural history the way these other sciences were." Seymour H. Mauskopf (ed.), *Chemical sciences in the modern world* (Philadelphia, 1993), p. xii.
34. David Harris, *From class struggle to the politics of pleasure: The effects of Gramscianism on cultural studies* (London, 1992); Henry A. Giroux and Roger Simon (eds.), *Popular culture, schooling, & everyday life* (Granby, 1989). See also: Forgacs, *The Antonio Gramsci reader* (ref. 20), chaps. 2 and 10.
35. Steven Shapin and Barry Barnes, "Science, nature and control: Interpreting Mechanics Institutes", *Social studies of science*, vii (1977), 31–74.
36. On the Mechanics' Institutes see: Ian Inkster, "Science and the Mechanics' Institutes, 1800–1850", *Annals of science*, xxxii (1975), 451–74; Ian Inkster, "The social context of an educational movement: A revisionist approach to the English Mechanics' Institutes, 1820–1850", *Oxford review of education*, ii (1976), 277–307; A. D. Garner, "The English Mechanics' Institutes", *History of education*, xiii (1984), 139–52, and xiv (1985), 255–262; Ann Firth, "Culture and wealth creation: The Mechanics' Institutes and the emergence of political economy in early 19th century Britain", *History of intellectual culture* v (2005), 1–14. See also: Jonathan Topham, "Science and popular education in the 1930s: The role of Bridgewater Treatises", *The British journal for the history of science*, xxv (1992), 397–430; Frank M. Turner, *Between science and religion: The reaction to scientific naturalism in late Victorian Britain* (New Haven, 1974); Frank M. Turner, "Public science in Britain, 1880–1919", *Isis*, lxxi (1980), 589–608; Adrian Desmond, "Artisan resistance and evolution in Britain, 1819–1848", *Osiris*, 2nd ser., iii (1987), 77–110.
37. Shapin and Barnes, "Science, nature and control" (ref. 35), 32.
38. Topham, "Science and popular education" (ref. 36).
39. Firth, "Culture and wealth creation" (ref. 36), 13.
40. In 1969, Raymond Williams had already warned about the rhetoric of political neutrality in the educational plans of the Mechanics Institutes. In his own words: "Politics in the wide sense of discussing the quality and direction of their living, was excluded from these Institutes, as it was

- to remain largely excluded from the whole of nineteenth-century education”, Raymond Williams, *The long revolution* (London, 1961), 143.
41. Morris Berman, *Social change and scientific organisation: The Royal Institution, 1799–1844* (London, 1978).
 42. Tony Bennett, *The birth of the museum: History, theory, politics* (London, 1995), 5–6.
 43. *Ibid.*, 9.
 44. Katherine M. Olesko, *Physics as a calling: Discipline and practice in the Königsberg seminar for physics* (Cornell, 1991).
 45. David Kaiser, *Drawing theories apart: The dispersion of Feynman diagrams in postwar physics* (Chicago and London, 2005).
 46. David Kaiser (ed.), *Pedagogy and the practice of science: Historical and contemporary perspectives* (Cambridge, MA, 2005).
 47. Ludwik Fleck, *Genesis and development of a scientific fact* (Chicago, 1979 [1935]).
 48. In her own words: “... we should study the less tangible, less interesting and less obvious aspects of the subjects that history of science is used to approach ...”, Katherine M. Olesko, “Science pedagogy as a category of historical analysis: Past, present, & future”, *Science & education*, xv (2006), 863–80, p. 877.
 49. John L. Rudolph, “Historical writing on science education: A view of the landscape”, *Studies in science education*, xlv (2008), 63–82.
 50. Yves Cohen, “Scientific management and the production process”, in J. Krige and D. Pestre (eds), *Science in the twentieth century* (Amsterdam, 1997), 111–24. Taylor’s ambitious principles were directed “... to show that ... [they] are applicable to all kinds of human activities, from our simplest individual acts to the work of our great corporations ...”, cited by Robert M. Young, “Science, alienation and oppression”, in Olby, Cantor, Christie and Hodge (eds), *Companion to the history of modern science* (ref. 17), 886–97, p. 894.
 51. Cohen, “Scientific management” (ref. 50).
 52. Holub, *Antonio Gramsci* (ref. 24), 111.
 53. “Gramsci was among the first to realise that Fordism was a new phenomenon, embracing not only a new mode of mass production, but the need for a new kind of social discipline, a new man to work in the new conditions. A loose form of economic determinism is suggested by this formulation, and a new metaphor — ‘regulation’ — giving due allowance for religious, social and even sexual practices”, Harris, *From class struggle to the politics of pleasure* (ref. 34), 45.
 54. Forgacs, *The Antonio Gramsci reader* (ref. 20).
 55. Herbert Marcuse, *One dimensional man: Studies in the ideology of advanced industrial society* (London, 1964); Jürgen Habermas, *Technik und Wissenschaft als ‘Ideologie’* (Frankfurt, 1968). See also: Jürgen Habermas, “Science and technology as ideology”, in B. Barnes (ed.), *Sociology of science* (Harmondsworth, 1972), 353–75.
 56. Robert Fox and Anna Guagnini (eds), *Education, technology and industrial performance in Europe* (Cambridge, 1993).
 57. Martin Bauer (ed.), *Resistance to new technology* (Cambridge, 1994).
 58. Jeffrey K. Stine and Joel A. Tarr, “Essay: At the intersection of histories. Technology and the environment”, *Technology and culture*, xxxix (1998), 601–40.
 59. David Edgerton, “From innovation to use: Ten eclectic theses on the historiography of technology”, *History and technology*, xvi (1999), 111–36. See also: David Edgerton, *The shock of the old: Technology and global history since 1900* (Oxford, 2007).
 60. Nathan Rosenberg, “Technology and the environment: An economic explanation”, *Technology and culture*, xii (1971), 543–61.
 61. Pnina G. Abir-Am and Clark A. Elliot (eds), *Commemorative practices in science: Historical*

- perspectives on the politics of collective memory* (Osiris, 2nd ser., xiv (1999)).
62. Holub, *Antonio Gramsci* (ref. 24), 7, 113.
 63. “One can say that until now folklore has been studied primarily as a ‘picturesque’ element.... Folklore should instead be studied as a conception of the world and life implicit to a large degree in determinate (in time and space) strata of society and in opposition (also for the most part implicit, mechanical and objective) to ‘official’ conceptions of the world.” Quoted by Bennett, *The birth of the museum* (ref. 42), 109.
 64. Roger Chartier, “Culture as appropriation: Popular cultural uses in early modern France”, in S. L. Kaplan (ed.), *Understanding popular culture: Europe from the Middle Ages to the nineteenth century* (Amsterdam, 1984), 229–53, pp. 233, 235. See also: Peter Burke, *History and social theory* (Cambridge, 2005).
 65. James Secord, “Knowledge in transit”, *Isis*, xciv (2004), 654–72; Jonathan Topham, “Scientific publishing and the reading of science in nineteenth-century Britain”, *Studies in history and philosophy of science*, xxxi (2000), 559–612; Aileen Fyfe and Bernard Lightman (eds), *Science in the marketplace: Nineteenth-century sites and experiences* (Chicago, 2007).
 66. Sam Lilley, *Men, machines and history* (London, 1948).
 67. Clifford D. Conner, *A people’s history of science: Miners, midwives and ‘Low Mechanics’* (New York, 2005).
 68. Morrell, “Brains of Britain” (ref. 26), 741.
 69. Cels Gomis, *La bruixa catalana* (Barcelona, 1987). (Biographical note by Llorenç Prats, pp. 5–31.)
 70. Among his works, it is worth mentioning: *Lo llamp y’ls temporals* (1884); *Meteorologia y agricultura populars ab gran nombre de confrontacions* (1888); *Botànica popular* (1891); *Rudimentos de agricultura española* (1900); *Zoologia popular catalana* (1910); *La lluna segons lo poble* (1912). The last-named had already been published in 1884 in short articles in the periodical *L’avens*.
 71. Cels Gomis, *La lluna segons lo poble* (Barcelona, 1884), 15.
 72. Gomis, *La bruixa catalana* (ref. 69), 21–9.
 73. Roger Cooter and Stephen Pumfrey, “Separate spheres and public places: Reflections on the history of science popularization and science in popular culture”, *History of science*, xxxii (1994), 237–67.
 74. *Ibid.*, 237.
 75. In a recent paper, Ralph O’Connor “analyses current historian’s usage of the categories ‘popular science’ and ‘science popularization’ and argues against the view that these categories should be expunged from our vocabulary (except as actors’ categories)”. Ralph O’Connor, “Reflections of popular science in Britain: Genres, categories and historians”, *Isis*, c (2009), 333–45, p. 333.
 76. For a general reflection on the historiography of hegemony and resistance, see Burke, *History and social theory* (ref. 64).
 77. See for instance Michel Callon, “The role of lay people in the production and dissemination of scientific knowledge”, *Science technology & society*, iv (1999), 81–94, and Darrin Durrant, “Accounting for expertise: Wynne and the autonomy of the lay public actor”, *Public understanding of science*, xvii (2008), 5–20. Here again, there is no reference to Gramsci.
 78. Bensaude-Vincent, *Les vertiges de la technoscience* (ref. 6), 34.
 79. Robert M. Young, *Colonial desire: Hybridity in theory, culture and race* (London, 1995).
 80. Edward W. Said, *Orientalism* (London, 2003 [1978]), 14.
 81. John Krige, *American hegemony and the post-war reconstruction of science in Europe* (Cambridge, MA, 2006).
 82. Ranajit Guha, *History at the limit of world history* (New York, 2002); Judith Carney, *Black rice: The African origins of rice cultivation in the Americas* (Cambridge, MA, 2001).
 83. Donna Haraway, *Primate visions: Gender, race and nature in the world of modern science* (London, 1989).

84. Deepak Kumar, *Science and the Raj: A study of British India* (Oxford, 2006 [1995]).
85. Carney, *Black rice* (ref. 82).
86. Ranajit Guha and G. C. Spivak (eds), *Selected subaltern studies* (Oxford, 1988). See also: Dhruv Raina, *Images and contexts: The historiography of science and modernity in India* (Oxford, 2003); David Arnold, "Europe, technology, and colonialism in the twentieth century", *History and technology*, xxi (2005), 85–106.
87. Guha, *History at the limit of world history* (ref. 82), 1.
88. *Ibid.*, 21–2.
89. "The noise of world-history and its statist concerns has made historiography insensitive to the sighs and whispers of everyday life ... the events and sentiments which inform the prose of the world remain unacknowledged", Guha, *History at the limit of world history* (ref. 82), 73.
90. For a general Introduction to the so called "Postcolonial Studies", see: <http://www.english.emory.edu/Bahri/Intro.html> (accessed 24 March 2009).
91. Vinay Lal, *History of history: Politics and scholarship in modern India* (New Delhi, 2003); Raina, *Images and contexts* (ref. 86).
92. Shigeru Nakayama, "History of East Asian science: Needs and opportunities", *Osiris*, 2nd ser., x (1995), 80–94, p. 82.
93. Jorge Cañizares Esguerra, *How to write the history of the new world: History, epistemology, and identities in the eighteenth-century Atlantic world* (Stanford, 2001); Jorge Cañizares Esguerra, "Iberian science in the Renaissance: Ignored how much longer?", *Perspectives on science*, xii (2004), 86–120; Antonio Barrera Osorio, *Experiencing nature: The Spanish American empire and the early Scientific Revolution* (Austin, 2006); Agustí Nieto-Galan, "The history of science in Spain: A critical overview", *Nuncius*, xxiii (2008), 211–36.
94. Frida Gorbach and Carlos López Beltrán (eds), *Saberes locales: Ensayos sobre historia de la ciencia en América Latina* (Michoacán, 2009). See also: Marcos Cueto, *Excelencia científica en la Periferia: Actividades científicas e investigación biomédica en el Perú 1890–1950* (Lima, 1989); Alexis De Greiff and Mauricio Nieto, "What we still do not know about South–North technoscientific exchanges: North-centricism, scientific diffusion, and the social studies of science", in Ronald Doel and Thomas Söderqvist (eds), *The historiography of contemporary science, technology, and medicine: Writing recent science* (New York, 2006), 239–59. See also: Mauricio Nieto, "Scientific instruments, Creole science and natural order in the new Granada of the early nineteenth century", *Journal of Spanish cultural studies*, ii (2007), 235–52; Eugenia Roldán Vera, *The British book trade and Spanish American independence: Education and knowledge transmission in transcontinental perspective* (Aldershot, 2003).
95. Josep Simón and Néstor Herrán (eds), *Beyond borders: Fresh perspectives in history of science* (Newcastle, 2008); Kostas Gavroglu *et al.*, "Science and technology in the European periphery: Some historiographical reflections", *History of science*, xlvi (2008), 153–75.
96. Gavroglu, "Science and technology in the European periphery" (ref. 95), 168.
97. Herrán Simón, *Beyond borders* (ref. 95), 5.
98. Terry Shinn and Richard Whitley (eds), *Expository science: Forms and functions of popularization* (Dordrecht, 1985).
99. Agustí Nieto-Galan, *Colouring textiles: A history of natural dyestuffs in industrial Europe* (Dordrecht, 2001).
100. Gavroglu *et al.*, "Science and technology in the European periphery" (ref. 95).
101. Faidra Papanelopoulou, Agustí Nieto-Galan and Enrique Perdiguero (eds), *Popularizing science and technology in the European periphery, 1800–2000* (Aldershot, 2009).
102. Morrell, "Brains of Britain" (ref. 26).
103. 29th November – 1st December 2007: International Gramsci Society-Mexico Conference: "Gramsci a

setenta años de la muerte” (Universidad Autónoma de la Ciudad de México); 9th–11th November 2007: Gramsci Symposium at Michigan State University, “Gramsci now: Cultural and political theory”, an international symposium to mark the 70th anniversary of the death of Antonio Gramsci; 1st, 2nd December 2007: Gramsci Symposium in Tokyo — A symposium commemorating the 70th anniversary of the death of Antonio Gramsci at the Liberty Tower of Meiji University (Surugadai), Tokyo; 28th January, 2007: Third International Gramsci Society Conference, “Antonio Gramsci: A Sardinian in the ‘vast and terrible world’”. For more details on these academic events see: International Gramsci Society: <http://www.internationalgramscisociety.org/>

104. Werskey, “The Marxist critique” (ref. 8), 447–9.
105. Perry Anderson, “The antinomies of Antonio Gramsci”, *New Left review*, cxliv (1976), 96–113, p. 96.
106. Forgacs, *The Antonio Gramsci reader* (ref. 20), pp. 12–13 of the introduction by Eric Hobsbawn.
107. Holub, *Antonio Gramsci* (ref. 24).

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