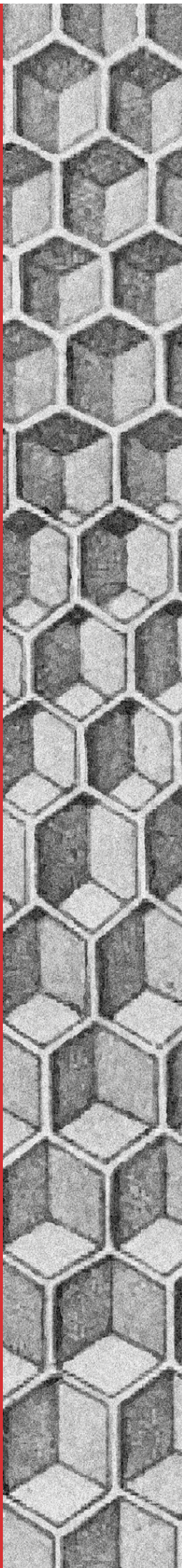

02



The Bee and the Architect

Scientific Paradigms
and Historical Materialism

Giovanni Ciccotti

Marcello Cini

Michelangelo De Maria

Giovanni Jona-Lasinio



Verum Factum
Studies and Sources on
Political Epistemology

Verum Factum 02

The Bee and the Architect

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NOTES ON THIS EDITION AND TRANSLATION

Unless otherwise stated, all quotes are translated from Italian into English by the translator. Wherever an English edition has been found, references can be found in the footnotes.

Since the parts of the book were written at different times, the reference style changes in the different parts of the book.

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An Italian Classic in Political Epistemology from the Seventies

Gerardo Ienna and Pietro Daniel Omodeo

1. The Radical Science Movement in Italy

In the wake of the international political turmoil generated by the protests of '68, a large number of social movements sought to address the problem of politics in science. They also contributed to establishing a new awareness of the social function of science in 'advanced' capitalist societies. Although the question of scientists' social responsibility had already been addressed before (notably by John Bernal)¹ and movements promoting social responsibility among scientists had already emerged after Hiroshima and Nagasaki,² they only became part of large radical-democratic and socialist struggles in the 1970s. As such, they became part of class and labor struggles, which went far beyond mere appeals to moral values.

Among the new groups, the *British Society for Social Responsibility in Science* (BSSRS) was founded in 1969. This was an association with a distinctly Marxist structure, which aimed to mobilize those scientists who were concerned about the social effects of their research and work. Shortly afterwards, again in Britain, a community of researchers and scholars began publishing the *Radical Science Journal*. At once, various subgroups formed within the BSSRS, including: Agri-capital, Hazards, Women in Science, Politics of Health, Politics and

¹ John D. Bernal, *The Social Function of Science* (London: Routledge, 1946).

² See Kelly Moore, *Disrupting Science: Social Movements, American Scientists, and the Politics of the Military, 1945-1975* (Princeton: Princeton University Press, 2008).

Energy, and Radical Statistics. In 1969, the organization *Scientists and Engineers for Social and Political Action* (SESPA) was created in the United States and soon started the publication of *Science for the People* (the name by which this movement would later be known). In the same period, radical science movements in France disseminated their “critique des sciences” through a wide range of journals, magazines, and bulletins such as *Suivre et vivre* (beginning in 1970), *Labo-Contestation* (1970), *Le Cri des Labo* (1969-1972), and *Impascience* (1975).

The Italian context witnessed similar tendencies, following the social unrest of 1968 and of the “Autunno Caldo” (Hot Autumn) of 1969.³ The Italian case differed from that of other ‘Western’ countries due to the general enthusiasm toward science shared by the hegemonic Communist Party (PCI, or Partito Comunista Italiano), which did not question the connection between technological and scientific advances, on the one hand, and societal progress, on the other. It should be recalled that the PCI played a unique political and cultural role in Italy, and was the largest and most influential Communist party in a capitalist country.⁴ According to its official line, techno-scientific innovation should automatically foster societal progress. This is why, in order to critically engage with science, Italian radical science movements also had to emancipate themselves from dominant positions within the Left.

Yet, left-leaning political dissidents, such as the initiators of ‘operaismo’ (workerism), criticized the PCI’s political line, including

³ This expression refers to a period of labor and worker struggles (partly inspired by the student protests of 1968) marked by a conspicuous number of strikes and factory occupations. The central theme of these claims was the demand for higher wages and greater labor protections. As a result of these events, the so-called “Statuto dei lavoratori” [Workers’ Statute] was signed on May 20, 1970.

⁴ The period between the late 1960s and the first half of the 1980s marks the maximum expansion of the Italian Communist Party, which established itself as the leading Communist party in the entire Western world. Most notably, in the 1976 elections the PCI reached its peak support by gaining 34.4% of the vote.

in journals and newspapers such as *Quaderni Rossi*, *Quaderni Piacentini*, and *Il Manifesto*. The views expressed by the political thinker Raniero Panzieri are especially noteworthy as regards the reflection on science and technology. In his papers, published in *Quaderni Rossi*, Panzieri addressed the problem of technology from the perspective of Marxist studies by deriving crucial insights from Marx's *Fragment on Machines* (from *Grundrisse*)⁵. In 1963, this capital text was made available in Italian and referred to in much-quoted essays such as *Sull'uso capitalistico delle macchine nel neocapitalismo* (*On the Capitalist Use of Machines in Neocapitalism*) (1961) and *Plusvalore e pianificazione: Appunti di lettura del Capitale* (*Surplus Value and Planning: Notes for a Reading of Capital*) (1963). These publications paved the way to subsequent criticisms of the politics of science of the day.

Beginning in 1969, political conflicts emerged within the scientific community. As was already the case in the United States and France, scientists and technologists occupied research laboratories with increasing frequency. Among the most famous actions of this sort, one ought to mention the first occupation of the headquarters of the *Centro Nazionale delle Ricerche* (National Center for Research) in Rome in 1969, as well as the occupation of the International Institute of Genetics and Biophysics in Naples.⁶

In contrast to the official position of the PCI, Italian radical scientists were united by their criticism of the non-neutrality of science. They opened up a broad debate, marked by at least two ways of

⁵ Karl Marx, "Frammento sulle macchine", *Quaderni Rossi*, 4, (1963): 257-288. This text is part of Karl Marx, *Grundrisse* (London: Penguin, 1997).

⁶ On this point see: Laser (ed.), *Valle Giulia e la luna. Lotte dei tecnici e critica della scienza* (Roma, Università di Roma La Sapienza, 1999); Mauro Capocci and Gilberto Corbellini, "Adriano Buzzati-Traverso and the Foundation of the International Laboratory of Genetics and Biophysics in Naples (1962-1969)", *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences*, 33, 3, (2002): 489-513; Francesco Cassata, *L'Italia intelligente: Adriano Buzzati-Traverso e il Laboratorio internazionale di genetica e biofisica, 1962-69* (Roma: Donzelli, 2013).

conceiving this problem. They argued that scientific production, like other cultural forms, is influenced by the historical and social conditions in which it occurs and is maintained. In this sense, science and technology are ideologically influenced by forms of cultural and economic hegemony. Moreover, science and technology were envisaged as forms of knowledge that contribute to structuring society, production, and power (thus bringing into play the question of the social function of science). In this sense, science and technology were seen as tools that can be used ideologically and contribute to the creation of cultural hegemonies, including emancipatory ones.

Drawing on these premises, various small groups began to emerge throughout Italy. They investigated issues of common concern and communicated their views by means of a large number of journals bearing titles such as *Sapere*, *SE Scienza Esperienza*, *Rosso Vivo*, *Testi e Contesti*, and *CRS Capitalismo Natura Socialismo*. More or less formal debates took place through meetings, too. In this context, monographs and collective works were published, as well as translations of foreign works that led to the circulation of ideas and the creation of transnational exchange opportunities for social movements belonging to different cultural traditions.⁷ This was the case with the book series *Science and Politics* edited by Marcello Cini and Giulio A. Maccacaro (who inspired health struggle movements such as *Medicina Democratica*, that is, Democratic Medicine). Feltrinelli, the publisher of this translation, owned one of Italy's main publishing houses. The series comprised – and made available to the Italian public – seminal texts of the international radical science movement, including: extracts from *The Radicalisation of Science: Ideology of/in*

⁷ See for example: Simone Turchetti, “Looking for the Bad Teachers: The Radical Science Movement and Its Transnational History,” in Elena Aronova, Simone Turchetti (eds.), *Science Studies during the Cold War and beyond: Paradigms Defected* (New York: Palgrave Macmillan, 2016).

the Natural Sciences and *The Political Economy of Science* (under the title of *Ideologia delle scienze naturali*), edited by Hilary and Steven Rose; *(Auto)Critique de la science* (under the title of *(Auto)Critica della scienza*), edited by Alain Jaubert and Jean-Marc Lévy-Leblond; and *China: Science Walks on Two Legs* (under the title of *Scienza e popolo in Cina*), edited by the Science for the People group.

As was the case in other countries, the physicists' community played a leading role in Italy. Within a short period of time, however, the process of radicalization of scientists extended to other disciplinary fields such as medicine, the life sciences in general, ecology, mathematics, and computer science. It was also at the initiative of the group gathered around Cini that De Donato (an academic yet politically engaged publishing house) printed the first Italian translation of *Science at the Crossroads*, the collection of the speeches of the Soviet delegation to the Second Congress of the History of Science (London, 1931), which had laid the foundation for externalism in the history of science.⁸

The Bee and the Architect can be regarded as the most vivid document of the Italian radical science movements of the 1970s and 1980s. Many saw it as a manifesto. First published in 1976 (but also including some articles that had already appeared elsewhere), this text was produced by a group of physicists from the Sapienza University of Rome: Giovanni Ciccotti, Marcello Cini, Michelangelo de Maria, and Giovanni Jona-Lasinio. Cini was the most prominent intellectual and political personality within the group. He was Full Professor of Theoretical Physics in Rome and already held important positions in the Italian Physical Society. As far as his political militancy is concerned, he had been a member of the PCI for many years but had eventually

⁸ Gerardo Ienna, "The International and Interdisciplinary Circulation of Boris Hessen's Theses," in Boris Hessen, *Manuscripts and Documents on the History of Physics: A Historical Materialist Textbook* (Venice: Verum Factum, 2022): 111-114.

been expelled along with other dissidents on account of his support of the Prague revolt and criticism of Soviet repression. He and others founded the political group and newspaper *Il Manifesto*. Moreover, Cini took part in the Russell Tribunal as a member of the Fourth Commission of Inquiry in Vietnam investigating US American war crimes. Jona-Lasinio, who was slightly younger, was Full Professor of Mathematical Methods for Physics.

2. Epistemology Meets Politics:

Thomas Kuhn and Karl Marx

From the viewpoint of science studies, the most striking feature of *The Bee and the Architect* (1976) is its explicit aim to integrate two heterogeneous intellectual legacies, namely the epistemology of Thomas Kuhn's *The Structure of Scientific Revolutions* (1962) and Karl Marx's political theory. The book written by Cini and his group bears the programmatic subtitle: "Scientific Paradigms and Historical Materialism".⁹

"Scientific paradigms" was a reference to Kuhn's theory of the discontinuous progress of science. The group of Italian scientists re-interpreted the idea of the historically mutable frameworks of science – an epistemology of historically changing *a priori* – in socio-political terms, in spite of the originally apolitical agenda of the American scholar, whose work was linked to the anti-Communist cultural politics of his mentor James Conant.¹⁰ The authors of *The Bee*

⁹ On the radicalization of epistemology in those years, see Ienna, 2020.

¹⁰ On Kuhn's link to Conant and the political agendas underlying his work see Omodeo, "Copernicus as Kuhn's Paradigm of Paradigms: The Epistemological Dimension of *The Copernican Revolution*," in *Shifting Paradigms: Thomas S. Kuhn and the History of Science*, ed. Alexander Blum, Kostas Gavroglu, Christian Joas, and Jürgen Renn (Berlin: Edition Open Access, 2016), 61-86. For insightful remarks on the stakes of post-truth, see Luigi Pellizzoni, "Innocent, Guilty or Reluctant Midwife? On the Reciprocal Relevance of STS and Post-Truth," in *Tecnoscienza: Italian Journal of Science & Technology Studies* 10/1 (2019): pp. 115-130.

and the Architect looked at the ‘structures’ of ‘normal’ science and its ‘ruptures’ as something that did not exist merely in the intellectual realm. In their view, knowledge systems were rooted in society; hence, the connection between epistemological structures and sociological structures needed to be addressed both in relation to their ‘normal’ and ‘stable’ forms and in relation to revolutionary phases.¹¹ To be sure, the sociologization of Kuhn’s paradigms is not unique to this line of reception, as British constructivists made similar interpretative attempts. The group around Cini was different, however, insofar as these scholars grounded their sociological views in the Marxist theory of society and confronted it with the class struggles of their time.¹² According to these researchers, far from transcending society, paradigms are the result of political agency. Thus, they deemed the following question to be both pertinent and politically relevant: “Who decides about the paradigm?”¹³ *The Bee and the Architect* explicitly tackled this question, which related to a further one concerning the legitimacy of the scientific elites who set the research programs and determine the paradigms of normal science, in spite of being a minority among scientific workers and a very small one within

¹¹ Giovanni Ciccotti, Marcello Cini, Michelangelo de Maria and Giovanni Jona-Lasinio, *L’Ape e l’architetto* (Milano: Franco Anceli, 2011), p. 54.

¹² On the sociological reception of Kuhn see, among others, Jan Golinski, *Making Natural Knowledge: Constructivism and the History of Science* (Cambridge: Cambridge University Press, 1998), pp. 13-27. As regards his own skeptical position vis-à-vis the sociology of paradigms, the remarks in the 1969 postscript to *Structures* are of utmost interest. See Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago-London: The University of Chicago Press, 1996), esp. pp. 176-181.

¹³ The same question has recently been addressed in the context of post-truth social epistemology. See Omodeo’s essay “The Political and Intellectual Entanglements of Post-Truth: A Review of Steve Fuller’s *Post-Truth: Knowledge as Power Game*,” in *Public Seminar: In the Spirit of The New School for Social Research, Informing Debate about the Pressing Issues of Our Times* (<http://www.publicseminar.org/2019/09/the-political-and-intellectual-entanglements-of-post-truth/>) (18 September 2019). Post-truth approaches lack analytical rigor, as they merely point to power relations without considering their socio-economic grounding.

society.¹⁴ Such a problem, which concerns democracy and power relations in scientific intellectual labor, lies at the heart of chapter two of *The Bee and the Architect*, “The Production of Science in an Advanced Capitalist Society”. This chapter emphasizes the central relevance of production. The Marxist analysis-cum-criticism of labor exploitation within historical relations of production was extended from the factory to the realm of scientific research. Hence, this reading of Kuhnian epistemology, far from being a mere sociological translation of statements about the scientific community’s validation of science’s paradigms, linked the latter to systemic considerations about societal formations, labor exploitation, and working-class struggles.

There was also another side to the political-epistemological challenge launched by the book. Alongside the political enframing science and of theory of knowledge, the authors of *The Bee and the Architect* pursued the epistemological integration of societal analysis and politics. They observed that the ‘founders’ of Marxism had not put science and knowledge theory at the center of their analysis.¹⁵ Although Marx and Engels’s work provided many important insights into knowledge theory, and although their historical materialism could be seen as a methodological prototype for historical-natural inquiry, their discussions of epistemology were limited.¹⁶ The reason for this limitation could be explained by considering the more limited role that science had played as a productive force in the nineteenth

¹⁴ On the problem of expertise see Gerardo Ienna, Flavio D’Abramo, and Massimiliano Badino (eds.), *Expertise ed epistemologia politica* (Milano: Meltemi, 2022). In general, the problem of the relation between democracy and scientific expertise was at the center of the debates on/against technocracy in the Sixties and Seventies. See, among others, Jürgen Habermas, *Technik und Wissenschaft als ‘Ideologie’* (Frankfurt/Main: Suhrkamp, 1968).

¹⁵ Ciccotti et al., *L’Ape e l’architetto*, p. 90. The expression “founders” here is taken from Leszek Kołakowski, *Main Currents of Marxism* (New York-London: W.W. Norton & Company, 2005), book 1.

¹⁶ With regard to Marx’s epistemology, Colletti’s work was – and still is – very influential: Lucio Colletti, “Marxism and the Dialectic,” *New Left Review* 93 (1975): pp. 3-29.

century, that is, in the phase of capitalism that Marx and Engels had experienced, analyzed, and criticized. According to the shared approach presented in *The Bee and the Architect*, the full potential of science as an indispensable asset for technology and capitalism in general had become evident over the course of the twentieth century with the emergence of the military-industrial complex and the commodification of science itself. Although the texts of the book date back to the Sixties and Seventies, their remarks still hold true, as the general tendency has not changed. On the contrary, social critique entails an adequate comprehension of the problem of science. Hence, the authors argued that it was necessary for political activists to deal with the problems of science and epistemology. Indeed, epistemology has become one of the indispensable areas of politics today, in relation to pressing themes that range from the multifaceted ecological crisis to pandemics management.¹⁷

In his contribution to the book, Cini regarded the connection between epistemology and politics as imperative. In a document concerning the political problems of research that he penned for the *Istituto Gramsci* in 1968, he argued that an important task for the workers' movement was "to indicate the times and modes of the bonding between socialist revolution and scientific revolution."¹⁸ The connection between socialism and epistemology, far from being an obvious one in need of no articulation, proved a political aim to be pursued.

Against the programmatic background that we have outlined thus far, the meaning of the quotation in the title, taken from the first

¹⁷ See, among others, Naomi Oreskes and Erik Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (London: Bloomsbury, 2012), and Corinna Guerra and Marco Piazza (eds.), *Disruption of habits during the pandemic* (Milan: Mimesis international, 2022). For a general program of political epistemology today, see Omodeo, *Political Epistemology: The Problem of Ideology in Science Studies* (Cham: Springer, 2019).

¹⁸ Ciccotti et al., *L'Ape e l'architetto*, p. 33.

book of Marx's *Capital*, becomes clear:

A spider conducts operations that resembles those of a weaver, and a bee puts to shame many an architect with the construction of her cells. But what distinguishes the worst of architects from the best of bees is this, that the architect raises his structure in the *imagination* before he erects it in reality. (p. 58)

This passage points to the central problem of the goals of science. Marx used the contrast between the bee and the architect – and the spider and the weaver, in the title of the French translation of the book¹⁹ – to illustrate the fact that human creations, including marginal forms of production, are dependent on consciousness, knowledge, and intentions. They are fundamental components of human production, which mark the difference between the capacities of humans and those of other animals. Chapter one of *The Bee and the Architect*, “Scientific Planning against Scientism,” emphasizes the relevance of goals in relation to the construction and development of science, because they determine what questions are relevant and what abstractions are necessary for the tasks that scientists take upon themselves within their societies. Decisions are always involved in the making of science; therefore, science and technology are marked by the interests that they follow. Since such interests are not individual but correspond to the changing functions of knowledge in society, science is intrinsically political. To use a formula, one could say that the political epistemology of *The Bee and the Architect* brings together: 1.) the problem of the socio-economic roots of science; 2.) the question of the functions of science; and 3.) matters of cultural politics. This

¹⁹ Ciccotti, Cini, de Maria and Jona-Lasinio, *L'Araignée et le Tisserand. Paradigmes scientifiques et matérialisme historique*, transl. by Charles Alunni (Paris: Seuil, 1979).

intellectual operation ideally connects Boris Hessen's structural analysis, John Bernal's functions analysis, and Antonio Gramsci's cultural critique of science.²⁰

Scientific advancement is neither an internal problem, linked to some autonomous logic of science, nor a mechanical movement, the consequences of which are predetermined. On the contrary, techno-scientific progress is impossible without struggles for social emancipation. Without freedom, science is turned into a means of oppression, as it reinforces power asymmetries. It would be illusory to foster technological advances as a premise for future societal emancipation without political action – and this illusion, in those days, marked technocratic positions both in capitalist countries and in socialist one towing the Soviet line (as well as those communist parties that took the USSR as a reference point, such as the PCI). As Cini observed, scientific advancement without freedom reinforces exploitative dependencies and the means of oppression.²¹ According to the introduction to *The Bee and the Architect*:

The confidence in creating the most advanced technological and scientific bases first, within capitalist social relations, is beginning to appear illusory. These bases could no longer allow us to replace – easily and painlessly – what has become an anachronistic framework with a social texture suitable to the level of development reached by the productive forces.

²⁰ Omodeo describes a similar political-epistemological move in “L'eredità di Boris Hessen: Per un approccio socio-politico alla scienza in età moderna,” in Boris Hessen, *Le radici sociali ed economiche della meccanica di Newton*, ed. Ienna (Roma: Castelvecchi, 2017), pp. 119-150.

²¹ Although he has often been accused of being anti-scientific, including by the authors of *The Bee and the Architect*, Marcuse argued for the need to free science and technology together with labor very early on. For an STS reappraisal of his ideas, see Andrew Feenberg, “Critical Theory of Technology and STS”, in *Thesis Eleven* 138/1 (2017): pp. 3-12.

Our attention is now turning to the contradictions of social relationships.²²

3. The Impact: Italian Science Wars

The Bee and the Architect was published in the Feltrinelli series *Science and Politics* under the direction of Cini and Maccacaro. The publishing success of this book was tremendous and definitely unexpected for its authors. The first edition was sold out within a few weeks. In the first year alone, six reprints were issued, despite the large print run. In a very short time, the theses of the book began to circulate broadly and sparked lively debates. As soon as it was published, British Marxists Hilary Rose and Steven Rose had the chapter *The Production of Science in Advanced Capitalist Society* translated into English for inclusion in their edited volume *The Political Economy of Science*. A full-length French translation came out in 1979 under the title of *L'Araignée et le Tisserand: Paradigmes scientifiques et matérialisme historique*.²³ It was proposed for publication by one of France's leading radical physicists: Jean-Marc Lévy Leblond, who entrusted Charles Alunni with the translation. Some recently discovered correspondence has revealed that in 1981, after having enthusiastically read the French edition of the book, Bob S. Cohen proposed to Cini to have the whole volume translated into English, offering to promote the work for publication either within his prestigious *Boston Studies in Philosophy of Science* series or by other publishers:

²² Ciccotti et al., *L'Ape e l'architetto*, p. 24.

²³ In 1978, a volume by François Mitterrand was published, entitled "*L'Abeille et l'Architecte*", which took inspiration from the same Marx passage that had inspired the Roman physics groups. The French translator and publishers were forced to change the title to "The Spider and the Weaver", drawing upon another passage from *Capital* that made use of the same metaphor.

I have read with pleasure the French translation of your joint work *L'araignee et le tisserand; Paradigmes scientifiques et materialisme historique*; and this ought to be available in English. I could see it in the Boston Studies in the Philosophy of Science or in the other Reidel Series, Studies in the History of Modern Science, or I could recommend it to Monthly Review Press. Would you like to try this?²⁴

Unfortunately, this project was never brought to completion: the book was never translated into English. From the exchange between Cini and Cohen, it is possible to speculate on two main reasons as to why the project failed. First, Cini seemed more interested in having more recent (and 'up-to-date') works of his published than *The Bee and the Architect*.²⁵ In his reply to the letter quoted above, Marcello Cini sent Cohen the proofs of *Il Gioco delle regole* (written in collaboration with Daniele Mazzonis), which would be published by Feltrinelli a few months after the letter was sent. At the same time, it is likely that Cini did not have the financial resources necessary to have the entire volume translated into English. In any case, correspondence between the two authors shows that Cini participated in the *Boston Colloquium for the Philosophy of Science* and that his ideas were beginning to circulate in the United States.²⁶

One of the main reasons for the success of *The Bee and the Architect* lies in the specific Italian cultural and intellectual context of

²⁴ Robert S. Cohen to Marcello Cini, March 1, 1981, in Marcello Cini Papers, Istituto di Fisica, Università 'La Sapienza', Rome, Italy.

²⁵ Marcello Cini to Robert S. Cohen, April 10, 1981, in Marcello Cini Papers, Istituto di Fisica, Università 'La Sapienza', Rome, Italy.

²⁶ Robert S. Cohen to Marcello Cini, October 7, 1980, in Marcello Cini Papers, Istituto di Fisica, Università 'La Sapienza', Rome, Italy. In this letter Bob Cohen invited Cini to give a lecture entitled *The Social Basis of Scientific Theory and Practice* on January 13, 1981 as part of the *Boston Colloquia for the Philosophy of Science*. The discussant was to be the Harvard historian of science Everett Mendelsohn.

the time. The publication of this book arguing for the non-neutrality of scientific knowledge engendered violent reactions on the part of several intellectuals who believed that its authors were questioning the validity of science. In a sense, this text was the spark that set off conflicts that had been latent until then. The Roman physics group gathered around Cini was simultaneously attacked by professional philosophers and historians of science, Marxist scholars, various members of the PCI, and liberals. This wide-ranging public controversy may be seen as an Italian anticipation of the (internationally) better known Science Wars. Indeed, it concerned the problem of the validity of the sciences and their objectivity, social determination, and political orientation. The polemic unfolded in the pages of major newspapers and weekly magazines, in militant journals and newspapers, as well as through typical scientific channels such as conferences. In contrast to the Anglophone “Science Wars”, however, a remarkable specificity of the Italian political ones is that they bear witness to two opposing disciplinary and political fronts. While the critics of the neutrality of science were members of the community of natural scientists, who were trained in physics and taught this subject at universities, the champions of the neutrality of science were mostly humanists, historians, and philosophers of science.

The main opposition to the Radical Science Movements in Italy came from three mainstays of Italian academia: Marxist philosopher and historian of science Ludovico Geymonat²⁷ (and his Milan group

²⁷ Ludovico Geymonat was the first to hold a chair of Philosophy of Science in Italy, which was created for him in 1956. Geymonat was a member of the Italian Resistance and, attracted to neopositivism, he spent several months of the winter semester of 1935 in Vienna in close contact with Moritz Schlick and other members of the Vienna Circle. Politically he was extremely active and, throughout his career he undertook an original attempt to rehabilitate dialectical materialism (after the scandals of the Lysenko affair) by integrating it with a historical perspective and some of the theses of neopositivism. He was one of the most influential Italian philosophers of the 20th century and built a substantial research group around his chair at the University of Milan.

of historians and philosophers of science); liberal historian of science Paolo Rossi;²⁸ and Marx scholar Lucio Colletti.²⁹

In 1974, two years before the publication of *The Bee and the Architect*, Geymonat published a volume that may be regarded as the manifesto of the Milan school of history and philosophy of science. Entitled *The Actuality of Dialectical Materialism*, it was written in collaboration with Enrico Bellone, Giulio Giorello and Silvano Tagliagambe. Its theses were later reiterated and strengthened in Geymonat's essay *Science and Realism* (1977). Geymonat and his group, based in Milan, had been working on this program from 1967-68. They centered their analysis on the relationship between science and socialism, specifically investigating the transformation of Soviet scientific culture in the transition from Leninism to Stalinism. Concerned with the ideological drifts affecting the production of scientific knowledge in the Stalin era (a phenomenon later brought to public attention through the Lysenko affair³⁰), this group attempted to rehabilitate the theoretical principles of dialectical materialism. To do so, Geymonat's school tried to connect the neopositivist trust in scientific facts and logic with dialectical materialism. In their view, this encounter would foster a neutral and progressive conception of scientific activity against ideological distortions. Their goals were mainly

28 Paolo Rossi was one of the most influential Italian historians of science. His works are well known internationally, particularly *Francis Bacon: From Magic to Science* (Chicago: Chicago University Press, 1968). In 1985 he was awarded the Sarton Medal by the History of Science Society. In 2007 John L. Heilbron edited the essays in Honour of Paolo Rossi entitled *Advancements of Learning* (Firenze: Leo S. Olschki Editore, 2007).

29 Lucio Colletti was an influential Marxist scholar. The following works have been translated into English: *From Rousseau to Lenin* (New York: NYU press, 1972) and *Marxism and Hegel* (London: Verso Books, 1973). He is also well-known for his celebrated "A Political and Philosophical Interview" published in the July/August issue of the *New Left Review* in 1974.

30 On the Lysenko affair see: Dominique Lecourt, *Proletarian Science?: The Case of Lysenko*, trans. Ben Brewster (Atlantic Highlands: Humanities Press, 2003 [1977]). For a specific analysis of the reception of these debates in the Italian context, see: Francesco Cassata, *Le due scienze. Il "caso Lysenko" in Italia*, (Torino: Bollati Boringhieri, 2008).

two: first, to reinforce the cultural relevance of science in Italy against the neo-idealistic tendency to downplay it in the wake of Benedetto Croce's influential philosophy (and partially that of Antonio Gramsci); second, to restore the credibility of a Marxist approach to science after the scandals of the Lysenko affair. *The Bee and the Architect* moved in a diametrically opposite direction, as it argued for the non-neutrality of science and favored the method of historical materialism against a dubious celebration of dialectical materialism.

Colletti's writings on Marxism and science had been an important theoretical building block for the formulation of the thesis of the non-neutrality of science. Yet, he did not welcome the publication of *The Bee and the Architect*. The theses advanced by these militant scientists turned out to be totally unacceptable because, in Colletti's view, their argument for the non-neutrality of science was theoretically wrong and politically idle. In 1976, he wrote a scathing review of *The Bee and the Architect* in a broadly read Italian weekly magazine, dismissing the book's theses with disconcerting simplicity: "Bodies fall in the same way under the action of gravity in socialist and capitalist countries."³¹

Along similar lines, Rossi – who had also been an early source of inspiration for some of these physicists who came to study the history of science – attacked the radical theses of the book by labeling its authors "Sunday epistemologists and amateur historians." He argued that their scientific training was rather an impediment than an advantage to their understanding of knowledge. The task of criticism, in his view, had to be reserved for professional historians and philosophers. Rossi made no secret of his aversion to Marxist thought: "Those who in their research work in Italy have referred directly to Marxism have generally followed two paths [that of Geymonat and that of post-Sixties culture]. Both lead very far from serious and articulated

³¹ Colletti, "La dea sragione," *L'espresso*, XXII, 17, April 25 (1976): pp. 66-71.

reflections on the science-society relationship.”³² In particular, Rossi saw the criticisms advanced by the Radical Scientists as a new form of irrationalism. On his part, Rossi embraced an approach that favored the intellectual history of ideas along the idealistic lines of Alexandre Koyré and Arthur O. Lovejoy.³³

The theses set forth in *The Bee and the Architect* were also criticized by prominent members of the PCI such as Valentino Gerratana (the editor of the critical edition of Gramsci’s *Prison Notebooks*) and Giovanni Berlinguer. The clash between Cini and the PCI leadership had already begun in 1968, during a conference on scientific research organized at the Istituto Gramsci by the party’s cultural committee. It was only in 1969, however, that this polemic acquired a public dimension through a heated debate about the scientific and political meaning of the Moon landing in a series of articles published in the party journal *L’Unità* and the dissident Communist journal *Il Manifesto*. While the space race and the related techno-scientific progress had been widely celebrated by party members, Cini was skeptical about its real scientific and societal value. In the article “The Satellite of the Moon”, which was reprinted as an appendix to *The Bee and the Architect*, he denounced the military, economic, and ideological interests behind space exploration.

4. Relevance to STS and Historical Epistemology Studies

32 Paolo Rossi, “Filosofia di fronte alle scienze: alcune discussioni sui rapporti scienza-società,” in Giuseppe Cantillo, Eugenio Mazzarella (eds.), *La cultura filosofica italiana. Dal 1945 al 1980* (Napoli: Guida Editori 1982): p. 146.

33 In addition to these public attacks, Rossi had Ludwik Fleck’s *Genesis and Development of a Scientific Fact* translated into Italian for the first time, to which he added an extensive introduction. In Rossi’s strategy, Fleck provided a potential antidote to the anti-scientific drifts that the Italian reception of Kuhn was generating in Italian far-left circles. This is clearly a specifically Italian paradox of the reception of both Kuhn’s and Fleck’s works. On this point see Paola Govoni, “Il Mulino, la storia della scienza e la ‘Cultural Cold War’,” in Annarita Angelini, Marco Beretta, Giuseppe Olmi (eds.), *Una scienza bolognese? Figure e percorsi nella storiografia della scienza* (Bologna: Bononia University Press, 2015): pp. 347-364.

The originality and relevance of *The Bee and the Architect* – in terms of its historical, theoretical, and sociological understanding of the scientific phenomenon – extends far beyond its original Italian context and should not be neglected. The specific attention that this book devoted to the goals of science in close connection to historical questions about the origin of knowledge, the non-neutrality of science, and its transformative function make it a valuable starting point for reflections both in STS and in historical epistemology.³⁴

4.1 Relations with STS as a Field

Marxist studies of science have played an essential role in the development of research on the relationship between science and society. In particular, during the 1960s, 1970s, and 1980s in the English-speaking world various historical and theoretical connections were established between the first generation of scholars in the field of Science and Technology Studies (STS) and radical science movements, because they shared the intention to highlight the problem of the non-neutrality of science. However, these alliances gradually broke up. Indeed, the process of academic institutionalization of STS led to a general loss of the critical Marxist dimension that lay instead at the basis of the approaches proposed by radical scientists.³⁵

³⁴ A chapter on *The Bee and the Architect* is featured in the recent introduction to the subject by Massimiliano Badino, Gerardo Ienna, and Pietro D. Omodeo, *Epistemologia Storica. Correnti, temi e problemi* (Roma: Carocci, 2022) and in Gerardo Ienna, “Esiste un canone dell’epistemologia storica italiana?” in Gerardo Ienna, *Genesi e sviluppo dell’épistémologie historique* (Lecce: Pensa Multimedia, 2023).

³⁵ Brian Martin, “The Critique of Science Becomes Academic”, *Science, Technology, & Human Values*, 18, 2 (1993): 247-259; Evelleen Richards and Malcom Ashmore “More Sauce Please! The Politics of SSK: Neutrality, Commitment and Beyond”. *Social Studies of Science*, 26, 2 (1996): 219-228; Gary Werskey, “The Marxist Critique of Capitalist Science: A History in Three Movements?” *Science as Culture*, 16/4, (2007): 397-461; Simone Turchetti, “Looking for the Bad Teachers: The Radical Science Movement and Its Transnational History,” in Elena Aronova, Simone Turchetti (eds.), *Science Studies during the Cold War and beyond: Paradigms Defected* (New York, Palgrave Macmillan, 2016); Sigrid Schmalzer, Daniel S. Chard, and Alyssa

The authors of *The Bee and the Architect* had no direct relationship with the emerging field of Sociology of Scientific Knowledge (SSK). Furthermore, at least at the time of writing the texts of this volume, they had no knowledge of the general structure of the debate that would lead to the establishment of STS. Indeed, the texts that make up the volume were written around the time when some of the early proponents of SSK such as Barry Barnes, the author of *Scientific Knowledge and Sociological Theory* (1974), and David Bloor, the author of *Knowledge and Social Imagery* (1976), were publishing their main contributions.³⁶ In *The Bee and the Architect*, there are only a couple of references to two essays contained in the volume *Sociology of Science: Selected Readings* edited by Barry Barnes. No other references to SSK can be found in the book. Nevertheless, many of the theses that were being developed in the English-speaking world were independently argued in the volume by the Roman physics group from a Marxist perspective.³⁷

By developing the methodological principles of historical materialism, the authors highlighted that science is a human and historical product subject to the social, political, and cultural factors of its production. In contrast to the epistemology of dialectical materialism, according to such a model, nature itself “denotes all that exists: thus

Botelho (eds.) *Science for the People. Documents from America's Movement of Radical Scientist* (Boston: University of Massachusetts Press, 2018); and the special issue edited by Peter J.

Taylor and Karin Patzke, “From Radical Science to STS”, *Science as Culture*, 30, 1 (2021): pp. 1-116.

³⁶ Although *The Bee and the Architect* was published in its final form in 1976, most of the essays that make up the volume had already appeared in earlier years. References to *Sociology of Science: Selected Readings* (edited by Barnes) were included in the third essay of the *Bee and the Architect* that was published by Ciccotti and Jona-Lasio in the Italian journal *Scientia* in 1973.

³⁷ We would like to emphasize that *The Bee and the Architect* was published in 1976, the same year as David Bloor's *Knowledge and Social Imagery* (Chicago: University of Chicago Press, 1976), which is widely considered the most comprehensive version of the Edinburgh Strong Program. Significantly, Marcello Cini was one of the very few Italians to take part in the first conferences of the European STS association EASST in the mid-1980s. This means that on the European level his research was seen to fall within the STS field at that time.

not only what is pre-existent, i.e., the material on which one operates – as is proper to every historically existing materialism – but also he who performs transformations, the law that allows their occurrence, and their product. [...] Nature is inseparably given and made.”³⁸ Thus, it would therefore be a mistake to construct a methodology based on a clear-cut separation between the analysis of human relations with nature and that of social relations.³⁹ Rather, one must first of all impartially apply historical materialism to the natural sphere as well as the historical and social spheres. Secondly, for the sake of consistency, one must avoid creating a methodological dissymmetry by understanding the relationship between the natural and the historical-social spheres as a one-way exchange (which would lead to a mechanistic approach).

The authors argued that just as it is impossible to account for the historical evolution of the organization of science without recourse to factors external to scientific knowledge, so it is also necessary to draw on social explanations when it comes to the processes of validation of scientific content. This means that the study of the adequacy of a scientific theory with respect to its empirical context must necessarily take into consideration the ideological elements that condition it.⁴⁰

From this derives the view of the non-neutrality of science, which in strictly epistemological terms is encapsulated by the notion that “with regard to no form of knowledge is it possible to strictly separate factual judgments and value judgments”⁴¹ – i.e., the idea that science and ideology are in close relation. It is therefore necessary to redefine the relationship that has traditionally been assumed

38 Ciccotti et al., *L'Ape e l'architetto*, p. 53.

39 *Ibid.*, p. 87.

40 *Ibid.*, p. 74.

41 *Ibid.*, p. 66.

between praxis – generally understood as the “pure passive mirroring of a given object” – and theory – which would instead represent an “active manifestation of subjective thought” – by envisaging it as a unitary dialectical relationship.⁴²

The point just described is precisely one of the most original features of *The Bee and the Architect*. Compared to other attempts to apply the analytical tools of Marxism from a socio-historical perspective, this text opened up the ‘black box’ of scientific knowledge, to use a key term found in social studies of science. Certainly, the idea of a close correlation between the emergence of the capitalist system, the rise of industrialization, and the birth of modern science was not new within historical materialism. What *The Bee and the Architect* added in terms of both epistemological and historiographical reflection was the thesis that there is a “coherence between theoretical knowledge and practice in any given society,” indicating a certain degree of “autonomy of theoretical formulations with respect to facts.”⁴³ In a nutshell, it is not only the social organization of science that is conditioned by the socio-economic structure, but its very theoretical content.

Applied science and the related technological innovations objectively operate as productive forces – that is, they play a cardinal role as structural determinants.⁴⁴ However, this is not sufficient to describe the social function of science in advanced capitalist societies, meaning that phase of capitalism in which ‘information’ becomes a commodity on a large scale: for it leaves totally unexplored the role that pure science acquires as a specific cultural form – that is, as a superstructural force that can be equated with ideology.⁴⁵ In this sense,

42 Ibid., p. 88.

43 Ibid., p. 77.

44 Ibid., pp. 92-94.

45 Ibid., p. 101.

the issue at stake is to show in what way representations of human-nature relations influence how individuals envisage their own position in social relations.⁴⁶

Several similarities to some of the foundational theoretical cores of the Strong Program in SSK are quite evident from the passages just quoted.⁴⁷ In contrast to SSK, however, the authors of *The Bee and the Architect* came to the conclusion that one cannot open the black box of science without an explicitly critical-Marxist approach, that is, without undertaking a macro-structural analysis of the social function of science. For the authors of *The Bee and the Architect*, the ideology of neutral and pure science is organic to the capitalist system of production. From a historical-materialist perspective, the contents of science are always a reflection of capitalist relations of production, insofar as they are generated within the capitalist mode of production. It is functional to capitalist ideology to consolidate an image of scientific products as fully neutral, based on an objective description of the relations between man and nature, and grounded in a function that is entirely an end in itself and not socially determined.

This kind of description helps justify the undue extension of such descriptive neutrality to the “scales of values, patterns of behavior, forms of organization, and social purposes” characteristic of the capitalist system of production which, for that reason, claims to absolutize its value of objectivity to the exclusion of other possible alternatives. This mechanism activates a process of technocratization – that is, the selection of expert skills to which decision-making power

⁴⁶ Ibid., p. 105.

⁴⁷ See classics such as Barry Barnes, *Scientific Knowledge and Sociological Theory* (London: Routledge & Kegan Paul, 1974); David Bloor, *Knowledge and Social Imagery* (Chicago: Chicago University Press, 1976); Michael Mulkay, *Science and the Sociology of Knowledge* (London-Boston: G. Allen & Unwin, 1979); Andrew Pickering, *Science as Practice and Culture* (Chicago: Chicago University Press, 1992); and Barry Barnes, David Bloor, John Henry, *Scientific Knowledge. A Sociological Analysis* (London: Athlone, 1996).

is attributed – intrinsic to the capitalist system itself. In such a way, the scientific organization of work and social life becomes the very principle ensuring the self-reproduction of capitalist society.

For these reasons, we believe that the translation of this volume into English can help to rethink the theoretical canon of STS, so as to reopen the dialogue between this field and Marxist studies of science.

4.2. The Contribution to Historical Epistemology

As much as *The Bee and the Architect* can contribute to the STS debate, it would be reductive to consider it a sociological essay, without taking into due account the crucial relevance of its historical analysis, epistemological reflection, and political theory as its key contributions to the reflection on science. Hence, we intend to stress the importance of the theses of the book for the political-epistemological debate fostered by *Verum Factum*. However, we should first take a moment to outline its relevance for historical epistemology more generally, beginning with a clarification of our understanding of this field.

Historical epistemology connects a historicized theory of knowledge with a theoretically-informed history of science.⁴⁸ Without denying the worth of their perspectives, our collective approach goes further as we here understand historical epistemology as a reflection on scientific knowledge which takes into account the entangled dimensions of 1. the genesis, 2. validity, and 3. the goals of science, in connection to 4. world-transformative praxis. We take ‘genesis’ to refer to the historical origins (including the socio-economic roots) of

48 Dominique Lecourt, *L'épistémologie historique de Gaston Bachelard* (Paris: Vrin 1969) and Hans-Jörg Rheinberger, *On Historicizing Epistemology: An Essay* (Stanford: Stanford University Press, 2010).

science as well as cognition.⁴⁹ The problem of validity concerns method and legitimacy, both intellectual (the accordance with established principles) and social (e.g., the dependence on institutions, canons, and authorities). Thirdly, the problem of the goals of science concerns both the social functions of scientific knowledge and cultural politics (including the ideological dimension).⁵⁰ Finally, the transformative element concerns the materiality of the conditions and effects of science. Following Marx, we might call this the problem of metabolism. By that we mean the fundamental relation of material exchange (*Stoffwechsel*) between society and the environment.⁵¹

Our understanding of historical epistemology is material, historical, and praxeological. All of these connotations are simultaneously present in the program of *The Bee and the Architect*, as is evidenced by its references to Marx's theses on Feuerbach as the theoretical starting point of a reflection on objectivity that is not limited to representation but also includes intervention.⁵² The third thesis is discussed in chapter one of *The Bee and the Architect* in order to illustrate

⁴⁹ As regards the social origins of science, Hessen is still a relevant author. See his classic work Boris Hessen, "The Social and Economic Roots of Newton's *Principia*," in *Science at the Cross Roads* (London: Kniga, 1931): pp. 147–212, reprinted in *The Social and Economic Roots of the Scientific Revolution: Texts by Boris Hessen and Henryk Grossmann*, ed. by Gideon Freudenthal and Peter McLaughlin (Dordrecht: Springer, 2009): pp. 41–102. See also the recently published materials included in Hessen, *Manuscripts and Documents on the History of Physics: A Historical Materialist Textbook*, ed. by Omodeo and Sean Winkler (Venice: Verum Factum, 2022) and Sean Winkler, *Boris Hessen and Philosophy: The Socioeconomic Roots of Classical and Modern Physics* (Lanham: Rowman & Littlefield, 2023). On the connection between history and cognition, see Peter Damerow, *Abstraction and Representation: Essays on the Cultural Evolution of Thinking* (Dordrecht: Springer, 1996).

⁵⁰ In this context, the problem of ideology proves fundamental too. It has been partly dealt with by Canguilhem, but finds a more nuanced ethnographic treatment in Fleck, whose concept of *Denkstil* translates Lucien Lévy-Bruhl's concept of *mentalité*.

⁵¹ John Bellamy Foster, *Capitalism in the Anthropocene: Ecological Ruin or Ecological Revolution* (New York: Monthly Review Press, 2022).

⁵² The 'representation-intervention' conceptual pair was taken up in a pragmatic sense by philosopher of science Ian Hacking, *Representing and Intervening: Introductory Topics in the Philosophy of Natural Science* (Cambridge: Cambridge University Press, 1983).

the dialectical relation between humans and their environments.⁵³ Although Marx meant this as a reference to the *social environment* (in German, in the plural: *Umstände*), which at once shapes human action and is shaped by it, a fruitful misunderstanding occurred with the standard Italian translation of this concept as *ambiente* (environment or milieu). In Italian, this can mean either the social milieu or the natural environment, conceived of as the background that makes action possible and is dialectically transformed.⁵⁴ In this perspective, Marx's epistemology is directly connected to environmental considerations about the interdependency and mutual transformation of human societies and their natural settings. This could also be seen as a naturalistic (yet not reductive) perspective on the human transformation of the world, which is consonant with Marx's views in general, as well as with the specific argument of *The Bee and the Architect*. Furthermore, the concept of *ambiente* fosters an ontological understanding of scientific processes, because science has proven a fundamental driver of world transformation, especially in the "technological phase" of capitalism.⁵⁵

The transformative interrelation of science and territory via technological intervention and economic activity rests on what can aptly be referred to as the "dialectics of the abstract and the concrete".⁵⁶ Determined abstractions emerge in history as suitable instruments of material manipulation. The determinant factor is societal and ultimately political. Following Evald Ilyenkov, the authors of *The Bee and the Architect* argued that it would be a big mistake

53 Ciccotti et al., *L'Ape e l'architetto*, p. 58, n. 14.

54 The translation of *Umstände*, circumstances, as *ambiente*, that is, milieu or environment, is common in Italian, as is also witnessed by Gramsci's *Prison Notebooks*. Omodeo develops an environmental reading of Marx's praxeology in relation to historical ge anthropology in "Geopraxis: A Concept for the Anthropocene," in *Journal of Interdisciplinary History of Ideas* 11/22 (2022): pp. 10:1-10:52.

55 Ciccotti et al., *L'Ape e l'architetto*, p. 51.

56 Ilyenkov, quoted in *ibid.*, p. 65.

to equate the determined abstractions of science with reality tout-court.⁵⁷ Reality is processual. It results from a material interaction between subjectivity and objectivity that cannot be reduced to representation, no matter how accurate the abstract representation might be. Scientific abstractions (quo representations) are never all-encompassing and their objective validity depends on their function, on the goals. Hence, the question of the means and the adequate abstractions is necessarily linked to the question of the goals and the desirability of the society they are consonant with. In other words – taken from Weberian sociology, which is here criticized – ‘instrumental rationality’ is the (often implicit or ideologically mystified) bearer of value-oriented rationality.⁵⁸

Thus, *The Bee and the Architect* offers a Marxist approach to historical epistemology. To be sure, it is not the only historically given Marxist take on historical epistemology, but it presents markedly original insights compared to other attempts (for instance the socio-economic one by Hessen, the structuralist one by Bogdanov, and Hegelian-Marxist approaches).⁵⁹ Its originality lies in the strongly historicist and praxeological orientation adopted, with a focus on subjectivity. Although it is faithful to the Hessian legacy insofar as it assumes science to be dependent on its contexts, this approach goes one step further compared to standard economicist positions, such as those inspired by Nikolai Bukharin’s contextualism: against any form of scientific bias, the validity of science is not posited as

57 Ibid.

58 In light of this one can understand an important element in the authors’ criticism of the Frankfurt School (including Habermas), which is seen as guilty of having reduced science to instrumental rationality without considering the value-dependency of science (ibid., p. 49, n. 2).

59 For an overview we again refer to Massimiliano Badino, Ienna, and Omodeo, *Epistemologia Storica. Correnti, temi e problemi* (Roma: Carocci, 2022).

meta-historical.⁶⁰ Science can never transcend history, that is, its cultural and political *a priori*. Moreover, the historical epistemology of *The Bee and the Architect* explicitly revisits historical-political and philosophical arguments against scientism. That is, the ‘contexts’ of science are traced back to production relations, without any determinism. Owing to this connection to the sphere of labor and injustice, science is not above class struggle, but part of it. It does not constitute an isolated autonomous sphere above the rift that divides society into contrasting groups and interests. Science, which is itself a force of production (but also an exchange commodity), is the outcome as well as the vehicle of power relations and ideologies⁶¹ — hence, the need to develop historical-epistemological reflections in a political direction.

5. Relevant Theses and Problems in Political Epistemology

We should now turn to examine a set of fundamental theses and interventions in political epistemology that illustrate the enduring relevance of *The Bee and the Architect* for present debates on science.

I. The non-neutrality of science: The non-neutrality of science is the most fundamental thesis of the book.⁶² This claim derives from the above premises, particularly those concerning the goal-dependency of the questions and validity of science. Claims to neutrality constitute a political problem in themselves because, by ideologically obscuring the social roots of science, they naturalize the objectives

60 Omodeo, “After Nikolai Bukharin: History of Science and Cultural Hegemony at the Threshold of the Cold War Era,” in *Social and Human Sciences on Both Sides of the Iron Curtain*, ed. by Ivan Boldyrev and Olessia Kirtchik, special issue of *History of the Human Sciences*, 29/4-5 (2016), pp. 13-34.

61 Ciccotti et al., *L’Ape e l’architetto*, p. 99.

62 *Ibid.*, p. 31.

that are implicit in its abstractions, making them invisible. As a consequence of this mystification, abstractions come to be seen as inescapable forces. This illusion has practical and psychological consequences. *The Bee and the Architect* explicitly deals with this in terms of alienation, as understood in Marx's 1844 economic manuscripts. Indeed, the problem concerns the heteronomy of research programs if they are posited as mechanically depending on pure and disinterested science. This alienation constitutes a problem for scientific workers, who are not in a position to decide about their own activity. Furthermore, the naturalized objectivity of scientific abstractions and their goals obliterates agency, because it fosters heteronomous decisions in the name of technological determinism.

Therefore, in order to express with a formula what we have been arguing so far, science is not neutral, but rather has ideological overtones, in terms not only of its social implications, but also of its more specifically technical contents and concepts. However, as a general rule, the awareness of the non-neutrality of science is not operational in the modern scientific community. [...] Let us note that scientific theories, which present themselves as neutral in both methods and results, suffer from a substantial mystification. Their formulations offer adequate rules to transform reality, but these rules are partial cases: it is impossible to define in relation to what purpose this takes place, without completely redefining the 'meaning' of science. Thus they [these formulations] seem to be opposed to humans – whose aims they spring from in reality – as inert matter, and as such they dominate them. The question posed at the beginning is essentially resolved.⁶³

63 Ibid., p. 71.

This criticism can be extended to the problem of ‘pure science’.⁶⁴ The idea of *science pour la science* is an expression of academic corporatism in the framework of a division of intellectual labor that obscures the functions of science.⁶⁵

The theme of the non-neutrality of science finds its most strenuous proponents today among feminist epistemologists, who argue for the relevance of one’s standpoint in the wake of Sandra Harding arguments about positioned “stronger objectivity”.⁶⁶ The argument of *The Bee and the Architect* is relevant insofar as it leads us to reconsider – in addition to the gender basis of scientific partiality – the class component, which is mostly neglected today. Rereading this book can help us to reconnect the epistemological chain science-consciousness-alienation-standpoint to economic analysis and labor struggles. In this respect, what is also in order is a reassessment of György Lukács’ trajectory from his early theses on class consciousness to their later integration as part of a labor ontology.⁶⁷ Moreover, criticism of the purity of science, which today is mostly discussed in the context of practical knowledge and the practical roots of science,⁶⁸ can be broadened to include socio-economic and cultural-political aspects. Most of the dominant approaches rely on premises stemming from pragmatism, which are mostly individual-oriented or partial as they isolate scientific practices from broader societal contexts. *The Bee*

64 Ibid., p. 105.

65 See Michael Polanyi, *Science, Faith and Society* (Oxford: Oxford University Press, 1946), p. 8.

66 See Sandra Harding, *The Science Question in Feminism* (Pittsburgh: Cornell University Press, 1986), and “Rethinking Standpoint Epistemology: What Is ‘Strong Objectivity’?” in *Feminist Epistemologies*, ed. by Linda Alcoff and Elizabeth Potter (New York: Routledge, 1993), pp. 49–82.

67 Ciccotti et al., *L’Ape e l’architetto*, pp. 211–223.

68 See Pamela Smith, *The Body of the Artisan: Art and Experience in the Scientific Revolution* (Chicago: The University of Chicago Press, 2004) and Pamela O. Long, *Artisan/Practitioners and the Rise of the New Sciences, 1400–1600* (Corvallis: Oregon State University Press, 2011).

and the Architect can help reactivate a praxeological dimension that goes beyond practice, to include collective social and political agency.

II. The non-separability of facts and values: The authors of *The Bee and the Architect* also argue that judgments of fact and judgments of value cannot be separated.⁶⁹ This is a consequence of the goal-oriented character of science. Indeed, it is connected with the thesis of scientific non-neutrality. The authors of the book also express this idea as the context-dependency of “dati” (i.e., data, empirical facts) and “fatti” (i.e., deeds, facts in Vico’s sense of historical constructions). It would make sense to connect such a thesis with the theme of the ‘epistemic values’ of science.⁷⁰ At this point, however, it is necessary to stress the main difference with respect to the current debate on values in science. It should be remarked that *The Bee and the Architect* is distant from the postmodern spirit that is often ascribed to the concept of epistemic values. In this work from the Seventies, the problem of the values that enter science via epistemology is presented as a historical-materialist thesis, which is to say that it directly descends from Marxist historicism. Thus, unlike postmodern relativism, this approach has the advantage of keeping together the cultural (praxeological) origin of values and the materiality of social structures.⁷¹

The thesis of the inseparability of scientific facts and values also implies a strong anti-reductionist stance. Societal facts cannot be deterministically deduced from natural, biological, or physiological data or theories, taken in isolation and without an epistemological-historical critique of their origin, validity, and goals. No facts are value-free.

⁶⁹ Ciccotti et al., *L'Ape e l'architetto*, p. 26.

⁷⁰ This is a major theme in Lorraine Daston and Peter Galison, *Objectivity* (New York: Zone Books, 2007).

⁷¹ Omodeo, “Soggettività, strutture, egemonie: Questioni politico-culturali in epistemologia storica,” in *Studi Culturali* 15/2 (2018): pp. 211-234.

Indeed, no political decisions can be considered to be necessitated by scientific or technological objectivity. This implies that technological transitions should never be implemented without political transitions, as if they were politically neutral: all techno-scientific solutions depend on the society that they envisage.

III. The inseparability of science and ideology: science is embedded in mentalities – what historians and philosophers of science variously refer to as “Denkstile”, “styles of thinking”, or “historical *a priori*”, depending on the reference authors (Fleck, Hacking, or Foucault). The basic idea on which the styles-of-thought problem or the ideological-embedment thesis rests, is that science is a cultural phenomenon. However, culture should not be regarded as a spiritual endeavor. Neither culture nor science can be seen as purely intellectual constructions, contrary to what the most radical social-constructivist views, post-modernism, and post-truth epistemologies suggest. As the authors of *The Bee and the Architect* emphasize, “social origin and arbitrariness are by no means synonyms”.⁷² A new paradigm should be achieved which is neither idealistic nor reductionistic. We might call it a historical-natural paradigm, one that incorporates an awareness of the cultural conditioning of science.⁷³ For the authors of *The Bee and the Architect*, historical materialism – and Marx’s own path to science, as exemplified by his political and economic theories – could be considered the missing paradigm. In other words, Marxism offers the paradigm of the ‘natural history’ to come, as it were, not because its scientificity is rooted in the method of the natural sciences at their present stage, but rather – on the contrary – because it questions the imperialism of the method of the natural sciences from a historicist

72 Ciccotti et al., *L'Ape e l'architetto*, p. 63.

73 *Ibid.*, p. 67.

and praxeological perspective. By pointing in this direction, this intellectual project runs counter to the view championed by supporters of ‘scientific’ Marxism such as Bukharin, Louis Althusser, and Colletti.

IV. The critical overcoming of the ideological either/or alternative between obscurantism and scientism: *The Bee and the Architect* argues that science should not be reduced either to bare facts or to pure ideology. In opposition to the view that it is necessary to choose between two opposite and irreconcilable camps (obscurantism or scientism, irrationalism or positivism),⁷⁴ the authors argue that science ought to be seen as the dynamic entwinement of cultural factors and material constraints. It is neither empirically given nor an arbitrary construction. Such an argument has not lost its relevance, as current academic and public debates on science and scientific facts tend to be polarized between radical populist skepticism and technocratic scientism.⁷⁵

The tension between the image and the reality of science⁷⁶ appears most clearly, and tends to erupt, in times of crisis:

In times of crisis, the conflict surrounding the goals of science, and therefore its better abstractions, will become sharper, and the assumed mixture between knowledge and interests will become particularly evident through the contrast between different scientific alternatives.⁷⁷

⁷⁴ Ibid., p. 50.

⁷⁵ Omodeo and Lukas Meisner, “L'aut aut di fatticità scienista e relativismo postmoderno quale semplificazione ideologica del problema epistemologico di expertise e populismo post-veritativo,” in *Expertise ed epistemologia politica*, ed. by Ienna, D'Abramo, and Badino (Milano: Meltemi, 2022), pp. 37-69

⁷⁶ On the images of science, see Yehuda Elkana, “A Programmatic Attempt at an Anthropology of Science,” in *Sciences and Cultures: Anthropological and Historical Studies of the Sciences*, ed. Everett Mendelsohn, and Elkana (Dordrecht: Springer, 1981), pp. 1-76.

⁷⁷ Ciccotti et al., p. 65.

Crises and paradigm shifts are as epistemological as they are political. A truly emancipatory leap forward should be fostered through an epistemology from below – the product of a radical science movement linking the rights of science workers to the desire for freedom and justice of society at large.⁷⁸

V. The solution of the dichotomy between nature and history: In the book, the need to overcome the dualism of nature and history⁷⁹ is expressed in terms of a task: to bring together ‘causes’ and ‘goals’,⁸⁰ materialism and historicism. The authors’ declared intention is to overcome the disciplinary rift between those dealing with nature and those investigating the human spirit, based on the canonical neo-Kantian separation between *Naturwissenschaften* and *Geisteswissenschaften*.⁸¹ This issue certainly carries methodological and epistemological significance, but it is also ontologically meaningful. It can be related to present-day criticisms of dichotomies ranging from the Anthropocene debate (epistemic history as the history of the Earth system) to eco-politics, as well as new materialism and the post-human condition.⁸² The approach of *The Bee and the Architect* embraces a materialist perspective that connects Marx to Gramsci and even Lukács in

78 On the general project of observing modes of knowledge formation “from below”, see the following special issue: Gerardo Ienna and Charles Wolfe (eds), “Knowledge from Below: Case Studies in Historical and Political Epistemology”, in *Berichte zur Wissenschaftsgeschichte / History of Science and Humanities*, 45 (2022): 535-650.

79 Ciccotti et al., p. 18.

80 Ibid., p. 45.

81 See also Charles P. Snow, *The Two Cultures and the Scientific Revolution* (Cambridge: Cambridge UP, 1959).

82 Among many others, see Jürgen Renn, *The Evolution of Knowledge: Rethinking Science for the Anthropocene* (Princeton and Oxford: Princeton UP, 2020) and Donna Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham: Duke UP, 2016). For a criticism of the flat ontology of new materialism, see Cat Moir and Charles Wolfe, “Sui fondamenti onto-politici del Nuovo Materialismo: dagli studi scientifici femministi alla metafisica”. In *Expertise ed epistemologia politica*, edited by Gerardo Ienna, Flavio D’Abramo, and Massimiliano Badino, (Milano: Meltemi, 2022): pp. 267- 298.

the direction of a historical ontology. Accordingly, the disciplinary rift between natural sciences and the humanities is the expression of a *real* rift, which is social and environmental. This is consonant with current attempts to connect political and ecological struggles in the pursuit of economic and environmental justice.⁸³

Concluding Remarks

The relevance of *The Bee and the Architect* for Italian debates on science is beyond dispute, although its legacy is controversial. The publication of the book, back in the Seventies, sparked controversies about science and society, scientific knowledge and ideology, power relations, technology, facts, and values. The echoes of these controversies still loom large over the current perception of science in Italy. They also mark a different path to the Science Wars, which – unlike the path followed in the Anglophone world – rested on materialist premises and Marxist critical theory.⁸⁴ Some of the most debated theses of those days have become common assumptions (e.g., the social and political relevance of science and the reflection on this topic), while others have come to the fore in the wake of recent debates about scientific facts and expert-based decisions (e.g., science and ideology). In some cases, themes that did not initially gain prominence have reentered Italian scientific culture via novel currents and trends. However, a full appreciation of the potential of *The Bee and the Architect* is still missing, as is witnessed by some of the most heated polemics that have gained prominence in times of pandemics management, environmental emergency, and war (for instance, the need

⁸³ Foster, above mentioned.

⁸⁴ On the limits of the Science Wars from a Marxist viewpoint, see Ali C. Gedik, “Back to Engels: A Long Century of the First Fiddle without the Second,” in *Marxism and Science: A Journal of Nature, Culture, Human and Society* 1/1 (2022): pp. xiii–xxxix.

for a critical theory that avoids both populism and scientism). The theses and spirit of *The Bee and the Architect* can help us to navigate an epoch that is in dire need of a critical and democratic scientific culture. Moreover, it is time to transcend the national boundaries that have limited the reception of *The Bee and the Architect* thus far. The concepts found in this book, which are centered on a criticism of our societies and stress the relevance of epistemology for politics, ought to be assessed in the context of today's international debates. In particular, *The Bee and the Architect* offers a model of political epistemology that moves beyond postmodernity, post-truth, and novel forms of scientific reductionism, by offering a cultural yet never arbitrary path – a historical-materialistic praxeological perspective. ⁸⁵

⁸⁵ This text is the result of collaborative work; however, Gerardo Ienna is the author of sections 1, 3, 4.1, Pietro Daniel Omodeo of sections 2, 4.2, 5, 6. For this project Ienna has received funding from the European Union's Horizon 2020 research and innovation programme under Marie Skłodowska-Curie grant agreement no. 101026146. Omodeo would like to acknowledge the UNESCO Chair *Water, Heritage and Sustainable Development*, the FARE project *EarlyGeoPraxis* (funded by the Italian Ministry of University and Research, cod. R184WNSTWH), the Max Planck Institute for the History of Science, Berlin, the Max Planck Partner Group *The Water City* (Berlin-Venice), and THE NEW INSTITUTE Center for Environmental Humanities (NICHE), Venice.