

Charles Alunni, *Spectres de Bachelard. Gaston Bachelard et l'école surrationaliste*, Paris: Hermann, 2019. 494 pp. Appendices, Bibliography (37 pp.), Onomastic Index.

Spectres de Bachelard. Gaston Bachelard et l'école surrationaliste provides a highly sophisticated account of Bachelard's work and its influence in the European philosophy of science. The volume is organized around two main parts, one devoted to Bachelard *per se* (*Partie I : Figure*, pp. 11-154), and another devoted to Bachelard *per alium* (*Partie II : Spectres*, pp. 157-422). The main concepts studied in the book are (i) *surrationalism* (a not always accepted translation of "surrationalisme") and (ii) *spectrum culturalism* (a new understanding of the term "spectre", blending irradiation, influence and inverse/negative approaches to knowledge). The difficulty in translation shows already the profound originality of Alunni's enterprise. The work is inscribed in a great French tradition (Poincaré, Brunschvicg, Cavallès, Lautman, Desanti, Vuillemin, Châtelet, Petitot, Badiou), but excels to *go beyond* the usual reception, and includes, around Bachelard, other resonances and harmonics with lesser known names (exceptional studies on Juvet and Winter, for example). In that sense, *Spectres de Bachelard*, where 20 years of Alunni's studies are summed up, may well be understood as a *culmination* in the French school of philosophy of mathematics.

On one hand, (i) *surrationalism* (term invented by Bachelard in 1936) introduces both an internal dialectics in which reason reflects on itself and *goes beyond* its very rationale, and an external dialectics in which objectivism is *augmented* through the abundant constructivist interpretations of the subject. In this frame, a thorough *spiritual liberty* is introduced in the philosophy of sciences, with strong consequences in esthetics and the philosophy of art. On another hand, (ii) *spectrum culturalism* offers both a *multiplication* of perspectives (iteration, recursion, distribution) and a possibility of *convergence* through a lattice order of *philosophical tones*. Some hidden harmonics and fractal deviations help to calibrate the *rich strata of the spectrum/specter* associated to Bachelard's figure.

The first chapter, "I. Relativités et puissances spectrales chez Gaston Bachelard" (pp. 11-70), studies the connections between Bachelard and Einstein, exposing many common points around their non-positivistic postures, their "constructive realisms" and their extraordinary riemannian-weylian vision of reality: "la matière nous apparaît sous la forme d'une contingence en quelque sorte feuilletée" (Bachelard's quote, p. 25). Alunni recalls that Einstein could not refer explicitly to Bachelard for chronological reasons, while, on the other hand, an explicit review of the many appearances of Einstein in Bachelard is provided (pp. 27-31). Alunni offers a thorough analysis of *La valeur inductive de la relativité* (1929), both external (through its reception, pp. 31-53), and internal (through Bachelard's "induction" and "synthèse inductive", pp. 54-63). A final section addresses the metaphysical consequences of their posture, and Einstein is seen as a welcome "électrochoc

métaphysique à l'usage des philosophes" (p. 65). In our short-visional era, Alunni's detailed study of the higher connections between Einstein and Bachelard, always looking *beyond* our restricted contingencies, offers some air and breath for the younger generations: knowledge do needs science, metaphysics, and metaphor.

The second chapter, "II. La valeur inductive de la relativité contre la Phénoménotechnique" (pp. 71-89), written as a counterpart to Daniel Parocchia's introduction to the long awaited reedition (2014) of *La valeur inductive de la relativité*, shows forcefully the continuity of Bachelard's thought, between *La valeur* (1929) and *Le rationalisme appliqué* (1949). Alunni deconstructs Parocchia's dubious interpretation of a shift, or even a "contradiction" in Bachelard's opus, and underlines on the contrary a continuous attention to mathematical abstraction ("induction algébrique et amplifiante", p. 83), key to a "noumenological mathematics" (p. 87) inscribed both in Relativity and Quantum Mechanics. The third chapter, "III. Pour une métaphorologie fractale" (pp. 91-112), introduces a beautiful dialogue between Bachelard and Alunni, where the latter displays his metaphorical imagination following a full counterpoint with Bachelard's profound ideas and images. Recalling Bachelard's insistence on the notions of spectrum and spectra, Alunni reveals the techniques that a pluralistic philosophy of science must possess, derived from spectrality conditions: order, diffusion, symmetry, dialectics (pp. 94-95), leading to a continuous "transduction" of knowledge, based on "*rappports sans supports et sans rapporteur*" (Bachelard's quote, p. 92; an incredible anticipation of the highest themes in Category Theory). The force of both Bachelard and Alunni's interlacing between abstract thought and metaphorical language is expressed in a pair of Alunni sentences, that this reviewer cannot resist to quote in full:

Il en va dès lors d'une double contamination, d'une rythmique dialectique et duale, d'une bi-réflexion arc-boutée et tendue selon les contraintes libératoires d'un échangeur commun. Question de partages, de pontage, et donc de tra(ns)ductions des frayages doublement engagés mais toujours repris dans l'unité d'un horizon de pensée irréductiblement commun. (p. 95)

Contamination, rhythm, dialectics, reflection, liberation, unity in the diverse, are some of the forceful characteristics of Bachelard's thought ("polyphilosophie en mesure de filer les brins différentiels de la pensée", p. 111), fully reflected also in Alunni. The third, brilliant, chapter finishes with some considerations around Derrida and Nottale in their reactions to Bachelard's metaphorology (pp. 101-112).

The fourth chapter, "IV. Bachelard face aux mathématiques" (pp. 113-138), addresses many Bachelard citations where his "*surrationalisme*" (1936) is closely related to the freeness of abstract mathematics, and where a negative mathematical dialectics opens the possibility of "*surobjects*" ("le surobject est le résultat d'une objectivation critique (...) [et] est très exactement la non-image", Bachelard's quote, p. 119). One senses fully the incredible Bachelard anticipations of the *extended reason* that other great thinkers will rediscover on their own in the 20th century. On the other hand, Alunni destroys the repeated prejudice ("poncif", spread through Roger Martin's intervention at the Cerisy Colloque, 1970) that Bachelard

would have been far away from mathematical thought. With his usual care – that is with high conceptual and terminological precision, and with a thorough reading of the literature, both primary and secondary, which this reviewer considers pretty unique –, Alunni shows how Bachelard was extremely aware of the mathematics of his time, how he mentioned them densely in his work, and how some models (particularly around algebraic geometry and riemannian geometry, pp. 136-137) were even at the very base of his “rationalisme appliqué”. The fifth chapter, “V. Métaphysique des mathématiques: Spinoza chez Bachelard” (pp. 139-154), uncovers a forgotten Bachelard article (“Physique et métaphysique”, in *Septimana Spinozana*, 1933), where Alunni sees already present the main operators of Bachelard’s thought: organic link science / metaphysics, pregnancy of a mathematical noumenology, centrality of induction, non-Kantian critique of the Real, “*surdialectique*” (p. 139). After reading in depth the texts on Spinoza (Brunschvicg 1894, Bellangé 1912) that may have influenced Bachelard, Alunni goes on to explain Bachelard’s main intuition: “Il y a peut-être intérêt à prendre un morceau de spinozisme comme *germe de cristallisation* pour une philosophie de la science moderne” (Bachelard’s quote, p. 149). There, we enter in an *axiomatics* of a dialectical superposition between Spinoza’s *natura naturans* (mathematical thought) and *natura naturata* (experimentation), modelled through... the Möbius strip! (p. 150). Towards an amplification of the polarities, towards the construction of a *natura constructa* and a *natura construans* (“créer l’expérience comme la pensée *more geometrico*”, Bachelard’s quote, p. 154), negations, inversions, gestures, contaminations, augmentations, become then fundamental operators of Bachelard’s “*surdialectique*” and “*surrationalisme*”. With the fifth chapter, ends Part I (“Figure”) of *Spectres de Bachelard. Gaston Bachelard et l’école surrationaliste*. Bachelard’s *figure* emerges with a sense of *deepness and never ending originality*, probably not sensed before in Bachelardian studies.

On the other hand, Part II (“Spectres”) studies the many counterpoints and echoes of Bachelard’s work along the non Anglo-Saxon philosophies of sciences in the 20th century. The French and Italian schools become prominent in a natural dialogue: Albert Lautman, Gustave Juvet, Maximilien Winter; Federigo Enriques, Ettore Majorana, Gian-Carlo Rota; and a small excursus on the ETH school (Hermann Weyl, Wolfgang Pauli) is provided on the German side. The sixth chapter, “VI. Albert Lautman et le souci brisé du mouvement” (pp. 157-179), offers an introduction to Lautman (in the appreciation of this reviewer, the deepest philosopher of mathematics in the 20th century), measuring his reception (pp. 159-161), his use of Heidegger (pp. 162-173), and his connection between mathematics and physics around symmetry and dissymmetry (pp. 173-179). In particular, Alunni’s careful discussion of Heidegger on Lautman (for which the young Normalien has been consistently criticized) shows the importance of a “desubstantialisation” or “*an-hypostatic will*” (p. 164) in Lautman’s project, akin to Heidegger’s architectural *hierarchy* of passages between essence and existence: beyond a naïve absolute Platonism that Lautman never supported, a dynamical, dialectical, differential, Platonism emerges, closer to Châtelet’s “*force de l’ambiguïté*” and “*balance dialectique*” (p. 165), which encompasses the fields of mathematical practice.

The seventh chapter, « VII. L'«École de l'ETH» dans l'oeuvre de Gaston Bachelard. Les figures spectrales d'Hermann Weyl, Wolfgang Pauli et Gustave Juvet » (pp. 181-208), situates, along with Mario Castellana, the haunting force of an *spectral* "Italian-French neorationalism" (p. 182), which will consistently oppose the Vienna Circle and its derivations into *bright* Anglo-Saxon analytical philosophy. First, Alunni studies Weyl's presence in Bachelard's principal and complementary Ph.D. theses (1927), as a "geometer of matter" (p. 189), following Riemann's structural and functional understanding of an augmented reality (pp. 188-189), where mathematics becomes a *commanding key* to phenomenology: "l'unité mathématique qui se constitue dans une axiomatique de la Physique commande entièrement l'unité du phénomène" (Bachelard's quote, p.192, a sense exactly anticipated in the 1880s by an unknown Peirce at Bachelard's time). Second, Alunni delves into Pauli (or the "Schola Quantum" in a wink), a central figure in Bachelard's writings on quantum mechanics and on its extension to a non-realistic "quantum metaphysics" (p. 195), part of a fundamental "complexification of philosophical thought" (p. 201). Third, Alunni, with his keen sense for recovering original and profound thinkers erased by the developments of normal academicist philosophy (an "aberration", p. 202), rediscovers for our times the work of Gustave Juvet (1896-1936), another of the French neorationalists (or surrationalists) dead at a young age (along with Cavallès and Lautman). Juvet's studies on the tensor calculus (1922), his articles (with Ferdinand Gonseth) on Kaluza-Klein's fifth dimension to extend Relativity (1927-1928), and his work on Clifford algebras and its applications to physics (1930-1932), summed-up in his book *La structure des nouvelles théories physiques* (1933, studied and mentioned both by Bachelard and Lautman), show not only Juvet's instinct to understand in depth some hidden mathematical structures of physics, but also his extraordinary actuality one hundred years later. The eight chapter, "VIII. Gustave Juvet (1896-1936), un pionnier oublié des études cliffordiennes" (pp. 209-257) offers the first complete study on Juvet's opus. Characteristic of Alunni's efforts, the text renders a tribute to the *forgotten*, situating the due relevance of alternative original thinkers, beyond the ephemeral modes of academic power. Alunni's *sacrifice*, offering his sharp intelligence to the resurfacing of *others*, is a jewel of generosity hardly seen in our times, where light navigation and self-promotion abound. A brief intellectual portrait (pp. 211-214) shows Juvet's pregnant interests, fostered in the Séminaire Hadamard, along the Riemann-Weyl lines of a geometrization of physics; at 26 years of age, Juvet founds and directs a "Collection de monographies scientifiques étrangères", where he translates Sommerfeld, Jeans, Wegener, before presenting his Ph.D. thesis (1926) under Élie Cartan; moving to Switzerland, he agitates the mathematical community, presides the Swiss mathematical society, edits its main journal, and publishes *La structure des nouvelles théories physiques* (1933) and *Leçons d'analyse vectorielle* (2 volumes, 1933, 1935), before dying of an embolism in a mountain promenade (recalling the tragic final of the mathematical genius, Jacques Herbrand, in 1931). Alunni offers a synthetic view of Juvet's writings (pp. 214-225), detailing his contributions in analytical geometry, differential geometry, Kaluza-Klein, and Clifford algebras, before proceeding to a novel understanding of his work in the main section "La

philosophie symplectique de Gustave Juvet. Un surrationalisme des structures” (pp. 226-254). Here, one reckons how much the philosophy of science *loses in forgetting* alternative figures as Juvet, Lautman, or Winter (chapter IX below): (i) a philosophy of structures and groups (pp. 235-242) deconstructs any substantialist perspective, well before a language theoretic orientation will proceed to a similar goal, (ii) a methodological “relationalism and algebrization” (pp. 243-247) and a “philosophy of operators” (pp. 247-252) sustain a functional ontology without points, well before a transitory or category-theoretic ontology will be suggested to understand mathematical practice, (iii) a “symplectic philosophy” (pp. 253-254) offers a wealth of interlacing and joining operators (“entrelace”, “tresse”, “tisse”, p. 254), anticipating our contemporary “knot” obsessions.

The ninth chapter, “IX. Maximilien Winter et Federico Enriques: des harmonies exhumées” (pp. 259-287), explores part of Winter’s work (again, one of the forgotten) in harmonic conjugation with Enriques, subsumed both under a “surrationalist constellation” (p. 261), where “rectified knowledge”, “recurrence foundations”, and a “constructability” drive beyond immediacy (p. 262), govern the situation. Alunni recovers the importance of the *Revue de Métaphysique et de Morale* (nicknamed by Alain, *Revue de Mathématiques et de Morale*, a conjunction unthinkable nowadays) as a “pourvoyeuse des sciences contemporaines” (p. 263), and studies the role therein exerted by Winter. The first to point to Einstein in France (*La méthode dans la philosophie des mathématiques*, 1911), Winter constitutes himself as a “passeur” between philosophers, mathematicians, and physicists, an incessant activity well documented through a copious correspondence. Contesting logistic (p. 272) and positivistic (p. 274) attitudes, Winter constructs his philosophy of science under an extended “mathématisme” (p. 275), very close to Enriques’ own position (in *Il significato della critica dei principi nello sviluppo delle matematiche*, 1912). In fact, Alunni detects in Winter one of the fundamental approaches of his very critical method:

(...) le philosophe doit s’immerger conceptuellement dans le texte mathématique pour en dégager *surrationallement* les enjeux fondamentaux. (p. 276)

The *immersion* in mathematical texts is indeed *mandatory* to be able to think about mathematical thought (fundamental recurrence). Far away from an analytical philosophy which has only handled set theory and classical logic, the “surrationalist constellation” was already dealing with the new developments of geometry, topology, algebra, number theory, functional analysis, mathematical physics... Through axiomatics, dialectics, harmonics, successive approximations, negativity (where Galois and Riemann, again, open modern mathematical thought), Alunni observes in Winter and Enriques the emergence of a *metaphysical mobility* (pp. 278-282), well present in Bachelard’s “pédagogie de l’ambiguïté” and “ontologie du complémentaire” (Bachelard’s quotes, p. 285), and which all Grothendieckian mathematics will *prove in act* in the second half of the 20th century. The tenth chapter, “X. Ettore Majorana et la philosophie: entre affinités électives et conjectures philosophiques” (pp. 289-314), evokes the many fictions written on Majorana

na, and opens the possibility of understanding his ghostly appearances through the notion of “spectre” (both *spectrum* and *specter*, pp. 298-299). Alunni then studies the many elective affinities between Majorana and Giovannino Gentile Junior (the son of Giovanni Gentile), both colleagues in Rome in the 1920s, where Gentile’s good knowledge of the developments of group theory in physics (pp. 310-312) is transmitted to Majorana’s fantastic intuition. Again, mathematical structures serve as a natural bridge between physical phenomena and spiritual content (following Heisenberg, p. 314).

The eleventh chapter, “XI. Gilles Châtelet, figure romantique du surrationalisme” (pp. 315-393), offers a very complete presentation of Châtelet’s work, the last gigantic philosopher of mathematics of the French school. Châtelet’s presentation is divided in two central parts. On one hand (sections 1-5 & 7-8), the main forces behind Châtelet’s work (*Les enjeux du mobile*, 1993, *L’enchantement du virtuel*, 2010, eds. Alunni, Paoletti) are revealed: Romanticism, creative Dialectics, articulation theory, gestural practice, metaphorical inventiveness, visual schematization, freeness operators, dynamic virtuality, mathematical pulsation, sensibility to the negative and the obscure. On another hand (section 6), a long study of Châtelet’s geometric thinking is provided, around some of his most intriguing and original visions: attention to points, arrows, and diagrams, in order to think synthetically the abstract and the concrete, and to foster a piercing imagination (“suture” / “structure” between images, diagrams, and developing thought, p. 385). In Alunni’s detailed analysis, one senses the greatness of both of Châtelet and his commentator (the “grand style”, as Badiou puts it, p. 320), who, in the *abyssal* dimension of the problems proposed and the *precision* of the terminology used, are able to deal with the very true and profound *raison d’être* of human thought. There, the Romantic attention to the *deep*, articulated with Châtelet’s *exact* knowledge of modern and contemporary mathematics, produces an extremely dynamic philosophy of mathematics (and culture, and life: “le philosophe est transversal, diagonal, voyageur”, Badiou’s quote, p. 393), beautifully captured in Alunni’s metaphor “structure möbiusienne de l’œuvre au noir” (p. 389). Finally, the twelfth chapter, the last chapter of the book, “XII. Gilles Châtelet et Gian-Carlo Rota: deux mathématiciens aux avant-postes de l’obscur” (pp. 395-422), underlines again the importance of a *wide reason*, a *spectral knowledge*, a *surrationalist openness*, where a “pensée jaillissante” (p. 401) *can never be reduced* to apparently exact linguistic constraints. Alunni underlines how both Rota and Châtelet, united around an appreciation of the forgotten Grassmann (pp. 403-406), proceed to a « refus *vigoureux* mais *rigoureux* de l’approche logique et langagière dans la pensée du nouage entre science et philosophie, précisément parce que les savoirs ne se réduisent pas à leur dimension officielle» (p. 398). Beyond academic officialism, beyond the modes of power, Rota and Châtelet (and Alunni with them) explore the *strategies of invention* in mathematics (also expressed in Grothendieck’s *Récoltes et semailles*, p. 416), where a full combinatorics of signs (vague/exact, visual/linguistic, abstract/concrete) governs mathematical creativity. Two useful appendices offer an indexing of all the articles of the *Revue de Métaphysique et de Morale* (1893-1947: fantastic presence of mathematical thought), and, in particular, a list of the articles of Maximilien

Winter in the *Revue* (1893-1931). An outstanding bibliography (pp. 439-476) will serve to experts and newcomers alike, in order to obtain a precise and deep approach to the “constellation surrationaliste”. A useful onomastic index completes the volume.

Physical robustness, mathematical precision, and metaphysical freedom, are all studied with outstanding imagination in Alunni's work. Through dense re-readings, new insights, reorganization of hierarchical information, Alunni explores the ever difficult *back-and-forth* between abstract universals and concrete particulars, following Bachelard's *spectrum irradiation*, an essential approach to understand our times. *Going beyond* is a Bachelardian characteristic of Alunni's conceptual framework, which becomes inscribed in his very style. In fact, *Spectres de Bachelard* not only offers an outstanding panorama of European philosophy of science in the 20th century, but also, through the richness of its language, the recursive development of concepts, and the material disposition of never ending notes at bottom of the page, the work becomes a *high example of literary style*, reminiscent of both Proust and Bachelard's *density of intelligence*. One cannot emphasize enough how Alunni's magisterial book lies in its most minimal details: “God is in the details” as Aby Warburg insisted in his understanding of art history and cultural studies. *Spectres de Bachelard. Gaston Bachelard et l'école surrationaliste* will be fundamental for a rebirth of Bachelard's legacy, and, as well, will provide an extremely useful *orientation guide* for new generations of philosophers and practitioners of science.

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