

FNRSCURRICULUM VITAE

Michel GHINS
Professeur ordinaire émérite

Institutional address:

Centre de philosophie des sciences et sociétés (CEFISES)
Institut supérieur de philosophie (Université Catholique de Louvain)
Place du Cardinal Mercier, 14
B-1348 Louvain-la-Neuve, Belgium
email: michel.ghins@uclouvain.be
Website: <https://www.researchgate.net/profile/Michel-Ghins/research>

Home address
Av. Nestor Plissart 96
B-1150 Brussels, Belgium

Personal data: Born 20 September 1948 in Schaerbeek (Belgium). Married. Three children.

Education

PhD (doctorat) in Philosophy. Université Catholique de Louvain. Title of dissertation : Absolute and Relational Conceptions of Space-time (in French). Supervisor: Jean Ladrière. *Summa cum laude* (la plus grande distinction). 1982.

M.A. in Philosophy (QPA: 3.9 / 4). Department of Philosophy of the University of Pittsburgh. 1977.

Graduate (licencié) in philosophy. Université Catholique de Louvain. Title of thesis: The Structure of Wittgenstein's Tractatus (in French). Supervisor: Jean Ladrière. *Summa cum laude* (la plus grande distinction). 1974.

Graduate (licencié) in (theoretical) physics. Université Catholique de Louvain. Title of thesis : Hadronic Spectroscopy (in French). Supervisor: Jacques Weyers. *Magna cum laude* (grande distinction). 1971.

High school education. Humanités latin-grec. Jesuit high school *Collège Saint-Michel*. Brussels. 1966.

Research and teaching positions

Professeur émérite. Université Catholique de Louvain. Institut Supérieur de Philosophie. Since October 2013

Professeur ordinaire. Université Catholique de Louvain. Institut Supérieur de Philosophie. 2003-2013

Professeur. Université Catholique de Louvain. Institut Supérieur de Philosophie. 1994-2003.

Chargé de cours. Université Catholique de Louvain. Institut Supérieur de Philosophie. 1986-1994.

Visiting Scholar (on sabbatical leave) at the University of Oxford (Sub-Faculty of Philosophy and Wolfson College). September 1995-August 1996.

Professore a contratto. Università degli Studi di Torino. Dipartimento di Ermeneutica e di Scienze dell'Informazione. April 1993. Invited series of lectures on scientific realism.

Visiting Associate Professor. School of Philosophy. Catholic University of America.

Washington D.C. January-May 1989.

Associate Professor. State University of Campinas (Sao Paulo, Brazil). 1983 - 1991.

Teaching Assistant. Université Catholique de Louvain. Institut Supérieur de Philosophie. 1977-1982.

Teaching Fellow. Department of Philosophy. University of Pittsburgh. 1976-1977.

C.R.B. Fellow (Belgian American Educational. Foundation). Department of Philosophy. University of Pittsburgh. 1975 -1976.

Publications

Books

1. *L'inertie et l'espace-temps absolu de Newton à Einstein. Une analyse philosophique.* Académie Royale de Belgique. Classe des lettres. Tome LXIX/2. 238 p. 1990.
2. *A inércia e o espaço-tempo absoluto de Newton a Einstein.* Portuguese translation of 1. *Coleção CLE, vol. IX.* 312 p. Campinas, Brazil. 1991.
3. *Uma Introdução à Filosofia da Natureza. Representação, realismo e leis científicas.* Editora da Universidade Federal do Paraná, Curitiba, Brazil. 2013.
<http://www.editora.ufpr.br/portal/livros/uma-introducao-a-metafisica-da-naturezarepresentacao-realismo-e-leis-cientificas/>
4. *Scientific Realism and Laws of Nature: A Metaphysics of Causal Powers.* Synthese Library 483. Cham: Springer Nature. 2024.
<https://link.springer.com/book/10.1007/978-3-031-54227-5>

Reviews

Mario Alai *International Studies in the Philosophy of Science.* 37, 3. 150-154. 2024.
<https://www.tandfonline.com/eprint/INCBVH47RKGSEEKPRNGE/full?target=10.1080/02698595.2024.2402886>

Deiver de Melo *Manuscrito Revista Internacional de Filosofia.* 47, 4. 2024

<https://doi.org/10.1590/0100-6045.2024.V47N4.DM>

<https://www.scielo.br/j/man/a/gnhZxP4YwBCv74T5TMKfPdh/abstract/?lang=en>

Book forum on *Scientific Realism and Laws of Nature.* Precis by M. Ghins followed by commentaries by Mario Alai, Alexander Bird, Otavio Bueno, Stathis Psillos. Forthcoming in *Philosophia.*

Edited Works

Actes du Colloque Newton (Louvain-la-Neuve, 13 february 1987). Special issue or the *Revue Philosophique de Louvain.* Vol. 96, n. 4. August 1988.

Histoire et Philosophie des sciences : quelles interactions ? Special issue of the *Revue Philosophique de Louvain.* Vol. 94. August 1996.

Les défis de la rationalité. Actes du Colloque organisé par l'Institut Supérieur de Philosophie à l'occasion des 80 ans du professeur Jean Ladrière. Edited by B. Feltz et M. Ghins. Peeters. Bibliothèque philosophique de Louvain 63. 2005.

Articles

1. « La forme et le sens dans le Tractatus de Wittgenstein ». *Revue Philosophique de*

Louvain. 751. 453-81. 1977.

2. « L'espace, la géométrie et l'expérience ». *Cahiers du séminaire de philosophie des sciences*. Louvain-la-Neuve : Cabay. 21 p. 1978.

3. « Le conventionnalisme géométrique de Poincaré ». *Cahiers du séminaire de philosophie des sciences*. Louvain-la-Neuve : Cabay. 29p. 1978.

4. « Trois interprétations du conventionnalisme géométrique de Poincaré : Eddington, Einstein, Grünbaum ». *Cahiers du séminaire de philosophie des sciences*. Louvain-la-Neuve : Cabay. 29p. 1978.

5. « La conception substantialiste de l'espace chez Newton ». *Cahiers du séminaire de philosophie des sciences*. Louvain-la-Neuve : Cabay. 28 p. 1979.

6. « L'espace relatif et l'espace absolu : Leibniz contre Clarke ». *Cahiers du séminaire de philosophie des sciences*. Cabay. Louvain-la-Neuve. 27 p. 1979.

7. « Géométrie et expérience : remarques sur le conventionnalisme géométrique de Poincaré ». *Abstracts of the VIth International Congress of Logic, Methodology and Philosophy of Science*. Hannover. 22-29 august 1979.

8. Book review of *Der Aufstieg der Wissenschaftlichen Philosophie* by Hans Reichenbach (ed. by A. Kamlah). *Revue Philosophique de Louvain*. 602-05. 1979.

9. «Newton, Leibniz and the Empirical Acceptability of Absolute Space ». *Epistemologia*. 8. 103-124. 1985.

10. «O argumento de Newton a favor do espaço absoluto». *Cadernos de História e Filosofia da Ciência* 1. 61-68. 1986.

11. «Popper on the Arrow of Time». *Manuscrito* 9. 77-94. 1986.

12. «A noção de progresso científico». *Cadernos da Pontifícia Universidade Católica de São Paulo*. 9-24. 1987.

13. "L'inertie dans les Principia". *Actes du colloque Newton. February 13, 1987. Revue Philosophique de Louvain*. 523-37. November 1988.

14. «Causal Antecedence: Logical or Temporal Order? ». *Proceedings of the 'Chaire Quételet' (13-16 october 1987): Explanation in the Social Sciences*. Louvain-la-Neuve : Ciaco. 215-23. 1989.

15. Entries « Positivisme logique », « Mécanisme », « Inductivisme », « Espace », « Loi de la nature », « Règle de correspondance », « Description d'état », « Dimension ». *Encyclopédie Philosophique* (ed. by A. Jacob). Paris : Presses Universitaires de France. 1990.

16. « Two Difficulties with regard to Aristotle's Treatment of Time ». *Revue de philosophie ancienne IX, 1*. 83-98.1991.

17. « Scientific Realism and Invariance ». *Proceedings of the Third SOFIA Conference on Epistemology. Campinas. July 30 - August 1, 1990. Philosophical Issues (Vol. 2: Rationality in Epistemology)*. 249-62. California: Ridgeview. 1992.

18. « La rationalité de l'espace et du temps absolus chez Newton : physique et théologie ». *Les procédures de preuve sous le regard de l'historien des sciences et des techniques. Actes du colloque de Lille. April 11-13, 1991. Cahiers d'histoire et de philosophie des sciences 140*. 137-46. 1992.

19. « A equivalencia dinamica segundo Mach e a teoria geral da relatividade ». *Anais do VII Coloquio de História da Ciência. Águas de Lindoia (Brazil). 12-15 October 1991*. Campinas: Coleção CLE. 161-75. 1993.

20. Book review of *Philosophical Perspectives in Newtonian Sciences* (ed. by Bricker and Hughes, MIT 1990). *Archives internationales d'histoire des sciences*, 8, 167-73. 1994.

21. « Un exemple d'interaction entre science et philosophie : le débat concernant le réalisme scientifique ». *Les sciences et la philosophie : quatorze essais de rapprochement*. (Ed. by Robert Franck). Paris : Vrin. 1995.

22. "A existência do espaço-tempo segundo Leonhard Euler." In F. Évora (ed.), *Espaço e Tempo*. Campinas: Coleção CLE. 41-51. 1995.

23. « L'existence de l'espace et du temps selon Leonhard Euler ». *Le réalisme* (Ed. by Jean-François Stoffel). 185-93. Louvain-la-Neuve : Publications de l'Université Catholique de

Louvain. 1996.

24. « Présentation » in *Histoire et Philosophie des sciences : quelles interactions ?* Numéro spécial de la *Rev. Phil. De Louvain*. Vol. 94, n. 3. August 1996.

25. « van Fraassen : les lois et la symétrie ». *Revue Philosophique de Louvain*. n°4, 738-754, 1997.

26. « Kuhn: realist or antirealist? ». *Principia*. Vol. 2, n°1, 37-59, 1998.

27. « Van Fraassen's Constructive Empiricism, Symmetry Requirements and Scientific Realism ». *Logique et analyse*. Vol. 164, 327-342, December 1998.

28. « Présentation du professeur Bas van Fraassen ». Chaire Mercier 1999-2000. *Rev. Phil. de Louvain*. Vol. 98, n. 3. August 2000. 445-448.

29. «Empirical versus Theoretical Invariance and Truth» (followed by a commentary by Bas van Fraassen: « Michel Ghins on the Empirical Versus the Theoretical »). *Foundations of Physics*, Vol. 30, 1643-1655. October 2000 (Special issue dedicated to Maria Luisa Dalla Chiara).

30. « The Principle of Equivalence ». *Studies in History and Philosophy of Modern Physics*. Vol. 32B, n. 1. March 2001, 33-51. With Tim Budden.

31. « Putnam's No-Miracle Argument: a Critique » in *Recent Themes in the Philosophy of Science: Scientific Realism and Commonsense*. Ed. by S. Clarke and T. Lyons. *Australasian Studies in History and Philosophy of Science*. Vol. 17. 121-138. Kluwer Academic Publishers, Dordrecht. 2002.

32. « Les atomes et l'espace absolu : les raisons et la nature de l'antiréalisme de Mach ». *Philosophia Scientiae*. Vol. 7, cahier 2, 2003, 3-22.

33. "Thomas Kuhn on the Existence of the World". *International Studies in the Philosophy of Science*. Vol. 17, no. 3, 2003. 265-279.

34. "Truth and Modelling in Science" in *L'uomo e l'agricultura: quale futuro?* ed. by Giuseppe Bertoni. Proceedings of the International Conference, Treviso 9-10 May 2003. pp. 85-96. 2004. Vita e pensiero: Milan.

35. "Can Common Sense Realism be Extended to Theoretical Physics?" *Logic Journal of the IGPL*. (Oxford UP). Vol. 13, pp. 95-111. January 2005.

36. "Howard Sankey on Scientific Realism and the God's Eye Point of View". *Epistemologia*. XXVIII. 2005. pp. 123-134.

37. "Putnam and the God's Eye Point of View". *Croatian Journal of Philosophy*. Vol. 5, n. 14. 2005. pp. 235-244.

38. «Empirical versus Theoretical Invariance and Truth» (followed by a commentary by Bas van Fraassen; reprinting of 29) in *Logic, Thought and Action*. Ed. by D. Vanderveken. *Logic, Epistemology and the Unity of Science*. Vol. 2. Springer, Dordrecht. 2005. 163-174.

39. Russo Federica, Mouchart Michel, Ghins Michel, Wunsch Guillaume, "Statistical Modelling and Causality in the Social Sciences" Louvain-la-Neuve, Institut de Statistique UCL, 2006 vol. 19 Discussion paper of the Institute of Statistics.

40. "Popper versus Grünbaum and Boltzmann on the Arrow of Time". *Proceedings of the Conference Karl Popper Philosopher of Science, Cesena 27-30/10/1994*. Mario Alai, Gino Tarozzi, Soveria Mannelli (eds.). 339-350. Rubbettino 2006.

41. "Scientific Realism and Scientific Laws: Comments on the papers of Mario Alai, Dennis Dieks and Michael Esfeld" in *The Controversial Relationships Between Science and Philosophy: A Critical Assessment. Proceedings of the Workshop at the Pontifical Gregorian University, September 30-October 1, 2005*. Ed. By Gennaro Auletta. The STOQ Project Research Series, vol. 3, 285-299. Rome: Libreria Editrice Vaticana. 2007.

42. Review of Thomas Ryckman, *The Reign of Relativity. Philosophy in Physics 1915-1925*. Review Symposium by Ron Rynasiewicz, Bas van Fraassen and Michel Ghins, with replies by Thomas Ryckman. *Metascience* 16, 397-407. November 2007.

43. "Les lois des chocs chez Descartes" in *La raison par quatre chemins. En hommage à Claude Troisfontaines*. Jean Leclercq (ed.). Bibliothèque philosophique de Louvain vol. 73, 97-115. Louvain : Peeters. 2007.

44. « Laws of Nature: Do we Need a Metaphysics? » *Fifth Principia International Symposium. Principia*, vol.11, n. 2, 127-149, december 2007.
<https://periodicos.ufsc.br/index.php/principia/article/view/16483/15048>
45. « Scientific Laws and Laws of Nature: Regularities or Necessities? » in *The Relationships between Science and Philosophy: New Opportunities for a Fruitful Dialogue. Proceedings of the Workshop in Vatican City. April 7-8, 2006*. Ed. by Gennaro Auletta. The STOQ Project Research Series, vol. 6, 85-106. Rome: Libreria Editrice Vaticana. 2008.
46. « Realism », entry of the online *Interdisciplinary Encyclopaedia of Religion and Science*. 2009. <http://www.inters.org>
47. « Bas van Fraassen on Scientific Representation », *Analysis* 70(3): 524-536. 2010
<http://analysis.oxfordjournals.org/cgi/reprint/ang043?ikey=8y8OZR6C4IhmJCy&keytype=ref>
48. Book review of *Galileo in Rome. The Rise and Fall of a Troublesome Genius* by William R. Shea and Mariano Artigas (Oxford: Oxford University Press, 2003) and *Galileo Observed. Science and the Politics of Belief* by William R. Shea and Mariano Artigas (Sagamore Beach: Watson Publishing International, 2006), *Revue philosophique de Louvain*. August 2010, 549-557.
49. "Models, Truth and Realism: Assessing Bas Fraassen's Views on Scientific Representation" in *Science, Truth and Consistency: A Festschrift for Newton da Costa- Proceedings of the CLE/AIPS Event 2009*. Ed. by Evandro Agazzi, Itala D'Ottaviano and Daniele Mundici. *Manuscrito* 34: 207-232, 2011. <http://www.cle.unicamp.br/manuscrito/>
50. "Scientific Representation and Realism", *Principia* 15 (3): 461-474, 2011.
<http://www.cfh.ufsc.br/~principi/15-3.html>
51. "Bohr's Modelling of the Atom. A Reconstruction and Assessment", *Logique et Analyse* 218 : 329-350, 2012
52. « Representation and the Loss of Reality Objection » in *Proceedings of the AIPS Conference in Louvain-la-Neuve, 26-28 April 2011, Epistemologia XXXV*: 47-58, 2012.
53. Blondeau & Ghins, "Is There an Intrinsic Criterion for Causal Lawlike Statements?", *International Studies in the Philosophy of Science* 26 (4): 381-401, 2012.
54. "Semirealism, Concrete Structures and Theory Change" Participation in a Symposium on *A Metaphysics for Scientific Realism. Knowing the Unobservable* by Anjan Chakravartty, *Erkenntnis* 78 (1): 19-27, 2013.
55. "Bohr's Theory of the Hydrogen Atom: a Selective Realist Interpretation" in Lorenzo Magnani (ed.), *Model-Based Reasoning in Science and Technology. Theoretical and Cognitive Issues*, Studies in Applied Philosophy, Epistemology and Rational Ethics (SAPERE) 8, Springer: ch. 10, 415-429, 2013.
http://link.springer.com/chapter/10.1007%2F978-3-642-37428-9_22
56. "Scientific and Religious Beliefs Revisited". Essay review of Brian Davies' *Why Beliefs Matter*. *Metascience* 23 (3), 581-87, 2014.
57. « Prefácio » de Daniel Tozzini. *Filosofia da Ciência de Thomas Kuhn. Conceitos de racionalidade científica*. Pp. XI-XVIII, Sao Paulo: Salta. 2014.
58. "Du réalisme scientifique à la philosophie de la nature". Text of a public lecture. *Revue philosophique de Louvain* 112(1), 201-209, 2014.
59. "Causal Powers as Metaphysical Grounds for Laws of Nature." *Proceedings of the AIPS Conference in Široki Brijeg (Bosnia-Herzegovina), 24-27 July 2013*. E. Agazzi (ed.). *Epistemologia*. FrancoAngeli: Milano. 83-98, 2014.
60. « Representing and measuring: discussing van Fraassen's views ». Essay review of Wenceslao Gonzalez (ed.) *Bas van Fraassen's approach to representation and models in science*. Synthese Library. Berlin: Springer. 2014. *Metascience* 24(1) 31-35, 2015.
61. Compte-rendu de Diego Marconi's *Il mestiere di pensare. La filosofia nell'epoca del professionismo*. Torino: Giulio Einaudi editore. 2014. *Revue philosophique de Louvain* 113 (4), 739-742, 2015.

62. Compte-rendu de l'ouvrage d'Evandro Agazzi *Scientific Objectivity and its Contexts*. Dordrecht: Springer. 2014. *Revue philosophique de Louvain* 113 (4), 730-736, 2015. <http://poj.peeters-leuven.be/content.php?url=article&id=3136934&download=yes>
63. "Evandro Agazzi on Scientific Objectivity". Essay review of Evandro Agazzi's *Scientific Objectivity and its Contexts*. Berlin: Springer. 2014.(Translation of 62) *Metascience* 25(1), 151-157, 2016. http://link.springer.com/article/10.1007/s11016-015-0036-7?wt_mc=internal.event.1.SEM.ArticleAuthorAssignedToIssue
64. "Bas van Fraassen on success and adequacy in representing and modelling" in Lorenzo Magnani & Claudia Casadio (ed.), *Model-Based Reasoning in Science and Technology. Theoretical and Cognitive Issues*, Studies in Applied Philosophy, Epistemology and Rational Ethics (SAPERE) 27, Springer: ch. 2, 21-42, 2016. <http://www.springer.com/gp/book/9783319389820>
65. "Selective Scientific Realism: Representation, Objectivity and Truth" in Agazzi, E. (ed.), *Varieties of Scientific Realism. Objectivity and Truth in Science*. Springer: ch.5, 109-131, 2017.
66. « Defending Scientific Realism without Inference to the best Explanation », *Axiomathes* 27, 635–651, 2017. DOI 10.1007/s10516-017-9356-0 <http://link.springer.com/article/10.1007/s10516-017-9356-0>
67. "Are de Broglie and Bohm right?", *Metascience* 27(1), 91-94, 2018. DOI 10.1007/s11016-017-0261-3 <http://link.springer.com/article/10.1007/s11016-017-0261-3>
68. "Mechanistic Explanation: An Extension and Defence" in Falkenburg, B. & Schiemann, G. (eds.) *Mechanistic Explanations in Physics and Beyond*. European Studies in the Philosophy of Science 11. Ch. 6, 93-110, 2019. Cham: Springer. DOI 10.1007/978-3-030-10707-9_6 <https://www.springer.com/fr/book/9783030107062>
69. "Uma defesa indutivista Bottom-Up do Realismo Científico Epistemológico", *Revista Instante* 5 (3), 10–32, 2023 <https://doi.org/10.29327/2194248.5.3-2>
70. "Stability of Reference through Theory Change and Scientific Realism" in *Realism and antirealism in metaphysics, science and language. Festschrift for Mario Alai*. Ed. by A. Angelucci et al. Milan: FrancoAngeli. 141-154, 2024.
71. « Justifying scientific beliefs: an anti-naturalist and anti-pragmatist perspective », in Magnani, L. (ed.) *Justification, Creativity, and Discoverability in Science. Comptes Rendus de l'Académie Internationale de Philosophie des Sciences, Tome II*, 85-102, 2024. London: College publications. <https://resources.illc.uva.nl/CRAIPS/Volumes/Tome-II/>
72. « The structural view of representation: a defence », in Grosshans, H.-P. (ed.) *Models and Representations in Science. Comptes Rendus de l'Académie Internationale de Philosophie des Sciences, Tome III*, 91-116, 2025. London: College Publications. <https://resources.illc.uva.nl/CRAIPS/Volumes/Tome-III/>

Translations

1. « Kuhn édenté : incommensurabilité et choix entre théories ». Trad. (avec J.P. De Schepper) de Tim Maudlin's « Kuhn defanged: incommensurability and theory-choice ». *Rev. Phil. De Louvain*. Vol. 94, n. 3. August 1996. 428-446.
2. « Est-il rationnel de chercher la vérité ? ». Trad. (avec M.-N. Sankey) de Howard Sankey's « Is it rational to pursue truth? ». *Rev. Phil. De Louvain*. Vol. 98, n. 3. August 2000. 589-602.
3. « La fin de l'empirisme ? ». Trad. (avec F. Battaglini) de Bas van Fraassen's « The demise of empiricism ? ». *Rev. Phil. de Louvain*. Vol. 98, n. 3. August 2000. 449-479

Editorial work

Editor of the *Bibliothèque philosophique de Louvain* (Peeters). 2001-2008.

Editor of the *Revue philosophique de Louvain*. 1992-2005.

Co-editor of *Manuscrito. Revista internacional de filosofia*. 1984-1986.

Member of the editorial committee of *Manuscrito*, *Cadernos de História e Filosofia da ciência*, *Principia*, *International Studies in the Philosophy of Science*, *Epistémologiques - philosophie, science, histoire*; *CLE (Centro de Logica, Epistemologia e História da Ciência) e-prints*, *Metascience*, *Revue philosophique de Louvain*, *Investigação filosófica*, *Journal for General Philosophy of Science*.

Member of the advisory board of the Springer series *Studies in Applied Philosophy, Epistemology and Rational Ethics* (SAPERE).

Referee for *Axiomathes*, *Foundations of Physics*, *Logique et analyse*, *Mind and Society*, *Oxford University Press*, *Philosophia Scientiae*, *Studies in History and Philosophy of Modern Physics*, *Erkenntnis*, *Journal for General Philosophy of Science*, *Foundation of Science*, *European Journal for Philosophy of Science*, *Epistemologia*, *Rivista di Filosofia*, *Theoria*, *Philosophia*.

Referee for the « Fonds national belge de la recherche scientifique » (FNRS), « Fonds voor Wetenschappelijk Onderzoek Vlaanderen » (FWOV), « Fonds national suisse » (FNSNF) and the « Institut historique belge de Rome ».

Main conference presentations and talks (since 2000)

« The Renewal of the Debate on Scientific Realism ». Estonian Society for the Philosophy of Science. Tallinn. 31 March 2000.

« van Fraassen's Constructive Empiricism ». Department of Philosophy. University of Tartu (Estonia). 1 April 2000.

« Symmetry Principles and Scientific Realism ». *26th Annual Philosophy of Science Conference*. Inter-University Centre. Dubrovnik. 10-15 April 2000.

« Il nuovo dibattito sul realismo scientifico ». Dipartimento di Filosofia. Università del Piemonte Orientale. Vercelli. 15 May 2000.

« Il problema del realismo scientifico ». Facoltà di Lettere e Filosofia. Università di Padova. 16 May 2000.

« L'antiréalisme de Mach ». International Conference : *Physique et physiologie chez Ernst Mach*, organisé par l'Académie Helmholtz. Louvain-la-Neuve. 12-13 October 2000.

« Einstein et le principe d'équivalence ». *Journées d'épistémologie : Physique, Mathématiques, Logique*. Institut Henri Poincaré. Paris. 5-6 December 2000.

« Comment défendre le réalisme scientifique ? ». Faculty of Philosophy. University of Bucarest. 17 May 2001.

« Scientific Realism without the no-miracle Argument ». *Australasian Association for History, Philosophy and Social Studies of Science Conference*. Melbourne. 24-28 June 2001.

« A 'Miraculous' Defence of Scientific Realism ». *Second Principia International Symposium*. Florianopolis. Brazil. 6-10 August 2001.

« L'espace et le temps ». Groupe d'histoire des sciences physiques. Séminaire « Fondements et notions fondamentales ». Département de physique. Louvain-la-Neuve. 17 December 2001.

« Le réalisme scientifique : entre le scepticisme et le scientisme ». Société philosophique de Louvain. 20 February 2002.

Discussion de l'intervention de Claudine Tiercelin « Expliquer et comprendre : l'approche pragmatiste de Putnam » au Colloque international : *Expliquer et comprendre dans les sciences humaines*. Université Libre de Bruxelles. 11-13 March 2002.

« Thomas Kuhn's Antirealism ». *28th Annual Philosophy of Science Conference*. InterUniversity Center. Dubrovnik. 8-13 April 2002.

« Realismo ed il successo della scienza ». Dipartimento di filosofia. Università degli studi di Genova. 23 May 2002.

Conférence « Science et foi ». Rotary club, Bruxelles. 27 January 2003.

« van Fraassen on Objectifying Inquiry ». *29th Annual Philosophy of Science Conference*. InterUniversity Center. Dubrovnik. 14-19 April 2003.

« Scientific Truth and its Confirmation ». *International Conference: Agriculture and the Future of Mankind*. Cassamarca Foundation, Treviso. 9-10 May 2003

Participation in the symposium « De Viena a Campinas ». *International Conference: The Center of Logic, Epistemology and History of Science. XXV years*. Campinas 26-27 May 2003.

« Einstein et le principe d'équivalence », Université de Genève. 10 June 2003.

"Popper vs. Grünbaum on the Arrow of Time". *ESF Conference on Statistical Physics*. Utrecht. 27-30 November 2003.

"Revisiting the Equivalence Principle in General Relativity". *ESF Conference on Spacetime Physics*. Oxford. 24-27 March 2004.

"Flèche du temps et causalité". *Journée internationale d'études en philosophie des sciences*. Université de Strasbourg II. 19 May 2004.

« Réalisme scientifique local et réalisme scientifique global ». *First Congress of the « Société de philosophie des sciences »*. Paris 21-22 January 2005.

« Rappresentazioni, leggi, modelli ed il realismo scientifico ». Dipartimento di filosofia. Università degli studi di Bologna. 10 March 2005.

"Laws, Theories and Models: Realism without Representation". *31th Annual Philosophy of Science Conference*. InterUniversity Center. Dubrovnik. 11-16 April 2005.

« Social Interests and the God's Eye Point of View ». *Fourth Principia International Symposium*. Florianopolis. Brazil. 8-13 August 2005.

"Social Constructivism and the God's Eye Point of View". *Congress of the International Academy for Philosophy of Science. Epistemology and the Social*. Tenerife, 22-25 September 2005.

"Conclusions" of the session on scientific realism. *Workshop on Science and Philosophy*. Gregorian University. Rome. 30 September - 1 October 2005.

"On Tom Ryckman's *The Reign of Relativity*". *Philosophy of Science Research Seminars*. Oxford. 27 October 2005.

"Le leggi di natura". Ateneo Regina Apostolorum. Rome. 22 March 2006.

"Laws of Nature: Regularities or Necessities". *Second Workshop on The Relationship between Science and Philosophy: New Opportunities for a Fruitful Dialogue*. Vatican. 7-8 April 2006.

"General Relativity and the Constitutive A Priori". *33^d Annual Philosophy of Science Conference*. InterUniversity Center. Dubrovnik. 10-15 April 2006.

« Sulle leggi di natura ». Department of philosophy, University of Rome III. 12 -13 April 2007.

« Scientific Laws and Laws of Nature: a Power Account ». *34th Annual Philosophy of Science Conference*. InterUniversity Center. Dubrovnik. 16-20 April 2007.

« La philosophie des sciences conduit-elle à la philosophie de la nature ? » Facultés Saint Pierre Canisius (Kimwenza, Kinshasa). 1 June 2007.

« Les lois scientifiques sont-elles des lois de la nature ? » Facultés catholiques de Kinshasa. 2 June 2007.

« Laws of Nature: Do we Need a Metaphysics? » *Fifth Principia International Symposium : the Philosophy of Bas van Fraassen*. Florianopolis (Brazil). 6-9 August 2007.

« Il realismo scientifico senza miracoli ». Università degli studi di Torino. Facoltà di lettere e filosofia. 10 March 2008.

« Bohr et la modélisation de l'atome: une reconstruction et une évaluation ». *Congress « Modélisation et vérité en sciences »*. Institut Supérieur de Philosophie, Louvain-la-Neuve. 25 April 2008.

“Bohr’s Modelling of the Atom. A Reconstruction and Assessment.” Second International Conference on the History of Quantum Mechanics. Utrecht. 14-17 July 2008.

“The Philosophical Grounds of the Humanity of Man”. Conference on “Human Beings”. Università di Trieste, Gorizia. 1-4 October 2008.

“Representing, Asserting and Scientific Realism”. Workshop on Scientific Representation. Katholieke Universiteit Leuven. 18 December 2008.

“Categorical and Dispositional Properties in the Metaphysics of Laws”. *36th Annual Philosophy of Science Conference*. InterUniversity Center. Dubrovnik. 13-18 April 2009.

“A Dualistic Ontology of Categorical and Dispositional Properties in the Metaphysics of Laws”. University of Athens. 11 May 2009.

“Laws of Nature: a Metaphysics of Powers and Categorical Properties”. Workshop on “Causality” organized by the Academia Europaea. Venice. 22-23 May 2009.

“Bas van Fraassen on Scientific Representation”. Congress « Science, Truth and Consistency », organized by the Centro de Logica e Epistemologia and the International Academy of Philosophy of Science in Campinas (Brazil). 23-28 August 2009.

“Objective Representation and Interpretation”. Congress “Science and Interpretation”, organized by the International Academy of Philosophy of Science in Zadar (Croatia), 6-10 September 2010.

“Bas van Fraassen on Scientific Representation”. Philosophy of physics seminars. Oxford University. 23 November 2010.

“Bas van Fraassen’s views on Representation: a New Challenge to Scientific Realism?”. International triennial Congress of the Italian Society of Logic and Philosophy of Science (SILFS). Bergamo. 15-17 December 2010.

«Representation and the Loss of Reality Objection ». Congress “Representation and Realism” organized by the International Academy of Philosophy of Science in Louvain-la-Neuve, 26-28 April 2011.

“Representação, realismo e leis científicas: rumo a uma metafísica da natureza”. 4 public lectures at the Universidade Federal do Parana, Curitiba, 10-13 August 2011.

“Scientific Representation and Realism”, *Seventh Principia International Symposium : the Philosophy of Nelson Goodman*. Florianopolis (Brazil), 15-18 August 2011.

« Is there an Intrinsic Criterion of Causality » (with Julien Blondeau), Congress *CaEitS2011: Causality and Explanation in the Sciences*, Center for Logic and Philosophy of Science, University of Ghent, 19-21 September 2011.

« Is there an Intrinsic Criterion of Lawlike Causality Statements?» *39th Annual Philosophy of Science Conference*. InterUniversity Center. Dubrovnik. 16-21 April 2012.

“Un realismo scientifico non-naturalista”. Department of Philosophy. Università di Roma III. 19 April 2012.

“Scientific Realism: between Naturalism and Metaphysics. One-day international Workshop on Scientific Realism. Louvain-la-Neuve. 27 avril 2012.

“Bohr’s Modelling of the Atom: Was his Demarche Inconsistent?” *6th International MBR (Model-Based Reasoning in Science and Technology) Conference*. Sestri Levante. 21-23 June 2012.

“A Mixed View Account of Laws of Nature”. International Workshop “The Metaphysics of Scientific Realism”. Philosophy and History of Science Department. National University of Athens. 1-2 March 2013.

“Le réalisme causal”. One-day international Workshop “La causalité en science contemporaine”. Faculté de philosophie et lettres. University of Liège. 22 March 2013.

“Causal Laws and Causal Explanation”. One-Day International Workshop on Explanation in the Sciences. Louvain-la-Neuve. 8 May 2013.

“An Intrinsic Criterion for Causal Lawlike Statements”. Australasian Association of Philosophy Conference. University of Queensland. Brisbane. 8-13 July 2013.

“Causal Powers as Metaphysical Grounds for Laws of Nature”. International Academy of the Philosophy of Science Conference on “Science, Metaphysics, Religion”. Siroki Brijeg (Bosnia-Herzegovina). 25-27 July 2013.

“Scientific Realism without the No-Miracle Argument”. Symposium on “Varieties of Scientific Realism” organized by Stathis Psillos with Mario Alai and Ilkka Niiniluoto. *World Congress of Philosophy*. Athens. 4-10 August 2013.

“van Fraassen’s Loss of Reality Objection: a Reply”. Science and Reality Conference. Rotman Institute of Philosophy, Western University London, Ontario, Canada. 5-6 October 2013.

„En quoi consiste la vérité d’une théorie scientifique ?“ Université Catholique de Louvain. Séminaire d’histoire des sciences. 13 December 2013.

“Is There an Intrinsic Criterion for Causal Lawlike Statements?” (with Julien Blondeau). Workshop on Causality. Institut Supérieur de Philosophie. Louvain-la-Neuve. 14 February 2014.

“Bas van Fraassen’s Voluntarist Epistemology: a Critique”. *41st Annual Philosophy of Science Conference*. InterUniversity Center. Dubrovnik. 14-18 April 2014.

“Do we Need Powers to Ground the Laws of Nature?” International Conference of the Italian Society for Logic and Philosophy of Science. Rome. 18-21 June 2014.

“Propriétés catégoriques et propriétés dispositionnelles : une ontologie mixte des lois de la nature ?” Conference of the « Société de philosophie des sciences ». Lille 25-27 June 2014.

“Pragmatic Realism”. International Academy of the Philosophy of Science Conference on “Pragmatism”. Pont-à-Mousson (France). 11-13 September 2014.

“Avons-nous des raisons de douter de nos théories scientifiques ?” Public lecture. Académie Royale de Belgique. Collège Belgique. 2 December 2014.

“Représentation et modélisation chez van Fraassen : une critique”. Séminaires « Work in Progress ». Institut Supérieur de Philosophie. Louvain-la-Neuve. 27 January 2015.

“Success and Adequacy as Values in Scientific Representation.” *42th Annual Philosophy of Science Conference*. InterUniversity Center. Dubrovnik. 13-17 April 2015.

“Bas van Fraassen on Success and Adequacy in Representing and Modelling”. *7th MBR (Model Based Reasoning in Science and Technology) International Conference*. Sestri Levante. 25-27 June 2015.

“Psillos vs. van Fraassen on the Existence of Atoms”. *Particles, Fields and Relativity. Conference in Honour of Harvey Brown in his 65th year*. Oxford. 13-14 July 2015.

“Scientific Realism: Representation, Objectivity and Truth”. International Academy of the Philosophy of Science Conference on “Scientific Realism: Objectivity and Truth in Science”. University of a Corunha, Ferrol, Spain. 22-26 September 2015.

“Psillos vs. van Fraassen on the existence of atoms”. Annual Conference of the Australasian Association for History, Philosophy and Social Studies of Science (AAHPSSS). Melbourne. 4-6 November 2015.

“La stabilità della referenza attraverso il cambiamento teorico: Nola contro Psillos”. Seminario di filosofia della scienza. Università di Roma Tre. 4 May 2016.

“Four requirements for deployment scientific realism”. Conference on “Explanation in Logic, Ontology and Science”. University of Macerata (Italy). 4-6 October 2016.

“Mechanistic Explanation: An Extension and a Defence”. International Academy of the Philosophy of Science Conference on “Mechanistic Explanations, Computability and Complex Systems”. Dortmund. 27-29 October 2016.

« La science est-elle une image du monde ? » Public lecture. Académie Royale de Belgique. Collège Belgique. 23 November 2016.

« The Stability of Reference of Theoretical Terms through Scientific Revolutions » Inaugural presentation. 4th Panhellenic Conference in the Philosophy of Science. National and Kapodistrian University of Athens. 1-3 December 2016.

“Newton’s Absolute Time and Space”. Workshop on “Physics and Metaphysics in Descartes and Newton”. Department of History and Philosophy of Science. Athens. 15 December 2016.

“An up-to-date neo-Aristotelian View of Laws of Nature”, XXIII International Conference “The Metaphysical Dimensions of Nature”. Università Santa Croce. Rome. 23-25 February 2017.

“Jean Perrin et la réalité des atomes”. Institut Supérieur de Philosophie. UCL. 21 April 2017.

“The New Mechanistic Account of Explanation”. Institut Supérieur de Philosophie. Louvain-la-Neuve. 31 May 2017.

“Qu’est-ce qu’une loi de la nature ?” Public lecture. Académie Royale de Belgique. Collège Belgique. 4 October 2017.

“Axiomatic Systems, Scientific Laws and Laws of Nature”. International Academy of the Philosophy of Science Conference on “Axiomatic Thinking”. Lisbon. 11-14 October 2017.

“A Non-Explanatory Defence of Scientific Realism”. Philosophy seminars. University of Melbourne. 15 March 2018.

“Defending Scientific Realism without Inference to the Best Explanation”. *45th Annual Philosophy of Science Conference*. Inter University Centre. Dubrovnik. 16-20 April 2018.

“Scientific Realism: A Contemplative rather than a Pragmatic Approach”. International Academy of the Philosophy of Science Conference on “Science’s Voice of Reflection: The philosopher of science as part of the scientific endeavour.” Amsterdam. 4-6 September 2018.

“Jean Perrin aux prises avec les atomes”. Séminaires d’histoire des sciences. Faculté des sciences. UCL. Louvain-la-Neuve. 8 March 2019.

“Qu’est-ce que la métaphysique des sciences ? Une réponse partisane” Entretiens Paris-Diderot. 5 April 2019.

“An Empiricist Defence of Scientific Realism”. *46th Annual Philosophy of Science Conference*. Inter University Centre. Dubrovnik. 15-19 April 2019.

“Scientific realism and the reality of properties”. *16th International Congress of Logic, Methodology, Philosophy of Science and Technology*. Prague. 5-10 August 2019.

“How Could we Tackle Creativity from a Philosophical Point of View?” First World Congress of the Brazilian Academy of Philosophy in honour of Newton da Costa’s 90th Birthday. Topic: Creativity. Rio de Janeiro. 8-13 December 2019. Keynote speaker.

“Wilfrid Sellars on Eddington’s Two Tables: a Critique”. 3rd workshop of the Olofos Group: Clash between the manifest and the scientific image of the world. Louvain-la-Neuve 28-29 May 2020. Invited speaker.

“Categorical properties and causal powers: for a dualist metaphysics of laws of nature”. Work in progress (WIP) seminars. CEFISES. Louvain-la-Neuve. 30 September 2020.

“What metaphysics for laws of nature?” Webinar. Urbino. 25 November 2020.

“How to judge the truth conduciveness of the theoretical virtues of a scientific theory?” International Academy of the Philosophy of Science Conference on “The role of judgement in the philosophy of science”. Zadar. 12-15 October 2021.

“What are the truth-tropic virtues of a scientific theory?” Work in progress (WIP) seminars. CEFISES. Louvain-la-Neuve. 14 January 2022.

“How to defend scientific realism without resorting to inference to the best explanation?” Department of philosophy. University of Cyprus. 17 May 2022.

“An inductivist defence of epistemological scientific realism.” Department of philosophy. Kapodistrian University of Athens. 19 May 2022.

“Scientific realism without abduction.” International conference in honour of Steven French on the occasion of his retirement. University of Leeds. 22 June 2022.

“Justifying scientific beliefs: an anti-pragmatist and anti-naturalist perspective.” International Academy of the Philosophy of Science Conference on “Explanation, creativity and discoverability in science”. University of Pavia. 26 September-1 October 2022.

“Stability of reference through theory change and scientific realism.” International conference on *Realism versus antirealism in metaphysics, science, and language* in honour of Mario Alai on the occasion of his retirement. University of Urbino. Department of pure and applied sciences. 11-13 April 2023.

<https://sites.google.com/campus.uniurb.it/realismvsantirealism/home>

“Powers without essences: a necessitarian account of laws of nature.” First NOMOS conference “laws and powers in the metaphysics of science”. Kapodistrian University of Athens. 12 -14 June 2023.

“Induction to justify, abduction to discover.” Symposium: “Justification, Creativity, and Discoverability in Science” (International Academy of the Philosophy of Science Conference). International Congress on Logic, Methodology and Philosophy of Science and Technology (CLMPST). Buenos Aires 24-29 July 2023.

“A defence of the structural view of scientific representation.” International Academy of the Philosophy of Science Conference on “Models & Representations in Science”. University of Muenster. 25-30 September 2023.

« Scientific understanding: an empiricist approach ». Debate on Scientific Understanding with Otavio Bueno, Anjan Chakravartty and Bas van Fraassen. International Academy of the Philosophy of Science Conference on Scientific understanding. XXV World Congress of Philosophy. Rome, 1-4 August 2024.

« Powers without essences: A metaphysical foundation for the natural necessity of laws of nature. » CEFISES seminar. Louvain-la-Neuve. 18 October, 2024.

“Grounding the necessity of both quantitative and conservation laws on powers” *50th Annual Philosophy of Science Conference*. Inter University Centre. Dubrovnik. 22-25 April 2025.

Courses taught

UCL

Philosophy of nature, philosophy of physics, philosophy of science, history of contemporary philosophy (analytic philosophy).

Lectures in Universities (from 2000)

National University of Ireland, Maynooth (Department of philosophy). *Defending scientific realism, within reason*. 30 October-2 November 2001. Erasmus exchange.

University of Urbino (Facoltà di filosofia). *Il realismo scientifico ed il successo della scienza*. 20-24 May 2002. Erasmus exchange.

University of Oxford (Faculty of Philosophy). *The Leibniz-Clarke Correspondence*. 3-6 June 2002. Erasmus Exchange.

University of Urbino (Istituto di filosofia). *Leggi e modelli nella fisica*. 8-12 March 2005. Erasmus exchange.

Gregorian Pontifical University, Rome. Seminars on *Laws of nature*. March 2006.

University of Urbino (Istituto di filosofia). *Leggi di natura: metafisica nella scienza?* 11-14 March 2008. Erasmus exchange.

Gregorian Pontifical University, Rome. Seminars on *Leggi di natura e il realismo scientifico*. May 2008.

Gregorian Pontifical University, Rome. Seminars on *Leggi di natura e il realismo scientifico*. October-November 2009.

University of Urbino (Istituto di filosofia). *Rappresentazione e modellizzazione nella scienza*. 11-15 May 2010. Erasmus exchange.

University of Torino (Facoltà di lettere e filosofia). *Determinismo, realismo e spazio-tempo*. 13-18 May 2012. Erasmus exchange.

University of Torino (Scuola di studi superiori). *La verità nella scienza*. 1 December 2012.

University of Genoa (Department of philosophy). *Le teorie scientifiche sono vere?* 11-16 March 2013. Erasmus exchange.

University of Torino (Facoltà di lettere e filosofia). *Scienza e realtà*. 13-16 May 2013.

Université Catholique de Louvain. Public lecture on the occasion of my emeritate. *Réalisme scientifique et philosophie de la nature*. 18 October 2013.

University of Torino (Facoltà di lettere e filosofia). *Che cos'è la verità?* 6-7 December 2013.

Université de Mons. *Thomas Kuhn : paradigmes et révolutions*. 3 February 2014.

Faculté Notre-Dame (Paris). Session de pré-rentrée à La Roche du Theil (Bretagne). Cours intensif de philosophie : *Savoir, vivre, espérer : que dit la philosophie sur notre humanité?* 15-19 September 2014.

University of Athens. Department of Philosophy. *Bas van Fraassen's Modelling and Representing: a Critique*. 4 November 2014.

University of Rijeka. Department of Philosophy. Intensive graduate course. *The Metaphysics of Laws of Nature*. 17-21 November 2014.

University of Torino. Department of Philosophy. *Rappresentazione scientifica secondo van Fraassen: una valutazione*. 5 March 2015.

Université Catholique de Louvain. Institut d'Etudes Européennes. *Les racines chrétiennes des valeurs de l'Europe*. 30 April and 7 May 2015.

Station océanologique de Villefranche-sur-mer (Paris 6). Summer session. Participation in debates on the meaning and utility of concepts in biology, such as evolution, individual and species. 31 August – 3 September 2015.

Université Catholique de Louvain. Institut d'Etudes Européennes. *Les racines chrétiennes des valeurs de l'Europe*. 28 April 2016.

Université Catholique de Louvain. Université des aînés. Six lectures on « Quelle métaphysique pour les lois scientifiques ? » October - December 2021.

Université Catholique de Louvain. Université des aînés. Five lectures on « Science et religion : une perspective philosophique. » November - December 2022.

Université Catholique de Louvain. Université des aînés. Five lectures on « Peut-on faire confiance à la science ? » Février – Mars 2024.

Université Catholique de Louvain. Université des aînés. Five lectures on « Les métaphysiques actuelles des lois de la nature : Hume, Platon ou Aristote ? » Février – Mars 2025.

International research collaborations

Member of the Scientific Committee of the « Centro interuniversitario di ricerca in Filosofia e Fondamenti della Fisica » (Urbino).

Member of the “Centre for Logic, Epistemology and History of Science” (Campinas, Brazil).

Member of the « Centre d'études franco-italiennes » of the University of Rome III.

Member of the “Steering Committee of the European Science Foundation network on Philosophical and Foundational Problems of Modern Physics” (with the Universities of Bonn, Paris VII, Oxford, Utrecht, Cracow, Budapest, Florence). 2003-2005.

Member of the Conseil d'administration de la « Société de philosophie des sciences » (Paris) (2003-2006)

Membre titulaire de l' « Académie internationale de philosophie des sciences ». Since 2011.

Member of the Scientific Committee of the “International Institute Jacques Maritain” (Rome). Since 2014.

Member of the board of the “Académie internationale de philosophie des sciences”. Since 2015.

Vice-president of the “Académie internationale de philosophie des sciences”. Since 2018. A

Doctor honoris causa. Brazilian Academy of Philosophy. 8 December 2019.

Other activities connected with research

Member of the *Société belge de logique et de philosophie des sciences* and the *Société philosophique de Louvain*.

Member of the *Centre interfacultaire d'histoire des sciences* (UCL).

Organizer of an international Symposium on *Isaac Newton*. Louvain-la-Neuve. 13 february 1987.

President of the *Société belge de logique et de philosophie des sciences*. 1992 - 1995.

Organizer of an International Workshop on *Empiricism in the Philosophy of Science*. Vrije Universiteit Brussel. 10 june 1995.

Director (with others) of the annual *Philosophy of Science Conference*. Inter-University Centre (Dubrovnik). Since 1997.

Organization (with B. Feltz) of an International Symposium *Les défis de la rationalité* for Professor Ladrière 80th birthday. Louvain-la-Neuve. 16 november 2001.

Organizer of an international ESF Workshop on « The Arrow of Time : Physics and Philosophy ». Louvain-la-Neuve. 7-8 may 2004.

Organization of a session on Scientific realism. *Workshop on Science and Philosophy*. Gregorian University. Rome. 30 september-1 october 2005.

Organizer of the Congress “Representation and Realism” of the International Academy of Philosophy of Science. Louvain-la-Neuve. 26-28 April 2011.

Organizer of the Workshop “Scientific Realism”. Louvain-la-Neuve. April 2012.

Organizer of the international Workshop “Explanation in the Sciences”. Louvain-la-Neuve. 8 May 2013.

Member of the FNRS Commission SHS-3 Sciences humaines et sociales. 2014-2016

Research stay at the University of Melbourne supported by the FNRS. 2-25 November 2015.

Member of the FNRS Commission Foresight. January 2016.

Research stay. University of Athens, supported by the FNRS. 1-15 December 2016.

Member of the jury of the “Prix Mercier”. June 2017.

Member of the FNRS Commission Foresight. May 2018.

Member of the FNRS Commission SHS-3 Sciences humaines et sociales. June 2018.

Organizer of a Symposium on Realism at the *46th Annual Philosophy of Science Conference*. Inter University Centre. Dubrovnik. 15-19 April 2019.

Member of the “Fundação Ciência e Tecnologia (FCT, Portugal) Philosophy, Ethics, and Religion” projects evaluation panel. 2020

Languages

Native language: French

Fluent: English, Portuguese, Italian

Read: Dutch, German, Spanish, Modern Greek

Other

Regular interventions in the press and other media on ethical and societal issues.