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Building the general relativity and gravitation community during the cold war

Roberto Lalli

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The detection of gravitational waves produced by the merger of a pair of inspiralling black holes in 2015 by the LIGO and VIRGO collaborations is a remarkable confirmation of Einstein's theory of general relativity (1915). It is also, in the circumstances, a vindication of "Big Science," inasmuch as these collaborations involve over 1000 scientists from 133 institutions and long-term international funding. One may wonder, then, how it is that Einstein's theory of general relativity became Big Science? Similarly, one may wonder how the scientific investigation of general relativity and gravitation became a community endeavour? It is the latter question that Roberto Lalli addresses in the book under review.

Albert Einstein's first paper on what he called his "general theory of relativity" appeared a few months after the outbreak of the Great War in 1914. Few scientists were interested in Einstein's quest to capture gravitational phenomena in a dynamic theory of curved spacetime. Some of those who studied the theory, like Willem de Sitter and Erich Kretschmann, convinced Einstein to modify his field equations and reformulate their philosophical foundations.

With the confirmation of an extraordinary consequence of the field equations—the deviation of starlight in the vicinity of the sun—Arthur S. Eddington announced Einstein's theory as the successor to Newton's, and Einstein became an international celebrity. Soon, hundreds of scientists engaged with Einstein's theory which, as a direct result, branched out in directions unforeseen by its creator, including big-bang cosmology, the unification of gravitation and electrodynamics, and, by the end of the 1930s, relativistic astrophysics.

The period from the mid-1920s to the mid-1950s has been described as the "low-water mark" of general relativity by Jean Eisenstaedt, an image meant to convey the resentment expressed by several scientists engaged with Einstein's theory during this period, over its marginal status in the scheme of institutional physics.[1] In fact, as Lalli's bibliometric study shows quite clearly, annual publication of papers on general relativity and gravitation first passed the 100 mark in 1955, such that it would be more accurate to speak of a rise, or as Clifford Will put it, a "renaissance" of general relativity in the late 1950s.[2]

The rise in annual publications was steady and substantial, such that in 1975 they passed the 600 mark. What was the driving force behind this surge in research effort? According to Will, the turning point was a series of experimental, observational and theoretical results that kicked off the 1960s, including the Pound-Rebka measurement of gravitational redshift, radar ranging of planets in the Solar System, the discovery of quasars, and spinor techniques.

[1]Eisenstaedt, (1989).
[2]Will, (1989).

In the space of a few years, the previously barren landscape of general relativity had bloomed with opportunity for theorists, observers, and experimenters alike.

A closer look at the publication numbers in general relativity and gravitation, however, shows that they were already on the rise when the new tests of relativity were introduced. Lalli argues that a "fundamental component" of the renaissance of general relativity was, as the title of his book suggests, the creation of a dedicated community of scientists. Drawing on an earlier paper, co-signed with two scholars from the Max Planck Institute for the History of Science (MPIWG), Lalli characterises the pre-1955 period in general relativity and gravitation as one of "epistemic dispersion."[3] The emergence of a community of scientists devoted to general relativity and gravitation helped focus efforts, according to Lalli's account, and reduce such dispersion.

One well-known sign that a scientific group has come into existence is the themed scientific meeting. Beginning with an invitation-only meeting in Bern, organized by André Mercier in 1955 to commemorate 50 years of relativity, scientists regularly came together from the Soviet Union, Israel, Europe (East and West), and the United States to discuss a variety of subjects related to Einstein's theory. The proceedings of the Bern meeting, edited by Mercier and Kervaire, make for interesting reading, and suggest an aspect of community building that Lalli does not explore: the role of textbooks.[4] While the participants of the Bern meeting spoke about current research on a variety of topics, three of them referred to monographs on general relativity by Peter Bergmann, Christian Møller, or Lev Landau and Evgeny Lifshitz.[5] All three textbooks went through several editions, and made great strides in revealing the epistemic resources of Einstein's theory. The sheer power of these textbooks to define the boundaries of general relativity was not lost on leading theorists like Charles Misner, Kip Thorne, and John Wheeler, who put out their famous "telephone book" in the early 1970s.[6]

By 1959, the International Committee on General Relativity and Gravitation (ICGRG) was established, and plans were made to launch a research journal, the *Bulletin on General Relativity and Gravitation*. The disciplinary identity of this new group was a subject of tense discussion. Following the discovery of quasars in 1963, Alfred Schild and his colleagues in Texas organized a symposium on "gravitational collapse and other topics in relativistic astrophysics," which Lalli sees as part of a ploy to portray relativistic astrophysics as a branch of physics, notwithstanding its ties to mathematics and astronomy. A founding member of the ICGRG, the French mathematician André Lichnerowicz, objected to a plan to integrate it with the International Union of Pure and Applied Physics (IUPAP); for him, the ICGRG was concerned with mathematics, astronomy, and mechanics, as well as with physics.

Further obstacles to the institutional unification of general relativity and gravitation arose from geopolitical strife linked to the Cold War. The ICGRG-sponsored meeting in Tbilisi in 1968, organized by Vladimir Fock and denoted GR5, was the first such meeting to take place in the Soviet Union. In the lead-up to the conference, however, the Six-Day War took place; in reaction, the Soviet Union cut off diplomatic relations with Israel. Probably in consequence of this, Fock issued no invitations to Israeli scientists, until he finally relented to pressure from the ICGRG president, Hermann Bondi.

The transformation of the ICGRG from a Committee to a Society, the ISGRG, was similarly subject to prolonged negotiation, with the main point of contention being the democratic nature of the proposed society. Scientists from the Eastern Bloc were subject to Party control, and were not allowed to join an international society where they could freely elect their representatives. A compromise was worked out by 1974, whereby individuals and corporations were recognized as potential members of the ISGRG, with representation on the executive council. A year later, the IUPAP recognized the ISGRG as an affiliated commission.

With the foundation of the ISGRG, Lalli's narrative draws to a close, and in his conclusion, he notes that the outcome was the result of a shared objective on the part of his actors, in favour of "social and epistemic unification." Additional objectives may be considered at this point, including the formation of coalitions to pursue expensive, large-scale international research projects like the Large Space Telescope, the idea of which was floated by NASA in the mid-

[3]Blum, Lalli, & Renn, (2015).
[4]Mercier & Kervaire, (1956).
[5]Bergmann, (1942); Møller, (1952); Landau & Lifshitz, (1951).
[6]Misner, Thorne, & Wheeler, (1973).

1960s, or the interferometric detection of gravitational waves, pursued since the mid-1970s with support from the National Science Foundation.[7] The venues provided for scientific exchange, such as the (ongoing) GR and Marcel Grossmann meetings, contribute to the coalition-building that is crucial to the success of Big Science projects such as these. Thanks to Lalli's research, we know better how scientists first formed an international society focused on furthering research in general relativity and gravitation, including, but not limited to, the organization of such meetings.

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Savantes nébuleuses: L'origine du monde entre marginalité et autorité scientifique (1860–1920)

Volny Fages

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Most histories of cosmology and galactic astronomy pay relatively little attention to the period of 1860–1920, but it is considered in great detail in Volny Fages's innovative and meticulously documented work on French "nebulous scientists." The period in question is limited on one side by Charles Darwin's *The Origin of Species*, and on the other side by the so-called "Great Debate" on the nature and location of the nebulae. It is also the period in which French astronomy developed into a professional science, and this socio-political and socio-epistemic process appears no less

[7]See Smith, (1992); and Collins, (2004), respectively.