

# Towards an Interconnected History of Semantics

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## 1 Introduction

The story of formal semantics is commonly split by approach when discussed technically and by location when discussed historically. While there are undeniable differences which make for interesting comparisons, as in [JA16], this can be reductive when exploring the history of the subject. As in most scientific disciplines, the interactions and influences between people and groups is an important part of the story. This talk will discuss some interesting interaction points.

### 1.1 Strachey’s consulting business, London, 1960–1965

Christopher Strachey employed Peter Landin as his sole employee in his computing consulting business from 1960–1964; during this time, Landin records that he and Strachey did research on the foundations of programming languages [Lan67]. Strachey was proud to note that it was the only work of its kind going on in England at the time [Str71; CK85]. During this time, Landin—who had already been interested in using  $\lambda$ -calculus in programming languages [Lan01]—produced a series of classic papers on semantics [Lan64; Lan66; Lan65a; Lan65b]. Strachey had been introduced to  $\lambda$ -calculus by Roger Penrose around 1958 [Pen00] while they both worked at NRDC,<sup>1</sup> and was interested in bringing additional mathematical rigour to semantics thanks to his experiences working on CPL, and so this period saw the genesis of denotational semantics.

Although Landin was the only permanent employee, Strachey also temporarily employed Rod Burstall in October 1965 [Bur00], whom he had met through Burstall’s friendship with Landin. Donald Michie had asked Strachey to recommend someone to join his new Experimental Programming Unit at Edinburgh, and Strachey suggested Burstall, on the condition that Strachey get him for

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<sup>1</sup>Interestingly, Strachey was responsible for this job, Penrose’s first.

a few months first. Burstall’s influence on denotational semantics is perhaps rather underestimated (Dana Scott credits him for the concept of the store as a function [Sco00]), and Burstall also went on to write some interesting semantics using first-order logic [Bur66; Bur70].

## 1.2 Mervyn Pragnell’s reading groups, London, early 1960s

Burstall and Landin had met in somewhat odd circumstances. Burstall recalls being in Foyle’s bookshop in London looking at the logic section and asking a bystander for advice. “I’m not a shop assistant,” the man replied, “but it is a rather good book!”<sup>2</sup> The man—Mervyn Pragnell—then invited Burstall to join his reading group, which met somewhat furtively in the basement of Birkbeck College. Both Burstall and Landin recall a distinctly theological atmosphere, taking turns to read aloud pages of hefty books on logic and mime the formulae! The group also included at various times Robin Milner, George Colouris, and John Iliffe [Lan01].

## 2 Formal Language Description Languages conference, Baden-bei-Wien, 15–18 September 1964

This IFIP-sponsored conference was critical in the history of semantics, but will not be discussed in detail here: the present author has a paper in draft form on the history of the conference in some detail, hopefully to be published later.

## 3 Mathematical Theory of Computation conference, IBM Yorktown Heights 27–30 November 1967

Instead, let us consider a much less well-known conference. There were no proceedings published, no list of attendees found, and almost no reference online,<sup>3</sup> but from the memories of some of those present,<sup>4</sup> the conference was crucial. People present at the meeting include Cliff Jones, John McCarthy, Bob Floyd and his students Jim King and Zohar Manna, Mike Paterson, and Rod Burstall. Paterson spoke about his work with Luckham and Park on schemas, and McCarthy dismissed the idea, instead pointing to Manna’s work. Burstall presented on his early work on structural induction, later published as [Bur69].

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<sup>2</sup>Interview with Rod Burstall, 2017.

<sup>3</sup>The present author is in touch with IBM archivists in an attempt to dig up information.

<sup>4</sup>Cliff Jones, Rod Burstall.

## 4 WG 2.2 meeting, Vienna 21–25 April 1969

This was another important IFIP meeting, and is the first time that Tony Hoare presented on his axiomatic semantics approach. This was only shortly after Hoare’s move from industry into academia.

Equally crucially, this meeting is where Scott met Strachey. Landin had met Scott in MIT in 1966, where Scott had been called in by Minsky to argue against too much computing research [Lan01], but Scott was becoming interested in programming from his work on ALGOL in Berkley and time with de Bakker at CWI [Sco00]. Scott “found [Strachey’s] approach the most sympathetic” and from their meeting went to spend his critical term in Oxford developing the foundations of denotational semantics.

This meeting being held in Vienna, several members of the IBM Vienna lab were also present [Wal69].

## 5 The Vienna switch

The Vienna group had been working on semantics using an operational, grand state approach, but had problems proving important properties due to the large state and complexity of control. Hans Bekič had spent the year 1968–69 with Peter Landin at QMC, giving fortnightly lectures in the autumn on “the description of programming languages” [Lan68]. From there, he learnt about the denotational approach proposed by Strachey. Additionally, Jones had been attending lectures given by Strachey in Oxford from January 1971 on semantics, whilst working at IBM Hursley on language definition work (see [ACJ72]). When Jones went back to Vienna to work on a PL/I compiler, he and Bekič agreed a denotational semantics was the way to approach the problem, although there were still elements characteristic of the Vienna approach in the abstract syntax and handling of jumps [JA16].

## 6 Conclusion

The history of semantics is not as siloed as sometimes presented: there are interesting overlaps and flows of influence, with certain aspects invented by “outsiders”. This has led to some peoples’ contributions being overlooked. It is also noteworthy how European the development of formal semantics has been, without some interesting exceptions such as John Reynolds and Bob Tennent. The present author’s forthcoming thesis will attempt to present a more interconnected view of the history.

*(Word count: 861)*

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