



## Grandmothers of Analytic Philosophy

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# GRANDMOTHERS OF ANALYTIC PHILOSOPHY: THE FORMAL AND PHILOSOPHICAL LOGIC OF CHRISTINE LADD-FRANKLIN AND CONSTANCE JONES

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## 1. ANALYTIC PHILOSOPHY, FEMINIST PHILOSOPHY, AND THE INFLUENCE OF WOMEN IN LOGIC

Analytic philosophy is a logic-focused, heavily male-dominated enterprise. Philosophers assume that its origins were all-male, or even somehow intrinsically masculine. Histories of analytic philosophy speak unironically of its ‘founding fathers’ Moore, Russell, and Wittgenstein, and its ‘grandfather’, Frege, whose seminal mathematical logic inspired them. No mothers or grandmothers feature in such narratives. A certain pervasive assumption exists that women gravitate towards normative philosophy, which had not been central to the original analytic project. Once analytic philosophy had moved beyond its early, logico-mathematical phase, according to this line of thought, women like Anscombe, Foot, and Murdoch began to play a role. But the historical record does not bear this out. Women were publishing on formal and philosophical logic, on debates at the heart of analytic philosophy, from the 1880s onwards. Female authors such as Victoria Welby, Christine Ladd-Franklin, E.E.C. Jones, Sophie Bryant, Mary Everest Boole, Elizabeth Haldane, Constance Naden, Mary Calkins, Beatrice Edgell, Augusta Klein, and Hilda Oakeley published on systematic philosophy in the 1880-1910 issues of *Mind*, *Proceedings of the Aristotelian Society*, *The Monist*, *Philosophical Review*, and *The Journal of Philosophy*.

Historical investigation of early analytic female logicians is only just beginning. In this paper I will chart the principal contributions of two female logicians from the very early analytic period, Christine Ladd-Franklin and Constance Jones. Although a single paper does not allow space for exhaustive descriptions of their work, I will present that work in outline, rectify some common misconceptions about early analytic philosophy, and point the way to a more accurate and inclusive way of writing its history. Jones and Ladd-Franklin were key figures in their day and made crucial contributions to early analytic logic. Ladd-Franklin was a formal logician who invented a novel calculus with a NAND-operator and held sophisticated philosophical views on logical consequence and domains of discourse. Jones was a philosophical logician who invented the sense-reference distinction two years before Frege. They were pioneers of women’s education, too, inspiring and teaching later generations of female logicians. Dorothy Wrinch and Susan Stebbing were noted analytic logicians in the 1920s, and had been students at Jones’s Girton College. 1930s Cambridge was home to the logician Alice Ambrose, the philosopher of language Margaret Macdonald, the philosopher of science Margaret Masterman, and the philosopher of science and art

Helen Knight. On the European continent, the Vienna Circle had three female members, Rose Rand, Olga Hahn-Neurath, and Olga Taussky, and further female associated such as Else Frenkel-Brunswik and Käthe Steinhardt, and several prominent female logicians worked in Poland, such as Janina Hosiasson, Maria Kokoszynska, Izydora Dąmbska, and Janina Kotarbinska (Janssen-Lauret forthcoming). The US had several prominent female logicians too, including Susanne Langer, Marjorie Lee Browne, author of a textbook on logic and set theory, and the modal logician Ruth Barcan Marcus (Janssen-Lauret 2015: 156-165).

A more viable hypothesis than women's supposed preference for the normative is that women's work in logic has been neglected due to sexism. As philosophers, even feminist philosophers, and historians we collectively fail to see the obvious appeal of the sexism explanation for male dominance because of inherited sexist bias. There is still more work to be done on uncovering the full effects, not just of the sexism of explicit or implicit attitudinal bias, but of structural and institutional sexism and their intersections with racism, classism, disablism, *etcetera*. Among early analytic logicians we find several women with intersecting marginalised identities: Jewish women like Janina Hosiasson, whom the Nazis murdered, Janina Kotarbinska, *née* Dina Stejnburg, who survived Auschwitz, and Ruth Barcan Marcus, black women such as Marjorie Lee Browne, disabled women like Susan Stebbing (Janssen-Lauret 2017: 8) and Olga Hahn-Neurath, and women with caring responsibilities such as Ladd-Franklin and Jones. But even white, non-disabled, independent middle- and upper-class women of the early analytic period faced severe sexism in academia.

Especially in the very early analytic years, explicit expressions of hostility towards female intellectuals, and disparagement of women's intelligence, was accepted practice. An 1891 review of the idealist philosopher of logic Constance Naden's book *Induction and Deduction* ascribes to her 'a power of acute reasoning such as few other women have ever possessed' ( $\Omega$  1891: 292). Explicit sexist bias and the dismissive attitudes of their contemporaries resulted in fewer citations and less acclaim for women's publications. Although he was supportive of some later female logicians such as Wrinch, in the case of our two subjects Russell was one of the main offenders, and a probable cause of their subsequent neglect. As we'll see below, female academics were in addition heavily hit by explicit institutional bias. Many universities were closed to women altogether, or allowed women to study but not to take degrees. Seminars, conferences, and journals were often invitation-only and dominated by elite men who rarely or never invited female scholars and sometimes banned women even from the audience. Academic jobs were rarely open to female applicants, and sexist bias harmed their chances of being selected for the jobs that were. Women's colleges filled some of these gaps, but were beleaguered and underfunded. A third, less explicit, kind of sexism resulted, consisting in stretched resources for female academics and students. Female philosophers were routinely overworked, underemployed, and underpaid. They felt duty-bound to spend significant time fighting for the cause of women's education through activism, fundraising, running women's colleges, and teaching. All this organisational and administrative labour cut into their research time.

A certain type of approach to feminist philosophy may also inadvertently serve to exclude female logicians, namely one based on the assumption that women have a common

philosophical orientation, less inclined towards logic and more towards normativity. Feminist historians of philosophy who make this assumption sometimes offer it up as a positive trait of women's thought: 'In the twentieth century ... women philosophers – such as Elizabeth Anscombe, Iris Murdoch, Mary Midgley, and Philippa Foot – have continued to demonstrate a strong interest in moral theory' (Broad 2006, p. 1069). Such remarks are an oversimplification even for a figure like Anscombe, who largely published in metaphysics and the philosophy of logic and language. They are strikingly inapplicable to the prominent female philosophers of the early analytic period. All female academic philosophers of the 1890s to the 1930s of whom I'm aware wrote primarily on theoretical, not normative, philosophy. Most of them published on logic in the broad sense of the term which was then common, which encompassed the intersections of formal and Aristotelian logic with philosophy of language, ontology, and certain questions in epistemology and the philosophy of science and mathematics. While there were women in the early analytic period who wrote only on normative matters, or on normative and social or economic matters, they typically did so outside academia and with a strong practical orientation, since these were the days of suffragist activism and the promulgation of birth control. Some of these women also published academic texts, such as Charlotte Perkins Gilman (Waithe 1991: 51-67). Some published primarily accessible political prose, or communicated their ideas via speeches, such as Emma Goldman (Waithe 1991: 323-324), and black feminist thinkers like Maria Stewart, Sojourner Truth, and Anna Julia Cooper (Hill Collins 2000: 1-43). There is a strong case for us now to consider them normative philosophers, and in some cases epistemologists or social ontologists. But Victorian and Edwardian women who engaged exclusively in such strongly practical moral and political philosophy tended not to think of themselves primarily as philosophers, and they did not hold academic posts in philosophy. Until the mid-twentieth century, it was rare for academics of any gender to confine their attention to normative philosophy. Fellows of women's colleges had to have a broad range of areas of competence in order to teach well and participate in academic life. They were usually well-versed in logic as well as philosophy of mind, ethics, or even economics. To my knowledge, the first female academic who wrote exclusively on normative philosophy was Foot, following increasing specialisation in academia.

Beyond a commitment to feminist or proto-feminist causes like women's education or female suffrage, there is no clearly identifiable set of philosophical positions or approaches held in common between early analytic female logicians. Although there are lines of influence between some individual women, their orientations, backgrounds, styles, and views are diverse. Some are mathematically inclined, some more philosophical; some are realist, some idealist, some pragmatist; some are foundationalists, some more holist; some are bold and outspoken, some cautious and scholarly. Some eventually left logic for other fields; some worked primarily in logic their whole careers. In denying that these women share a common or feminine philosophical style or orientation, there are two subtler, related feminist theses I don't mean to deny: that political factors contribute to how academic fields take shape, and that feminine socialisation, or the experience of living as a woman, may enable female thinkers to see things their male counterparts cannot see clearly. The former clearly applies to early analytic logic. As I will show, political and gendered factors

affected who received credit for an idea or discovery. The latter phenomenon is perhaps less applicable to the non-gendered subject matter of logic than to fields like epistemology, ethics, or philosophy of language. Still, some female logicians did believe in special insights drawn from a woman's experience, or provide striking illustrative examples about their children or their traditionally feminine interests. Others did not; this is another respect in which these women are all individuals.

Another cause of the erasure of early analytic female logicians from the canon, I argue, is the conventional narrative of early analytic philosophy. Mainstream histories describe an edifice erected in Cambridge entirely by men: Moore and Russell inventing their New Philosophy around 1898, and soon afterwards Wittgenstein and Russell's logical atomism, inspired by the great Frege. Some historians include the Vienna Circle as part of early analytic philosophy, but generally fail to mention its female members Olga Hahn-Neurath, Rose Rand, and Olga Taussky (Janssen-Lauret forthcoming). Several fail to discuss any female philosophers at all (e.g. Coffa 1991, Skorupski 1993). Some assume the first female analytic logician emerged in the 1940s. They discuss only Ruth Barcan Marcus and, despite the importance of her work in logic, deal with it rather briefly (e.g. Cocchiarella 1987). Even the comparatively feminist Beaney, who stresses the centrality of Susan Stebbing, states the early development of analytic philosophy took place 'as the ideas of Frege, Russell, Moore, and Wittgenstein in its early period were applied, criticized, extended, and transformed' (Beaney 2015: 13).

Beaney makes explicit a conception of analytic philosophy others assume implicitly: one which simply identifies early analytic philosophy with the works of four male 'founders'. According to this conception analytic philosophy spread to the European continent via the Vienna Circle's interest in Wittgenstein's *Tractatus*, and subsequently to the US as European Jewish and left-wing analytic philosophers fled the Nazis (Beaney 2015: 13-15). Naturally, it is difficult to find room for early female contributors in a field defined as the ideas of four men and their successors. Worse, it implies that no thinker contemporaneous with the 'great men', and critical of them because she preferred setting out her own philosophical programme to applying and extending that of the men, counts as an analytic philosopher, no matter how much her programme resembles analytic philosophy. Both Jones and Ladd-Franklin are in this category. Though explicitly critical of Russell, their work prominently features themes important to later analytic philosophy. Early analytic philosophy, then, is more fruitfully described as a movement with a variety of strands, each with a range of central and more peripheral figures. On that alternative conception of analytic philosophy, there is room for multiple grandfathers and grandmothers besides Frege, including Ladd-Franklin and Jones.

## 2. FEMINIST PHILOSOPHY, FORMAL LOGIC, AND THE PRE-FREGEAN ANALYTIC PERIOD

Analytic philosophy began in the late nineteenth century, when the cause of higher education for women was controversial, its institutions insecure. For a woman to study any subject at university level was a defiantly feminist act. To hold a research or teaching post in

academia, even more so. Our present-day assumption is that women struggle, or experience hostility, in fields we regard as masculine, such as logic. Disciplines based around language or normativity we now consider more gender-balanced and feminine, a more welcoming environment for female scholars. But that perception is to an extent anachronistic. In the Victorian era, the idea of a woman excelling in any academic field was transgressive. All fields were male-dominated, languages just as much as mathematics. Male Victorian scientists and establishment figures argued specifically that women's language use was inferior to men's. Men arrived at that conclusion by comparing women to upper-class men who modelled their usage on Latin—which most of their female contemporaries could not do, because they rarely received a thorough education in the classics (Cameron 2007 p. 126).

In the early analytic period, women had to fight to be treated even as second-class academics by male colleagues. But logic was not a particular bastion of masculinity. When students at Cambridge's first women's colleges won the right to sit the same exams as male students, in many fields the women's results were equal to the men's—to widespread surprise. Logic was one such field. In 1880, Constance Jones was the first woman to achieve a First class result in the Cambridge Moral Sciences (philosophy) exam, which included logic, psychology, ethics, and economics (Jones 2018). She especially excelled in logic and, in her subsequent academic career, published four books on the subject. Cambridge's notorious mathematics exam remained male-dominated for several more years, until Philippa Fawcett outperformed all the Cambridge men in 1890. But the same had been true for classics, which held equal cultural significance, until in 1887 Agnata Ramsey had achieved a First class result higher than any man's. Although these trailblazing women helped change public perception of women's abilities, the old prejudices died hard. In 1922, Jespersen still claimed that women's speech is less considered and has less logical complexity (Jespersen 1922: 252-253). Even in the 1940s, Mary Warnock and her fellow female classics students found 'what a struggle it was for girls to keep their heads above water in Mods, an examination based on the assumption that boys had been learning Latin and Greek almost as soon as their education had started' (Warnock 2000: 39).

Twenty-first century feminist philosophers have not always shaken off all biases depicting women as more linguistically and normatively gifted, but less at home in logic and mathematics. Perhaps part of the explanation is that several classic works of analytic feminist philosophy date from the 1970s and '80s. At the time the consensus among social scientists was that men outperform women in mathematics due to gender differences in their psychology. Prominent analytic feminists accepted the gender differences hypothesis, but suggested, in the interest of fairness, to avoid judging women by male standards (e.g. Gilligan 1982, pp. 8-16). More recent research in psychology indicates that women's mathematics performance has largely caught up with men's, lending support to the contrary hypothesis of gender similarity (Hyde et al 2008). There is no strong evidence that women are intrinsically more inclined towards language or normativity and men towards logic and mathematics.

### 3. CHRISTINE LADD-FRANKLIN: LIFE AND WORKS

Ladd-Franklin (1847-1930), who made crucial contributions to psychology as well as logic, was a towering intellectual force in her day. Whitehead, detailing the latest work on quantification and existence assumptions cited, not Frege, but Ladd-Franklin (Whitehead 1898: 116). A paper on her contributions rhapsodised, ‘No scheme in logic that has ever been proposed is more beautiful than that ... of Dr. Ladd-Franklin’ (Shen 1927: 54). Nowadays American psychologists and historians remember her for her pioneering research into colour vision and writings on women’s education and female mathematicians (Furumoto 1992, Furumoto 1994, Scarborough and Furumoto 1987, Spillman 2012). But in logic, the subject of her PhD and early publications, she is hardly remembered at all. While several historical logic papers mention her in the footnotes, feminist philosophy papers tend to list her only as one of the first female philosophy PhDs without discussing her ideas. There are very few contemporary papers about her philosophical views (Aglar and Durmuş 2013), or her contributions to formal logic (Russinoff 1999).

Christine Ladd was born in 1847 in Connecticut, to feminist parents who encouraged her to study science at Vassar College. Between 1866 and 1869 she took in a broad range of scientific subjects, including mathematics, physics, and botany. She was especially inspired by her professor Maria Mitchell, a female pioneer of astronomy. Ladd yearned for a career in physics, but open and explicit institutional discrimination against women was rife. No male physicist would let a woman work in his research laboratory. Ironically from the contemporary point of view, her teachers encouraged her to pursue what she considered ‘the next best subject, mathematics’ as more suitable for a woman, since she could study it independently (Furumoto 1994: 98). After graduating, she spent some years as an independent scholar researching mathematics and botany. Between 1872 and 1878 Ladd published some twenty proofs and notes in the mathematical journal *The Analyst* and more in the British *Educational Times* and the *London Educational Journal*. She engaged in independent study with academics at several universities, including Harvard, while she made her living teaching mathematics in girls’ schools. Having grown tired of school-teaching, she received encouragement from the mathematician James Sylvester, who admired her published work, to apply to his university, the all-male Johns Hopkins, for postgraduate study. She applied as ‘C. Ladd’. When the trustees discovered that C. Ladd was, in fact, a lass, Sylvester intervened on her behalf. Although not officially recognised as a fellow or even a student, she received a fellowship stipend from 1879 to 1882, working on mathematics with Sylvester and logic with Peirce. In 1882 she completed her PhD (published as Ladd 1883). As a woman, she was not permitted to graduate with the degree—until the university finally relented and awarded her doctorate many years later, in 1926.

Ladd’s PhD was a *tour de force*. She revolutionised traditional syllogistic logic by subjecting it to an algebraic treatment which includes a NAND-operator, apparently its first use in the history of logic. Ladd demonstrated that all syllogisms are triads of sentences which share a certain form in her algebraic system, a form such that the truth of the premises is inconsistent with the falsity of the conclusion. Her contemporaries had high

regard for her work. Venn's review of the volume in which it first appears devotes more space to discussion of Ladd's paper than any other (Venn 1883: 595-601). Josiah Royce described it as 'the definitive solution of the problem of the reduction of syllogisms' and praised 'the crowning activity in a field worked over since the days of Aristotle ... the achievement of an American woman' (Royce quoted in Shen 1927: 60). Ladd's solution is not a proof by modern logicians' standards, since it deploys a different conception of inconsistency from the present one. Ladd took a triad of statements to be inconsistent just in case the truth of one implied the falsity of one or both of the others. Modern logicians hold that a triad of sentences is inconsistent just in case there is no possible interpretation which makes all three statements true. Susan Russinoff has since provided a proof of Ladd's Theorem using contemporary logic (Russinoff 1999).

Ladd's work was, despite its differences from contemporary logic, thoroughly formal. Her system stood in the tradition of Boole's algebra with the revisions of Peirce and Schröder, with substantial further revisions of her own. Standard Boolean algebras are calculi which allow for a variety of interpretations, including one in terms of classes in extension, and one in terms of propositions. The key relation of the class-based interpretation is inclusion:  $a$  is included in  $b$  iff every member of  $a$  is a member of  $b$ . Ladd chose a different relation as the basis of her system: exclusion, symbolised by ' $\bar{\vee}$ '. She stipulated ' $a\bar{\vee}b$ ' is true whenever  $a$  and  $b$  are disjoint, and ' $a\vee b$ ' for its negation, which is true whenever  $a$  and  $b$  overlap. Ladd let her ' $a$ 's and ' $b$ 's range over both classes and propositions; ' $a\bar{\vee}b$ ' also has a propositional reading, meaning 'neither  $a$  nor  $b$ '. Her propositional exclusion most closely resembles the contemporary Sheffer stroke. Unlike Sheffer's operator, Ladd's is not used as the sole operator in her system, but as far as I'm aware it is the first occurrence of a NAND-operator in formal logic.

Exclusion has other striking features: unlike inclusion, it is symmetric, and Ladd's vocabulary is order-indifferent. The formulae ' $a\bar{\vee}b$ ', ' $b\bar{\vee}a$ ', and ' $ab\bar{\vee}$ ' are all equivalent. Where  $a$  and  $b$  are classes, they all connote class exclusion; where  $a$  and  $b$  are propositions, they all connote the inconsistency of  $a$  and  $b$ . Traditional syllogistic forms are readily translated into Ladd's symbolism. 'No  $a$  is  $b$ ' is true just in case  $a$  is excluded from  $b$ , so it is equivalent to ' $a\bar{\vee}b$ '. 'Some  $a$  is  $b$ ' is its negation, ' $a\vee b$ ', true just in case  $a$  wholly overlaps  $b$ . 'All  $a$  is  $b$ ' says that  $a$  and  $b$  wholly overlap, that is, that  $a$  is excluded from non- $b$ , so it is ' $a\bar{\vee}\bar{b}$ '. 'Some  $a$  is not  $b$ ' says that  $a$  overlaps with non- $b$ , so it is ' $a\vee\bar{b}$ '. Ladd also added four further forms using the exclusion relation which traditional logic does not countenance: 'All but  $a$  is  $b$ ', 'None but  $a$  is  $b$ ', 'Not all but  $a$  is  $b$ ', and 'Some besides  $a$  is  $b$ '. These may also feature in syllogisms in her sense of the word. She described her translation scheme as one in which the universal propositions (which begin with 'All' or 'No') have a negative copula—the exclusion relation  $\bar{\vee}$ —and particular propositions (which begin with 'Some') have a positive copula— $\vee$ , connoting overlap.

To effect a reduction of all syllogistic forms to one, Ladd first noted the following formula, with '+' representing class union, is always true for any  $a, b, c, d$  in her system:

$$(I) (a\bar{\vee}b)(c\bar{\vee}d)\bar{\vee}(ac\vee b+d)$$

(I) says that the three bracketed formulae form an inconsistent triad. The truth of the first two formulae—no  $a$  is  $b$  and no  $c$  is  $d$ —implies the falsity of the final formula, which says that something which is  $a$  and  $c$  is in the union of the classes  $b$  and  $d$ —that is, something  $a$  and  $c$  is either  $b$  or  $d$ . Ladd notes that the traditional syllogism eliminates a middle term common to two premises (Ladd 1883: 33). Aristotelian syllogisms have three terms: major, minor, and middle. The major and minor terms occur in the first and second premise respectively, concatenated with the middle term, and are concatenated together in the conclusion minus the middle term. Take the syllogism ‘all cats are mammals; all mammals are vertebrates; therefore all cats are vertebrates’. Its middle term is ‘mammal’, the major, ‘cat’, and the minor, ‘vertebrate’. Ladd’s (I) does not have such a middle term but, she noted, a special case of it does: the case where we take  $d$  to be not- $b$ , symbolised as  $\bar{b}$ . This would yield ‘ $(a\bar{v}b)(c\bar{v}\bar{b})\bar{v}(ac\vee b+\bar{b})$ ’. But the subformula ‘ $b+\bar{b}$ ’ denotes everything which either is or isn’t  $b$ , that is, the entire universe of discourse. Trivially, every class overlaps with the universe of discourse. For that reason, Ladd adopted the convention that formulae denoting the entire universe of discourse may be freely omitted in contexts where they are concatenated with ‘ $\vee$ ’ or ‘ $\bar{v}$ ’. As a result, ‘ $b+\bar{b}$ ’ is dropped, yielding

$$(II) (a\bar{v}b)(c\bar{v}\bar{b})\bar{v}(ac\vee)$$

Ladd concluded that we may test any syllogism for validity by considering it as a variant of (II). For any syllogism, our first step is to ‘[t]ake the contradictory of the conclusion’, and then to express the premises and conclusion in terms of class exclusion, or, equivalently, universal propositions with the negative copula and particular propositions with the positive copula. Translated into that form, a syllogism will be valid just in case ‘two of the propositions are universal and the other particular, and if that term only which is common to the two universal propositions has unlike signs’, where ‘unlike signs’ means that it occurs once in the form  $b$  and once in the form  $\bar{b}$ . As Ladd’s vocabulary is order-invariant, she presented her governing formula once again in a more perspicuous form:

$$(II) (a\bar{v}b)(c\bar{v}\bar{b})(a\vee c)\bar{v}$$

Ladd thought of her result not just as a formally elegant reduction of syllogistic form, but also as encapsulating the philosophy of language of rebuttals. In later work, she coined the term ‘antilogism’ for a syllogistic rebuttal, an order-invariant process where ‘for the usual three statements consisting of *two premises and a conclusion* one substitutes the equivalent *three statements that are together incompatible*’ (Ladd-Franklin 1928: 532). She gave a memorable example drawn from life: four-year-old Emily tried to eat soup with a fork. When she was told, ‘Nobody eats soup with a fork’, Emily retorted, ‘But I do, and I am somebody’ (Ladd-Franklin 1928: 532).

Soon after completing her PhD, Ladd married her colleague Fabian Franklin, a junior professor in the Johns Hopkins mathematics department, and began to go by ‘Christine Ladd-Franklin’. An unusually feminist move at the time, the hyphenated surname seems to have confused many journal editors and indexers, who frequently list her as ‘CL Franklin’ or ‘Mrs Franklin’. In the next few years she had two children: a baby who died very young, and a daughter, Margaret Ladd-Franklin. Ladd-Franklin *fille* grew up to publish on female suffrage (M. Ladd-Franklin 1913). Academic employment was even more difficult to find

for a married mother than for women who remained single. By now Ladd-Franklin was publishing prolifically on formal and philosophical logic as well as mathematics, and would continue to do so for the rest of her life. Still drawn to experimental science, she also began research on vision within the newly emerging field of psychology. Her publications on both logic and psychology were of such high quality that they became difficult to ignore, but still Ladd-Franklin could obtain no academic appointment. In 1901 she became associate editor for Baldwin's hugely influential *Dictionary of Philosophy and Psychology*. Finally, in 1905, Johns Hopkins let her lecture part-time for four years. Afterwards Ladd-Franklin moved to New York with her husband. She successfully taught on a part-time basis at Harvard, Chicago, and Columbia, but never secured a permanent academic post. Opportunities for women to promulgate their work also remained scarce. Conferences and seminars were generally all-male and invitation-only. Men defended women's exclusion on spurious grounds as smoke-filled rooms. Ladd-Franklin sardonically replied, 'I for one always smoke when I am in fashionable society' (Ladd-Franklin to Titchener, quoted in Scarborough and Furumoto 1987: 125).

Ladd-Franklin's sanguine persistence in the face of discrimination was singular and admirable. Besides advocating for herself and her own work, she continued to agitate for women's higher education and employment in academia, and wrote historical-mathematical papers raising awareness of her female forerunners, such as the number theorist and positivist philosopher Sophie Germain. Ladd-Franklin's style of engagement, which an obituary calls her 'cheerful aggressiveness' (Woodworth 1930: 307), was straightforward, plain-speaking, and self-assured. What's more, as we can see from the quotations above, she was an engaging writer, able to move from exacting mathematical proof to rousing persuasive rhetoric to a well-crafted example about a little girl in equal parts illustrative and funny. Why is such a brilliant and powerful role model for women in logic now almost wholly forgotten? My hypothesis is that it is connected to her disagreement with Russell.

Ladd-Franklin's algebraicism led her to oppose the logicism of Frege, Russell, and the early Wittgenstein which took logic to be not merely a calculus, but a universal language. As a result of the common historical narrative according to which early analytic logic is just Frege, Russell, and Wittgenstein, her sophisticated arguments against this conception of logic will seem surprising, both modern and radical. Historians know but that Russell viewed logic as, in Leibniz's terms, not merely a *calculus ratiocinator* to model reasoning, but a *lingua characterica*, a universal language to reveal the ontology and structure of reality. We are also familiar with interpretations of Wittgenstein, Carnap, and Quine as adherents of the *lingua characterica* approach to logic (Hintikka 1997). Very few of us know that Ladd-Franklin had issued strong rebuttals to Russell's main arguments in favour of this conception of logic. She drew upon strikingly contemporary ideas including implicit existence assumptions, multigrade relations, the philosophy of language of domain restrictions and expansions, and the relationship between formal and informal logic. As such themes have made a resurgence in middle and late analytic philosophy, not infrequently motivated by pragmatism, tracing them to an early analytic author with pragmatist sympathies is appealing from a historical point of view.

Ladd-Franklin preferred to see logic as a *calculus ratiocinator*, a method of symbolic calculation intended to mirror, and facilitate, good reasoning. She argued that ‘[l]ogic can therefore throw no light upon the particular meaning to be attached to such terms as reality, existence, occurrence, “things.” They mean, all of them, occurrence within a given domain of thought’ (Ladd-Franklin 1912: 653). According to Ladd-Franklin, the domain of discourse may vary. It cannot simply be assumed to be all of reality. We must express our ‘field of thought’ explicitly. She argued that ordinary-language domain restrictions make this prudent —‘If I am talking about ripe apples which exist, I may be thinking simply about existence within my own garden’ (Ladd-Franklin 1912: 653)—but also that logical considerations mandate it. This latter argument is only alluded to in her published work, but intriguing when combined with material from her notes. Ladd-Franklin asserts that ‘Russell ... develop[ed] a theory of types which, if his universe-terms had been more explicitly in his mind, and on his paper, he would doubtless have seen to be ... nothing but the good old doctrine of the variable domain of thought’, suggesting that type-theoretic thought is an admission that a single domain of discourse cannot be maintained. Given The Contradiction, even Russell conceded this, hence his move to type theory. But Ladd-Franklin had already made her version of the argument while Russell was just barely an undergraduate, against Constance Jones.

In her first book, Jones had argued against the limitations of restricted domains (Jones 1890, pp. 97-102). Ladd-Franklin summarised Jones’s objection as ‘the universe is no sooner named than it is transcended’, and countered, ‘but the very meaning of universe is the understood container of all our terms (including their negatives), and if any thing is named it is a term and not the universe of the given discussion’ (Ladd-Franklin 1890: 563). An undated note in her *Nachlass* explains further, ‘It is a fundamental principle of logic *that you have but to state your universe ... to transcend it*. For you cannot have any term whatever without having at once, along with it, as a subject of discussion ... not necessarily as an existent thing in your given universe, its negative’ (Ladd-Franklin undated, quoted in Pietarinen 2013; drawn from the Fabian Franklin and Christine Ladd-Franklin Papers, Box 36, Folder 4). What she appears to have had in mind is that for any specification of an object or class, we can generate ‘its negative’, a complementary class. Whenever we specify a given class as our domain of discourse, treating it as a single, describable thing, we have to admit that something falls outside it: a position resembling indefinite extensibility. Ladd-Franklin was moved to take this view by her admiration for Mary Calkins’ ‘brilliant and, I believe, unanswerable defense of idealism’ (Ladd-Franklin 1911: 711). Ladd-Franklin’s last paper, published posthumously, in French, combined Calkins’s position, pure idealism, with ‘hypothetical realism’ about objects outside the realm of conscious experience, such as other minds and physical objects (Ladd-Franklin 1931). She claimed that recent physics supported this (Ladd-Franklin 1931 p. 183). We might view Ladd-Franklin as an early exponent of the type of view according to which the proper response to the paradoxes is a deep critical re-examination of our presumed mathematical knowledge and ontology. Russell’s approach was to pinpoint the source of the inconsistency in the prior best theory of mathematics—roughly, the idea that a set or class corresponds to any apparently specifiable condition—and amend it to find the closest

consistent theory. By contrast, the family of views to which Ladd-Franklin's belongs would have it that the lesson of the paradoxes is that we can't take for granted the existence of mathematical objects on the scale posited by the theory of classes. Perhaps we ought to abjure the mind-independent existence of classes, or withhold judgement about accepting the higher infinities. A later American exponent of this type of view was Ruth Barcan Marcus (Janssen-Lauret 2015, pp. 163-164).

Early analytic logicians' version of the logic-as-universal-language doctrine aimed to identify mathematics with logic. As a young woman, Ladd-Franklin had taken a liberal attitude about calling logic a branch of mathematics or *vice versa*, arguing that either is justifiable; while logic is unlike mathematics in not being restricted in 'its subject-matter [to] dealing with any kind of quantity', it resembles mathematics in its formal rules of procedure (Ladd-Franklin 1889: 546). Yet as she saw the details of Russell's logicism filled in, she began increasingly to set her mind against it. She valued logic as an instrument to encode our natural processes of reasoning, set up with 'simple and appropriate symbolism' so as to 'inculcate fresh habits of exact and clear thinking' (Ladd-Franklin 1912: 641) and help us sidestep fallacies. From a feminist point of view, it is striking to see her illustrate natural principles of sound reasoning with examples drawn from parenting, for example, 'When I said to my little girl, "I will take you down town this afternoon if you are good," she said "And only?"' – meaning: That is no doubt a sufficient condition, but is it also indispensable?' (Ladd-Franklin 1912: 646). She urged that clarity and the avoidance of an infinite regress of definitions required each theory to spell out explicitly its domain of discourse as well as its 'primitives' (Ladd-Franklin 1911: 709)—a term which, in the sense where it is equivalent to 'indefinable terms and unprovable assumptions', she describes as her own coinage adapted from the Italian usage (Ladd-Franklin 1931: 164).

Ladd-Franklin took exception to the system of *Principia Mathematica*, especially to Russell's Introduction, firstly because its domain was not explicitly specified, which led to significant confusion: 'this personal idiosyncrasy of Bertrand Russell's has not been without its consequences; it has led him to develop a theory of types which, if his universe-terms had been more explicitly in his mind, and on his paper, he would doubtless have seen to be ... nothing but the good old doctrine of the variable domain of thought' (Ladd-Franklin 1912: 652). Secondly, Ladd-Franklin recognised that *Principia* proved a great range of propositions based on the slender primitives of quantification, membership, and the Sheffer stroke, but objected that there was another, hidden, primitive of 'implication', which did not model the logical consequence of everyday reasoning very well. In her view, early analytic logicians privileged the 'mathematization of logic' over making the forms of good reasoning perspicuous.

Ladd-Franklin deplored Russell's artificial construction of implication – an asymmetric relation between two propositions, namely a conjunction of the premises and the conclusion – as lacking versatility. She argued instead for a logical consequence relation which she called 'entailment' and which looks remarkably contemporary. According to her, entailment is both symmetric and, in modern parlance, 'multigrade': able to hold between a conclusion and any thinkable number of premises (Ladd-Franklin 1912: 655). Ladd-Franklin was ahead of her time. Proposals for a multigrade entailment relation did not resurface until

the 21st century (MacBride 2005: 573-578). Ladd-Franklin allowed entailment to hold directly between qualities or classes without need for instances or propositions: ‘when I say that, in a given field [of thought], the blue objects are all square and the round objects all red ... I do not need to think [of] objects; I may just as well have in mind that “blue colour implies square shape” or that “roundness implies redness”’ (Ladd-Franklin 1931, p. 171, my translation from CLF’s French). Her sophisticated views on logical consequence contradict historians’ common assumption that logicism allowed much more expressive power and versatility than the *calculus ratiocinator* approach. Such an assumption is made, for example, by van Heijenoort, in a famous paper on *lingua characterica vs. calculus ratiocinator*, which states that ‘in [Boole’s] logic the proposition remains unanalyzed. The proposition is reduced to a mere truth value. With [Frege’s] introduction of predicate letters, variables, and quantifiers, the proposition becomes articulated and can express a meaning.’ As we saw above, Ladd-Franklin’s logic did not suffer from any of these defects. Her calculus applied equally to classes in extension and individuals as to propositions. Her symmetrical, order-invariant exclusion operator symbolised both class exclusion and propositional inconsistency.

Ladd-Franklin considered such inconsistency a far more perspicuous model of ordinary-language entailment than Russellian implication, arguing that, if used properly, it helps guard against fallacy. Avoidance of affirming the consequent or denying the antecedent, errors which she calls ‘Wrong Conversion’, is made easy. ‘The fatal error of Wrong Conversion is eliminated automatically, – it is practically impossible to make it. You may inadvertently infer from [if  $p$  then  $q$ ] that also [if  $q$  then  $p$ ], as who has not done upon some occasion? But who would infer from the fact that  $p\bar{\vee}q$ , that  $\bar{p}\bar{\vee}\bar{q}$ , – from the fact that  $p$  and  $q$  are incompatible that their negations are incompatible? But this is what false conversion is, in terms of the negative relation. You see at once that it is impossible to commit this error. From ‘no dancing is moral’ it does not follow that ‘nothing which is not dancing is immoral,’ and it almost makes one dizzy to try to believe that it does.’ (Ladd-Franklin 1912: 646-647).

Ladd-Franklin’s striking and sophisticated arguments against Russell and in favour of the *calculus ratiocinator* view of logic deserve to be better known by logicians and historians of philosophy. Identification of analytic philosophy with the Russellian strand of *lingua characterica* thinking, arguably followed by Wittgenstein, Carnap, and Quine (Hintikka 1997) has led to the neglect of the algebraic approach. But a better understanding of early analytic exponents of that train of thought might be helpful in informing how we view the recent resurgence of inferentialism in logic, many of whose exponents are, like Ladd-Franklin, Americans or pragmatists.

#### 4. CONSTANCE JONES: LIFE AND WORKS

Across the Atlantic in Cambridge, at the tail end of the nineteenth century, is where tradition places the beginning of analytic philosophy. Tradition portrays that project, Moore and Russell’s New Philosophy, as setting itself against British Hegelianism exemplified by Bradley. It also stresses that Russell took great inspiration from the works of Frege: his

mathematical logic and sophisticated moves in the philosophy of language, including the distinction between sense and reference distinction (Frege 1892). But Russell was not to read Frege until 1902. And there had been another logician in Cambridge who had argued for the sense-reference distinction two years before Frege did: Constance Jones.

Emily Elizabeth Constance Jones, who went by her second middle name and published under her initials, had been born into a privileged, conservative Victorian family in Herefordshire in 1848, the same year as Frege. The daughter of a loving, well-read mother, Emily Oakeley, and John Jones, a physician and apparently rather reactionary father given short shrift in Jones's autobiography (Jones 1922), Constance had only an erratic education as a girl. She spoke regretfully of not being allowed to read novels or learn much Latin, as she had longed to study Classics at a women's college (Jones 1922: 25). Her father paid for higher education for his sons, but not his daughters (Jones 1922: 44). Still, her mother had taught Constance fluent French, and a German governess made her trilingual. Money provided by a supportive aunt finally saw her to the newly-established Girton college in 1875 (Jones 1922: 52). She had to miss several terms of study because her aunt could only afford the expense intermittently. As classics was out of reach for her, she chose a subject which suited her rigorous interests but did not require much Latin: Moral Sciences (philosophy). Once she began studying Mill's logic with Keynes, psychology with Ward, and ethics with Sidgwick, she shone. At Cambridge, women were permitted to sit exams alongside men, but not to graduate with their degrees, a state of affairs which would persist until 1948. In Jones's time, women's results were not even announced. The news that she was the (joint) first Girton student to obtain a First in any field came scribbled on the back of an envelope, for which a persistent emissary had had to pester Sidgwick at dinner (Jones 1922: 55). After her finals, Jones tackled the translation of Lotze's *Mikrokosmos*, while taking care of the aunt who had been so generous to her until 1884.

Jones then managed to do, in the 1880s, what is still made very difficult for many women today: returning to work in academia after a period of caregiving. Upon her aunt's death, she returned to Girton as a librarian, and was soon promoted to Lecturer in Logic. She subsequently published four books on Aristotelian and philosophical logic (Jones 1890, 1892, 1905, 1911). She further published her translation of Lotze, some two dozen articles – most on logic, some on ethics and metaphysics – and an edition of her friend and teacher Sidgwick's posthumous works. In 1903 Jones took up the post of Mistress of the college. Where Girton students had previously been tightly chaperoned, Jones ran the college in a spirit of academic inquiry and religious tolerance. Though a devout Anglican, she admitted and supported students who were nonconformist, Jewish, or atheist like the mathematical logician Dorothy Wrinch. Jones even let them stay out late to go to freethinkers' talks (Senechal 2013: 49). While we might expect female educators, themselves victims of sexist oppression, to oppose ethnic and religious discrimination, not all women's colleges did so. Carey Thomas, president of Bryn Mawr and cousin of Alys Pearsall Smith, Russell's first wife, opposed appointments of Jewish staff and admission of Jewish students to her college (Horowitz 1944: 232, 381). By contrast, Jones was an excellent Mistress in her welcoming attitude to minorities as well as in her talent for financial management. She raised substantial funds, saving the previously very poor college from financial ruin and

closure in 1913. And all the while she taught, introducing female students to the joys of logic.

Jones was by any measure an impressive figure, and a stalwart of the philosophical community from the 1890s until her death in 1922. A pioneer of women's education and the first woman to present a philosophy paper at the Cambridge Moral Sciences Club, she was admired by Sidgwick and by Stout, the founder of trope theory. Stout, though about ten years younger, arrived in Cambridge as a student a few years after Jones, taught Russell and Moore, and seems to have been a long-time fan of Jones's work by the time he wrote a foreword to her monograph (Jones 1911). She was still remembered as a fairly significant philosopher in the 1960s (Passmore 1966). But nowadays hardly any historians of analytic philosophy remember her at all. She is not mentioned even in a volume with comparatively more focus on female philosophers such as Beaney's 2015 *Handbook*. The only contemporary papers about her are an entry in Waithe's *Women Philosophers* and a Stanford Encyclopedia piece (Ostertag 2011). This stands in stark contrast to her treatment by her contemporaries.

During the early analytic years, we find philosophers ascribing the invention of the sense-reference distinction straightforwardly to Jones. J.N. Keynes, Jones's own logic teacher, added twelve points he owed to her in the revised edition of his *Formal Logic*, and particularly stressed that he had 'practically borrowed the above [sense-reference distinction] from Miss Jones, who describes an affirmative categorical expression as 'a proposition which asserts identity of application in diversity of signification ([Jones 1892] p. 20)' (Keynes 1906: 190). Augusta Klein explicitly adds Frege's later, independent discovery of it as an afterthought: 'the post-Hegelian doctrine which treats all predication as the statement of an Identity in Difference ... has been strikingly illustrated by a theory expressed first by Miss Constance Jones as long ago as 1890, and, a little later, by Prof. Frege' (Klein 1911: 521).

Why has Jones's discovery been forgotten by historians, and credit reassigned to Frege? Part of the answer may lie in historians' being justly struck by the mathematical innovation of Frege's project, which is not present in Jones' work. As a Victorian girl, she had never been taught much mathematics. She presented a fairly traditional Aristotelian logic, although she made use of the latest Victorian formal methods such as Venn diagrams (e.g. Jones 1890: 47-8, Jones 1893: 35-48). Because the formal logic is relatively conservative, and the vocabulary unfamiliar, it is easy for us—as perhaps it was for the young bucks Russell and Moore with their New Philosophy—to miss the strikingly modern features of Jones's philosophical logic. She proposed certain theses central to analytic philosophy, such as anti-psychologism about logic, her description of logic as the science of the relations between propositions, and most strikingly, the distinction between identity of denotation and diversity of intension, which we now know as the distinction between sense and reference, years before the advent of the New Philosophy.

Another key part of Jones's neglect is likely to be connected to the explicit attitudinal sexism of some of her contemporaries and inherited bias by present-day historians. Russell, while a great champion of Frege, treated Jones very dismissively. Certain historians have taken Russell's dismissive attitude towards Jones as fact rather than investigating the issue dispassionately. In addition, certain other historians, in the grip of slightly simplified

origin stories of analytic philosophy, have a skewed perception of its intellectual context, misinterpreting both British Hegelianism and its opponents.

First of all, since Bradley played the role of foil to the New Philosophy, it is easy for some historians to overestimate Bradley's domination of the late Victorian philosophical world in the United Kingdom. Second, since Bradley was an idealist, and Frege was famously anti-psychologistic, contemporary philosophers slide into thinking that he was the source of analytic anti-psychologism, and that Bradley and his supporters must have embraced psychologism, a 'denial of mind-independent objects' (Glock 2008: 32). Both assumptions are false. First, while idealism and British Hegelianism enjoyed significant popularity in the 1890s, Bradley by no means reigned supreme. Empiricism was alive and well in British universities. Mill's disciples propounded his logic, which argued that logical and numerical judgements are generalisations from experience. Inductive logic such as Venn's and the innovative symbolic logics of Boole and De Morgan were widely studied as well.

Second, all psychologism in late nineteenth-century British logic was on the empiricist side, the same Millian empiricism Frege had scoffed at. Bradley's idealism was of a thorough-going anti-realist variety. He vehemently opposed Mill's and all other forms of psychologism. Bradley railed against the facile psychologism which takes reality to be composed of mind-dependent objects—the view sometimes attributed to him and his fellow idealists by present analytic philosophers. His point was well taken by Moore, who disavowed psychologism in his 'Nature of Judgement' (1899: 180, 183). Moore and Russell had been anti-psychologistic even in their pre-Fregean phase, but anti-psychologism was also the view of several of their opponents, including Bradley, and also Jones (1890: 2).

Keynes and Klein's formulations of Jones's view, and Jones's own later characterisation, 'any Subject of Predication is an identity of denotation in diversity of intension' (Jones 1910-11: 169), make use of Hegelian terms. To many twenty-first century analytic philosophers, these Hegelian terms are so foreign that we may easily pass over without understanding, and not recognise it as an independent statement, two years prior to the one we know, of what Frege called the distinction between 'Sinn' and 'Bedeutung'. On my reading of Jones, she deployed Hegelian vocabulary because it was familiar to her audience in 1890s Cambridge, when Hegelianism was popular, but did not endorse it herself. My interpretation is confirmed by Klein's description of both Frege and Jones as advocating the same '*post-Hegelian doctrine*' (my italics). Klein specified that the doctrine itself was not a Hegelian one, but a reaction to Hegelian ideas, a subsequent stage of the development of philosophical logic.

Jones's Hegelian vocabulary makes it difficult for twenty-first century readers to see just how original she was. Her philosophical positions and Bradley's were quite different. Bradley, our archetypal Hegelian, used the nomenclature of identity in diversity to argue that the singular subject-predicate form of ordinary judgements is deeply misleading. Due to their covert reliance on a range of background judgements, he claimed, such statements never truly manage to predicate something of a subject clearly distinguishable from the predicate (Bradley 1883: 95, see also Janssen-Lauret 2017: 11). Jones's project was very different. Bradley was a monist, while Jones believed in a plurality of properties and individuals. Bradley maintained that subject-predicate judgements were inherently misleading

and could not share a structure with reality. By contrast, Jones held that a search for the underlying form of subject-predicate judgements was fruitful, and advocated a novel account of them as having the form of expressing an identity of denotation in diversity of intension.

Waithe and Cicero claim that Jones influenced Bradley away from regarding identity as incoherent (Bradley 1883), towards a more sensible view of identity (Bradley 1897), more resembling hers (Waithe and Cicero 1991: 38). While it is certainly possible that she influenced him, I do not think Bradley fully came round to Jones's position on identity. In the late 1890s, Bradley continued to maintain an extreme form of holism and monism which denied the coherence of subject-predicate analysis (Bradley 1897: 17) on the grounds that singular judgements always leave out significant aspects of the description of the referent (see also Janssen-Lauret 2017: 11). Still, they may be correct that the influence on the young Russell, who in his 1897 dissertation advocated an identity-in-diversity analysis of predication combined with a pluralism about things or contents, came in part from Jones (Waithe and Cicero 1991: 39), who adhered to pluralism rather than monism.

Jones advocated the view, common among analytic philosophers but controversial among the Aristotelian, Boolean, and empiricist logicians of her day, that logic is the science of the relations between propositions. We might describe her as engaged in the project of finding the general form of the proposition. Although Frege's logic has the great advantage of broadening 'proposition' to include the relational case, and Jones confined herself to subject-predicate form, she made a significant advance, which she called 'a new law of thought'.

According to traditional Aristotelian approaches, logic has three main laws: noncontradiction ('not both  $A$  and not- $A$ '), excluded middle ('either  $A$  or not- $A$ '), and identity (' $A$  is  $A$ '). Jones was dissatisfied with these laws. She saw that most statements deployed in logical inferences are not identities of the form ' $A$  is  $A$ '. First, she put forward an argument later independently made by Frege: that some statements which are indeed identities are, unlike ' $A$  is  $A$ ', informative. 'Though  $A$  is  $A$  conveys absolutely nothing more than mere  $A$  does (and this appears to me to be nothing at all, for a mere isolated name is a complete nonentity), the exigencies of assertion introduce difference of position in space or order in time between the subject  $A$  and the predicate  $A$  ... Unless we could speak or write  $A$  twice over we could not assert  $A$  to be  $A$ .' (Jones 1890: 48-9).

Second, Jones dug more deeply into the general form of the subject-predicate proposition, arguing that most subject-predicate statements cannot be reduced to identity. By contrast, identity can be viewed as a special case of subject and predicate. Jones proposed that identity is a special case of the more general propositional form of ascribing a characteristic to a subject. A more accurate description of the general form of statements featuring in traditional logical inferences is that they are true just in case they ascribe to something with 'identity of denotation', that is, sameness of reference, distinct intensions to which it belongs, since it is 'in [a] diversity of intension[s]', i.e. can be described by words with different senses or meanings. Jones symbolises her law as ' $S$  is  $P$ '. This is the general form of the proposition, her new law of thought, and it allows us to rewrite the other traditional laws more perspicuously, e.g. as ' $A$  is either  $B$  or not  $B$ ' (1890: 176-177).

In the only article on Jones written in the twenty-first century, Gary Ostertag claims that ‘it’s not clear what she means [because] not every instance of  $S$  is  $P$  is true’. But Ostertag has misinterpreted Jones. He appears to read her ‘ $S$  is  $P$ ’ as schematic in the sense of contemporary logic, assuming that she means that any substitution of terms for ‘ $S$ ’ and predicates for ‘ $P$ ’ yields a true result. Such a reading is anachronistic. Contemporary schemata of the sort Ostertag is thinking of were unknown among Aristotelian logicians. Jones’s work predates the logical tradition where symbolisations like ‘ $S$  is  $P$ ’ were intended schematically. Even well into the twentieth century, several of the pioneers of mathematical logic did not have this conception of schemata. Quine, for example criticised Russell and Whitehead for confusing variables with schematic letters (Quine 1941, pp. 144-145). Aristotelian logicians’ use of letters to stand in for parts of formulae was significantly looser still. That traditional Aristotelian logic lacks contemporary schemata can easily be seen from the fact that the expression ‘ $A$ ’ features in both the laws of Excluded Middle (‘either  $A$  or not- $A$ ’), and Identity (‘ $A$  is  $A$ ’), even though their instances contain substituends for  $A$  of distinct syntactic categories. In the law of Identity, ‘ $A$ ’ is replaced by singular terms, and in Excluded Middle, by sentences. Jones’s ‘ $S$  is  $P$ ’ is therefore not a schema in which substitutions may freely be made. A more charitable reading renders it simply as an abbreviation or symbolic representation of her law ‘any Subject of Predication is an identity of denotation in diversity of intension’, and there is a plausible reading of that law on which all instances of it are indeed true. If the law is interpreted as ‘to one identical subject (‘identity of denotation’) different intensions (‘diversity of intension’) are attributed, it fails to be true in all cases. The sentence ‘Dr Ladd-Franklin is a mathematician and a mother’, for example, is true, but the sentence ‘Miss Jones is a mathematician and a mother’ is false, even though each sentence attributes diverse intensions to a self-identical referent. But I propose a different reading of Jones’s law. It is significant that her formulation specifies that any subject of predication ‘*is* an identity of denotation *in* diversity of intension’: there is an identical subject denoted and it is in multiple intensions. I propose that the ‘*is*’ and ‘*in*’ should be read as factive, not syntactic. Thus read, Jones is not formulating a law of grammatical form, but one of truth conditions for subject-predicate sentences. Thus interpreted, Jones’s law translates as ‘a subject-predicate sentence is true just in case one identical referent belongs to different intentions, and the subject and the predicate each express an intension to which the thing denoted belongs’. All sentences which do so are true, and all subject-predicate sentences which fail to do so—those which either do not single out an identical referent or attribute to that referent an intension to which the referent does not belong—are false.

Jones’s philosophy of logic was recognised as daringly innovative by her contemporaries. A review in *Science* of her first two books reads, ‘There is so much that is new under nearly all the topics discussed that these two books may be regarded as a distinct step in advance in formal logic’. The review refers to the ‘peculiar standpoint taken to begin with, that logic is a science of relations between propositions’ as well as the ‘analysis of the import of propositions which includes an identity of that to which the terms are applied along with a diversity of aspect marked by the distinctness of term’ (Anonymous 1894: 54). Her view was in part superseded by Frege’s more encompassing analysis of propositions

in his polyadic logic, which could accommodate relational propositions as well. Yet this had not stopped Stout, Keynes, Klein, or Russell's student Jourdain, from taking note of her denotation-intension distinction and attributing it correctly. In part, Jones has been forgotten because her influence was written out of history by Russell and his followers.

Russell had proposed a sense-reference distinction in *Principles of Mathematics*, of which he finished a draft in 1901-02—that is, before he had read Frege (Waithe and Cicero 1991: 47). Waithe and Cicero painstakingly lay out all Jones's publications in *Mind* and *Proceedings of the Aristotelian Society* in which Russell, a regular reader, would have come across her name prior to 1902, as well as the references to her in Keynes (Waithe and Cicero). Jourdain, in a 1909 letter now lost, appears to have pressed Russell to include a reference to Jones as the originator of the sense-reference distinction. Russell replied, 'It would seem, from what you say in your letter, that Miss Jones's distinction of signification and denotation must be much the same as Frege's Sinn and Bedeutung. But of course *some* such distinction is a commonplace of logic, and everything turns on the form given to the distinction. I have neither Keynes nor Miss Jones here, or I would look up the point' (Grattan-Guinness 1977: 119). But we have seen above that Jones's sense-reference distinction was a cornerstone of her innovative and highly original philosophy of logic, not a commonplace distinction made in passing as many had made it before.

Jones had become aware in the 1900s that her distinction was being hailed by the New Philosophy boys as a great discovery of Frege's. It may have rankled to hear this, as Russell was routinely dismissive of Jones. Then again, like all pioneers of female education, Jones was used to persevering in the face of disparaging and patronising attitudes. A review of her second book (Jones 1893) had condescendingly remarked that 'when we find scholarly women manifesting a real relish for this "dry light" [of logic], it gives promise of a coming day when the intellectual appetite will rise above the level of mere entertainment, the level of the play-house and the circus, and take kindly, and perhaps zealously, to real edification' (*ρσλ*1893: 315). Undeterred, she went on to publish two more books and a dozen or so articles on logic. Her one twenty-first century commentator, Ostertag, compounds the problem of historically entrenched sexism when he conjectures that 'For Russell, mindful both of the figures he was allying himself with and of the innovation in thought that they were introducing, acknowledging that Jones had anticipated some of his ideas may have been repugnant'; willing to acknowledge a debt to 'intellectual giants' Frege and Peano, he would not do the same for Jones. Ostertag explains that Jones was 'manifestly *not* of their caliber' (Ostertag's italics) and 'philosophically quite retrograde' (Ostertag 2011).

I cannot see how Ostertag can justify his claims, nor why he expects the reader to take Russell's judgements as truth. The first author to formulate the sense-reference distinction as we know it was manifestly far from philosophically retrograde. Jones's formal logic doesn't deserve the epithet 'retrograde' either; she was a highly regarded, competent expositor of the typical logic of her generation. While her formal logic was not innovative, Ostertag must surely admit that her philosophical logic was. Anyone who considered the sense-reference distinction an impressive achievement when they attributed it to Frege ought to bestow equal praise on the person who got there before him. To downgrade the same distinction first published under a female name, while praising it under the mode of

presentation of publication under a male name, is illogical. Ironically, this illogical inference itself proves an instance of the sense-reference distinction: Ostertag takes different attitudes the same identical distinction, presented as a man's discovery vs. presented as a woman's discovery. The phenomenon of a woman's point not being heard until repeated by a man is nowadays sometimes called 'hepeating'. Jones did not use a snappy name for it, but wryly noted in her reply to Russell, 'If it had not been ... for the fact that I had recently become aware that Professor Frege's Analysis of Categoricals seemed to be really the same as mine, and had been approved by Mr. Bertrand Russell in his *Principles of Mathematics*, I should not at this time have returned [Russell's] attack' (Jones 1910: 167).

Ostertag adds, almost apologetically, that 'it should be mentioned [that Russell] later expressed misgivings about Jones's abilities ... Russell wrote to Lady Ottoline Morrell, on January 14, 1914: "poor Miss Jones (Principal of Girton, inventor of a new law of thought, motherly, prissy, and utterly stupid)" (Russell 1992, 470).' (Ostertag 2011). Ostertag fails to note that Russell made rather a habit of rudely expressing misgivings about the abilities of other philosophers, male and female. Russell made similar remarks about, for example, F.C.S. Schiller and John Dewey. Yet encyclopaedia articles about Dewey never seem to mention in an apologetic tone that Russell described him as 'not a very clever one' (Misak 2018: 104). In fact, the *Stanford Encyclopedia* article on Dewey (Hildebrand 2018), the counterpart of Ostertag's article on Jones, does not discuss Russell at all.

Unlike Ostertag, I view Russell's 'misgivings about Jones's abilities' not as truth but as evidence of a gendered ageism. Russell's 'prissy' and 'motherly' epithets suggest that he regarded this decorous lady some twenty years his senior as a stuffy Victorian relic. Jones appears to have had a sweet and gentle manner about her, in this respect unlike self-assured Christine Ladd-Franklin or plain-speaking Susan Stebbing (Janssen-Lauret 2017 p. 9). A biographical note of Jones by R.W. Inge, which appears as a preface to her autobiography, speaks of her encyclopaedic knowledge of the Bible, her love of plants and poetry, and her famous annual garden parties for children on the Girton lawns (Jones 1922 v-vi). Even in her logic books, her examples focus on flowers, architecture, and small animals (e.g. Jones 1893, p. 133) where male logicians might use battles, beheadings, and the assassination of Caesar. Yet she must have been made of stern stuff underneath the pious and refined exterior, pursuing the academic career which she had wanted since her youth and which no one had expected her to have, while bravely facing down sexist and ageist bigotry. Her success in forging her way to an education in the face of paternal disapproval, her continuous scholarly output defying patronising male reviewers, her quiet but robust support of religious minorities, and her steely determination to get Girton out of financial trouble all tell of significant strength and resolve. Cutting remarks about the age and lack of mathematical sophistication of someone who received no mathematical instruction as a child, for whom there were no colleges until her mid-twenties, and who took several years' career break to nurse a dying aunt, should be viewed through the lens of systemic and cultural sexism rather than taken as read.

## 5. CONCLUSION

Early analytic women demonstrably produced high-quality work on logic both formal and philosophical, as the contributions of Ladd-Franklin and Jones outlined above reveal. Women's absence from the early analytic canon is therefore not due to women's lack of interest in logic or preference for normative philosophy. An examination of the historical record suggests, rather, that women's work was marginalised as a result of sexism in a variety of guises. I put forward several complementary hypotheses to explain the neglect and marginalisation of women's work on logic by analytic philosophers, all of which are, directly or less directly, related to sexism. I have also made the case that two assumptions common among analytic philosophers feed into some of these kinds of sexism. Firstly, female logicians' work has fallen into neglect partly as a result of the general cultural emphasis within philosophy of women's supposed preference for normativity. Secondly, the conventional identification of early analytic philosophy with the works of Frege, Russell, Moore, and Wittgenstein excludes female founders by fiat, and gives an incomplete account of its history. Analytic philosophy is best seen as a broader movement influenced by European and American mathematical logic, British empiricism, and American pragmatism.

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