European Journal of English Studies

ISSN: 1382-5577 (Print) 1744-4233 (Online) Journal homepage: https://www.tandfonline.com/loi/neje20

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To cite this article: Steve Nathaniel (2018) Engineering the ideal: applied modern poetics as applied modern science, European Journal of English Studies, 22:3, 302-316, DOI: 10.1080/13825577.2018.1513721

To link to this article: https://doi.org/10.1080/13825577.2018.1513721

EUROPEAN JOURNAL OF ENGLISH STUDIES
2018, VOL. 22, NO. 3, 302–316
https://doi.org/10.1080/13825577.2018.1513721

Engineering the ideal: applied modern poetics as applied modern science

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ABSTRACT

Many scholars have traced the influences of theoretical science in modernist poetry. However, at the beginning of the twentieth century western audiences were principally enamoured of the applied sciences (or engineering) and especially the ideal of efficiency. The principles and processes of engineering permeated modernism, including its poetry, and, accordingly, the 'science' of modernist poetry is often an applied science. Specifically, Imagist and Objectivist poets implemented processes of optimisation and systematisation, which dramatise the iterative improvements that characterised the contemporaneous Efficiency Movement. That movement's exemplar, Frederick Winslow Taylor, is remembered for conforming factory labour and labourers to exacting empirical ideals, leading this study to question the social repercussions of perfectly 'efficient' poems. However, poets H.D. and Charles Reznikoff actually disperse this impracticable ideal through their process-oriented forms. Thus, the modernist poetry inspired by the applied sciences revolves around scientific ideals, but it ultimately emphasises their fiction.

KEYWORDS

Modernism; Imagism; Objectivist poetry; applied science; engineering; efficiency; H.D.; Charles Reznikoff

Introduction

Scholars committed to the intersection of modernist poetry and science have become increasingly preoccupied with a limited sub-set of 'science'. The theoretical (as opposed to the applied) and the cutting-edge (as opposed to the systematised) have come to stand for science in its dynamic relationship with English literature. The title of Daniel Albright's *Quantum Poetics* (1997) epitomises this theoretical mystique. Scholars like Albright have argued that breakthroughs in particle physics, electromagnetism and molecular biology inspired scientific poetic theories, but the ensuing poetry often arose within societies ignorant of, or indifferent to, theoretical advancements. When such discoveries as relativity and quantum mechanics found expression in the burgeoning mass media of the late 1920s, theoretical science indeed took hold of the imagination of the western public, but in the early part of the century the applied sciences prevailed. This disparity inspired one opinion writer in the *Saturday Evening Post* to name 'pure' or theoretical science the 'ugly duckling, the elder sister who lives secluded and remote, unknown and unpraised' ('Opinion', 1926: 38). In this paper, I examine certain

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applied scientific (or engineering) processes which early twentieth-century European and American audiences did know and praise, and their imitation by poets who professed applied science as an inspiration. I draw on the testimony of engineer and theorist Frederick W. Taylor to define the processes of optimisation and systematisation, and to study the expression of these processes in the poetic tradition that extends from Imagism, exemplified by H.D. (Hilda Doolittle), to the Objectivist poets, exemplified by Charles Reznikoff.

Perhaps the foremost scientific ideal of the early twentieth century, efficiency, began as a strictly industrial method of creating more products with less material, with fewer labourers and in less time. However, it grew into a social phenomenon following the events in August 1910, when factory labourers in Watertown, Massachusetts went on strike. Their dissent provoked a House of Representatives committee hearing on efficiency and labour. During the heavily publicised trial, Taylor testified from 25 to 29 January 1912 and defended 'scientific management', his method of establishing efficiency, against its detractor's complaint that it dehumanised labourers. During the hearing, Taylor often declined to identify scientific management with its practicable techniques, which for example included using stopwatches to determine optimum walking paths for coal-shovellers. Instead, he portrayed the system as an ideal: utter submission to empirically determined improvements. When pressed about how such improvements were applied, Taylor responded evasively that:

> scientific management is not time study. It is not functional or divided foremanship. It is not any new cost system. It is not the printing and ruling and un-loading of a ton or two of blanks of printed matter, and saying 'There is your system; go ahead and use it.' It is none of those things.
>
> (Taylor, 1916: 773)

In spite of Taylor's cagey defence that obscured rather than revealed efficiency's method, many in the western public enthusiastically adopted efficiency as an aspirational ideal.

One year later, Ezra Pound would draw on efficiency rhetoric to posit another kind of scientific management, one designed to engender a 'maximum efficiency of expression' in the poems of the Imagist movement (Pound, 1913b: 214). Pound's poetics swayed a generation of poets whose styles were marked by brevity, impersonality and precision, but, like Taylor's, Pound's adherents never succeeded in attaining his radical ideal. While decoding the fraught relationship between the ideal of efficiency and an efficient poem, some critics have truncated the meaning of efficiency to that of 'brevity', which, although characteristic of many modernist poems, fails to preserve efficiency's most fascinating poetic registers. The ideal of poetic efficiency, which might be represented as the ratio *maximum expressiveness/minimum number of words*, actually accommodates both short and long poems and actually depends on density of meaning. In fact, Imagists do not often achieve this primary sense of efficiency, even in poems such as H.D.'s 'Oread', which is frequently anthologised as a paragon of Imagism. Although brief, the first three lines involve a repetitive mode of expression: 'Whirl up, sea –/whirl your pointed pines,/splash your great pines' (H.D., 1925: 81, ll. 1–3). In repeating 'whirl', 'your' and 'pines' these lines apparently fail to achieve 'efficiency'. H.D.'s high quotient of

repetition, which may be found throughout her early works, demands another explanation if the applied science on which Pound and others drew contributed to a discriminating poetics, as I argue it did.

In 'The Rhetoric of Efficiency in Early Modernism' (Raitt, 2006), Suzanne Raitt associates Pound's ideal of efficiency with Taylor's scientific management and also notes H.D.'s apparent inefficiencies. She describes the ends of efficiency theories, of industry and poetry, as 'a more efficient product', and she determines that 'neither the efficiency movement nor Imagism could ever quite live up to their ideals' (842–843). She has in mind a sense of poetic efficiency in which each word is engorged with meaning. However, the applied-scientific poem may serve as more than efficiency's 'product'; it may also dramatise efficiency's process: rather than simply procuring an efficient poem, the ideals of Imagism often led its adherents to act like engineers, designing *iterative processes* aimed at increasing a reader's apprehension of the Image over the course of a poem. That is to say, they aimed to increase the reader's efficiency. In *Modernism and the Culture of Efficiency: Ideology and Fiction* (Cobley, 2009), Evelyn Cobley illuminates the engineer's task,

> to minimize waste and to increase the ratio of useful energy to be squeezed out of a mechanism. It is not the static balance between output and input that fires the cultural imagination but the dynamic desire to increase the total output of machines at all cost. Efficiency is thus marked by the lure of a perfectibility remaining always out of reach.
>
> (Cobley, 2009: 8)

Here, Cobley aptly delineates the components of efficiency, process and ideal: efficiency involves a dynamic process of approaching a static ideal. Yet, because such processes of iterative improvement do not fall within the purview of theoretical science, their poetic forms have largely gone unnoticed.

The question of what constitutes a scientific poem should conceivably stand at the centre of this conversation, but scholars have often relegated this enquiry in favour of those concerning scientific poetics. Providing an impetus to this trend in *The Modernism of Ezra Pound: The Science of Poetry* (Kayman, 1986), Martin A. Kayman shows Pound's poetics manoeuvring between the aesthetic, scientific, philosophical and political forces of his time. With scrupulous attention to the period's theoretical temperament, Kayman demonstrates that Ernst Mach's and Henri Poincaré's philosophies of science are pertinent to the poetics of Pound, but when Kayman examines the formal processes in the *Cantos* he turns to traditional close-reading strategies or else to abstractions: '*compounds* which produce *shifts*' (115, emphasis in the original). If modernity's most arcane theories and philosophies of science exerted such influence on Pound's theory, should not the period's popularised engineering techniques prove salient to the Imagist poem's inner workings?

Going beyond Kayman's theory-oriented enquiry, most studies of science and poetry have drifted far from the poem as such, dwelling instead on such indirect discussions as the science-inflected intellectual biographies of poets. In *Aethereal Rumours: T.S. Eliot's Physics and Poetics* (Lockerd, 1998), Benjamin G. Lockerd addresses Eliot's 'physics', which turn out to be preoccupations with atomic materialism and Cartesian idealism – that is, preoccupations with philosophies of science and their incidental repercussions in

theoretical physics. Similarly, in *Irresistible Dictation: Gertrude Stein and the Correlations of Writing and Science* (Meyer, 2001), Steven Meyer describes Stein's rejection of deterministic science and her turn instead toward William James' radical empiricism. Like Lockerd's, Meyer's study depends on science's philosophy and theory to reveal poetry's philosophy and theory, declining direct enquiries into scientific *poetry*, especially its formal disposition. Other studies have seated poetics in acculturated science. Lara Vetter's *Modernist Writings and Religio-Scientific Discourse* (Vetter, 2010) considers the sub-discipline of electromagnetism, but none of her readings of H.D., Mina Loy and Jean Toomer show the writers to measure, conduct, store, generate, insulate or direct (electricity), as in the science of electromagnetism; instead, the writers incorporate electromagnetism's diction into their works as a timely but superficial metaphor. One of the most recent surveys of the trend is the collection *Science in Modern Poetry: New Directions* (Holmes, 2012), edited by John Holmes. The accounts are varied and indeed often take a new perspective, investigating topics such as genetics, non-Euclidean geometry, endocrinology and Darwinian evolutionary theory – a multifaceted picture, but ponderously theoretical in orientation. Methodologically, the collection employs science as analogy, theme, diction and context – but rarely as a demonstrable process in a poem.

These studies recognise that most modernist poetics retain little scientific theory as such; rather, they extract its diction, metaphors and ideals. Indeed, Taylor's theory of scientific management is plainly too nuanced and obscure to inspire a vivid poetics, but its ideal, of maximum efficiency, proved aesthetically potent. However, neither in science nor in poetry do ideals directly procure unique material configurations. While theoreticians like Taylor derive ideals, it is engineers that shape materials accordingly; poets whose inspiration includes science must, similarly, conform language to science-inspired ideals. Thus the study of scientific poetry dictates two stages: the first, which I have reviewed above, traces the scientific theory leading to a shared ideal; the second, which I address presently, traces the implementation of this ideal to the material, focusing on the engineer-poet.

Although the applied sciences often pertain to their particular origins in physics, chemistry or biology, they also involve a number of common processes that attempt to ameliorate inaccuracy, imprecision, noise and – of course – inefficiency. In this study, I describe optimisation and systematisation as two crucial processes (among many) within engineering that serve to mediate ideals and materials. I define optimisation as the iterative process of improving the efficiency of a given mechanism, and systematisation as the process of uniting multiple (optimised) mechanisms. Accordingly, the engineer-poet optimises individual expressions and integrates them into a poetic system, a poem. I would like to note that the writing process might also include compelling analogues to engineering processes, but this study examines optimisation and systematisation as processes which are dramatised in published poems.

To demonstrate the first process, optimisation, I turn to the school of modern poetry considered most antagonistic toward protracted expressions or redundant iterations: Imagism. Imagism's theorists demand expressions that occupy as little as, in the words of Pound, 'an instant of time' (Pound, 1913a: 201). Yet even the terse Imagist poem reveals processes of optimisation. As an engineer optimises mechanisms iteratively, an Imagist poet formulates increasingly more efficient expressions of the Image.

Optimising the image

The doctrines put forth in early Imagist publications set an impossible standard for its affiliates. When we consider the hyperbole with which Imagism's theorists, Pound, Amy Lowell, F.S. Flint and Richard Aldington, posit their theories, we cannot but expect Imagist poets to fail – and, given this inevitability, should not our first enquiry attend to *how* they fail? Consider the prescriptions of 'an instant of time', 'no superfluous word' and 'precision' (Flint, 1913: 199; Pound, 1913c: 126). Perhaps the Image to which these theorists aspired could take on an instantaneous and precise form in the mind of the reader, but the temporal process of comprehending written language resists such focus. If an Imagist poem cannot be read in an instant, at what moment does the reader apprehend the Image, and what can we make of the rest of the experience? Any introductory phrase or penultimate verbiage has become quite 'superfluous'. Of course, Imagism's theorists formulated the movement as a revolt against a precedent that they regarded as adversely symbolical, verbose, ornamental, formalistic and sentimental, and one might read their doctrines sympathetically as encouraging relative instantaneity, economy and precision. However, this does not resolve the conspicuous problem that Imagism's idealistic poetics fail to describe any of the processes through which a poem conducts a reader in pursuit of the Image. The movement's impracticable ideals do not necessarily lead its members to fail at 'science', but rather to negotiate the conditions of the ideals' failure, much as an engineer negotiates a mechanism's inevitable inefficiency.

Although Taylor largely assumed the posture of the idealist and the rhetorician during his testimony, he offers a few brief glimpses of his past work as an engineer and of the processes through which one struggles (and fails) to attain ideals. From his perspective as an engineer, he describes the optimisation that he performed at the Midvale Steel Works: 'by using the finest steel that could be had, hydraulic forging, or forging under a heavy hammer, oil tempering it, annealing it, getting out test bars until we had refined the grain until it had been so refined that it was uniform all the way through' (Taylor, 1975: 783). The steel bars gain enhanced properties when the engineer subjects them to a series of special contexts. Later Taylor prescribes controlled repetition and the adjustment of variables in 'the art of cutting metals': 'there are 12 variable elements, 11 of which have to be kept constant while the twelfth is varied' (787). Thus, Taylor experiments to ascertain a data set of increasing clarity. In another anecdote, Taylor explains that scientific managers subject their labourers to educational processes. They commit to 'the progressive development of that workman in training and educating him, and bringing him to a better class of work' (776). Through education, the manager concentrates skill in a limited set of labourers, and those labourers then procure products in an efficient manner.

As we will see, H.D. subjects her Images, and consequently her readers, to optimisation processes that closely resemble Taylor's. By analogy we might conclude that H.D. indoctrinates her readers – like labourers – into the cult of efficiency. This potential relationship between poet, poem and reader enfolds a number of troubling questions. What may be said of the reader whose capacity for refinement proves inadequate for her poem's processes? Chief among the complaints during the efficiency hearing was that Taylor's method led to the firing of inefficient or superfluous labourers. We may further ask whether H.D. manages her readers with something like Taylor's empirical

detachment. If subservient to efficiency techniques, labourers and readers both sacrifice some autonomy. What commission then will hear the labouring reader's complaint? As we will see, although H.D. initially seems to imitate the problematical systems of control and training implicit to Taylor's system, her poetry actually serves as much to overturn Taylor's idealism as to propagate it.

To demonstrate what Imagist poetry enacts in place of the ideal of perfect efficiency, I turn to H.D.'s first collection, *Sea Garden* (1925), which she published concurrently with the Imagist theories that ostensibly governed the movement's poets. Yet, while the ideal Image is concentrated and clear, what H.D. enacts are the processes of concentrating and clarifying (which in Taylor's parlance are the processes of refining and experimentation). In 'Sea Gods', H.D. performs an extended apostrophe in three parts, summoning absent deities whose destruction or whose dwelling or whose corpus is the sea crashing against the shore. The gods act as idealised figures that, like efficiency, elude immediate expression, but nevertheless H.D. attempts to summon them through the process of optimisation. In the first part, the speaker wonders doubtfully at the gods' absence and refers to 'they', sceptics who believe the gods to have been destroyed upon the rocky coast. H.D. gives voice to the gods' derisive sceptics and describes this destruction through an iterative process:

> They say you are twisted by the sea,
> you are cut apart
> by wave-break upon wave-break,
> that you are misshapen by the sharp rocks,
> broken by the rasp and after-rasp.
>
> (1925: 42, ll. 11–15)

Instead of using few words to express a clear, hard image, H.D. facilitates her readers' iterative re-visions of the wave-break. The repetitively formulated images initially seem to vex 'concentration' and mark an infidelity to the Imagist ideology on the part of the poet. However, it is only through their connotative accumulation that H.D. makes the breaking, rasping waves lucid to her reader, not in spite of but by way of their redundant expressions. Through repetition, the 'break' and 'rasp' of the waves come to connote an enduring and violent rhythm; thus H.D. trains her readers to invest these syntactically limited incantations with temporally protracted imagery. The waves remain the poem's focus throughout, and that enduring focus marks the poem as distinctly Imagist, but the repetition reveals that 'refining' is a protracted process facilitated by the poet and executed by the reader.

This limited example of repetition demonstrates quite a different effect than that of a product-oriented efficiency in which few words mean much. In the context of the ostensibly singular Image, the question of efficiency leads to more questions: Which word? Which 'you'? Which 'wave'? And as compared with which other? Indeed, the early iterations of H.D.'s Image may be less efficient, and the later iterations may be more so, but certainly none are perfect. In repetition, the product-oriented sense of efficiency dissolves, and *Sea Garden* is replete with repetitions of all kinds; anaphora is among the stylistic signatures of H.D.'s early work. In 'The Shrine' she utters the refrain 'you are useless' (1925: 5, ll. 28, 32, 35). Similarly, in 'The Contest' she defines a statue through anaphoric declarations of 'you are' (1925: 10, ll. 20, 22). Elsewhere she adopts the

manner of neo-classicism with direct repetitions: 'wood to wood/and hill to hill' ('The Helmsman', 1925: 3, ll. 1–2), 'swift, swift!' ('Pursuit', 1925: 8, ll. 25), 'tear –/tear' ('The Wind Sleepers', 1925: 13, ll. 10–11) and 'each from each' ('Night', 1925: 35, l. 2). Each of these exact repetitions seem to invalidate the poem by Imagist standards, if, of course, H.D. had set out to exemplify a *state* of concentration. Instead, she facilitates the readerly process of refining by which the same word or phrase becomes an increasingly rich semantic unit.

Here the materialities of language and industry begin to show their incongruence. Forged steel may seem a less compliant medium than language to the literary critic. Certainly a word's connotations shift with discursive context, while a metal's intensive properties endure. Yet, while one would err in underestimating the semantic plasticity of a word, one might equally overestimate the metallurgical homogeneity of a steel bar. The uniformity to which Taylor attests assumes acceptably limited flaws and impurities – 'industry standards', in the technical idiom. Such unspoken limits attest to a much broader context, involving economic limitations, technological capacities and cultural preferences. By describing the steel bars as 'uniform', he elides this crucial context and conjures the illusion that he has achieved his ideal. Judging by their poetics, it seems that the Imagists likewise aspired to products resistant (if not immune) to the caprice of context. For example, in his essay 'Prolegomena' (1912) (included later in 'A Retrospect'), Pound calls for an 'absolute rhythm', 'which corresponds exactly to the emotion or shade of emotion to be expressed. A man's rhythm must be interpretive, it will be, therefore, in the end, his own, uncounterfeiting, uncounterfeitable' (Pound, 2003: 934). By focusing on the 'expressed', Pound discounts audience, whose hermeneutic surely contributes to a poem's emotional content and whose context demands consideration. While Pound's uncompromising language resembles Taylor's, the particular ideal of 'absolute rhythm' refers to a rate of change and thus concedes the possibility of process. Absolute rhythm emphasises a poem's continual motion, which distinguishes it from Taylor's product-oriented description. Rather than an ideal product, Pound calls for an ideal process; however, H.D.'s iterative processes refuse to satisfy even this prescription.

While H.D. *refines* a single word by associating multiple iterations of a word with a single context, she also *experiments* by associating a single word with multiple contexts. By reiterating a single object but with various patterns of intonation and stress, she forecloses the possibility of an 'absolute rhythm'. In the second section of 'Sea Gods', she famously catalogues 'violets'. Among the 13 kinds of violets, H.D. names 'single, sweet,/ wood-violets, stream-violets,/violets from a wet marsh' (1925: 43, ll. 21–23). In each instance she alters the attribution, and consequently establishes what one might parse as two lists. One is repetitive and associated with refining: violets, violets, violets, violets. A second list accounts for the violets' attributes and offers vivid difference, of context and rhythm: single, sweet wood-; stream-; from a wet marsh; in clumps from hills. (ll. 21–24). In this catalogue, H.D. experiments in image by maintaining a constant, 'violets', while adjusting the independent variable of the violets' attribution. In effect the reader begins with an abstract image of a violet, but through iteration gains an ever-growing aggregate of experimental data and thus a clearer Image. The repetition of refining and the difference of experimentation act as the complimentary qualities of optimisation by which H.D. procures an increasingly efficient expression.

In the third section of 'Sea Gods', H.D.'s speaker contradicts the sceptics' depiction of the sea gods as having been destroyed like waves upon the rocks. Instead, the speaker imagines the previously passive gods in a flurry of action:

> You will trail across the rocks
> and wash them with your salt,
> you will curl between sand-hills –
> you will thunder along the cliff –
> break – retreat – get fresh strength –
> gather and pour weight upon the beach.
>
> (1925: 43, ll. 42–47)

Here, H.D.'s speaker calls these waves into being with the anaphoric assertion 'you will'. Once more, repetition ties each action to the next, facilitating the gods' gradual semantic refinement in 'you'. Repetition also acts as an experimental control, as in the case of 'violets'. To each of the imperatives she adds an additional attribute – 'trail', 'wash', 'curl', 'thunder' – to experiment with the god's potential forms. Yet, the future tense reframes optimisation as hypothetical, as a literal hypothesis that proceeds from the poet's patently unscientific intuition. Imagism demands the 'direct treatment' of its object, but this third movement regards the Image as a highly constructed thing: the reader imagines the speaker imagining the waves (Flint, 1913: 199). And yet, their constructedness does not disenchant the speaker with the gods; quite the opposite, the poem reaches its vigorous climax as it contrives the god's imminence. Accordingly, the poem models a final and crucial condition of optimisation. The speaker's optimistic 'you will' suggests a step of faith to precede optimisation. H.D.'s speaker believes the gods capable of sustaining their vigour in spite of the rocky shoreline, which here stands for the entropy that threatens all systems scientific, poetic and otherwise.

Although their methods initially appeared to align, H.D.'s applied science actually diverges from Taylor's rigorous systems of control. By analogy it would seem that H.D. can only produce a clear image of a 'violet' through an iterative process in which she tests each of the violet's aspects. Yet, whereas Taylor depicts scientific management as a methodical application of empiricism, there is a haphazardness to H.D.'s list that belies the 'pure' science model; she frequently alters her grammatical patterns; she changes more than one variable. She is not simply implementing a vetted and controlled experimental method like a theoretical physicist; instead, she conceives new methods, new processes, even as she tests them: she is tinkering like an engineer whose materials remain unreliable, whose instruments demand recalibration, whose results correlate imperfectly. As her iterations increase, the gods become more nearly realised, but at the same time each successive repetition makes the inadequacy of the preceding expressions increasingly conspicuous.

H.D.'s process calls into question the ideals of uniformity and control at which applied science aims, and her failure to attain them also helps reconcile the overarching qualities of transgression and compliance that have largely divided H.D. scholars. Critics celebrate her as an adept and expressive feminist in a masculinist milieu, yet she is side-lined for subscribing to Imagism's posture of objectivity (which, some argue, veils a patriarchal ideology); these characteristics are generally regarded as mutually exclusive. For example, in *Optical Impersonality: Science, Images, and Literary Modernism* (Walter, 2014),

Christina Walter describes H.D.'s relationship to her poem's Imagist materiality as 'constructed and constraining', and explains that only later when she rejected the biological essentialism implicit in Imagism's objectivity did she achieve political consequence (83). However, if H.D. is acting as an engineer rather than a theoretical scientist, her quarrelsome identities cohere in her poetry. H.D. adopts Imagism's rigid dogma as aspirational hypotheses, but by refusing a product-oriented poetry she underscores those ideals' untenability; H.D. is most transgressive when most attentive to Imagism's dogma, because her processes both foreground an idealistic end and articulate its fiction.

While Imagist poetics prescribe efficient expressions, H.D.'s poetry instead enacts the process of optimisation. As an engineer-poet she trains readers to become efficient, but, far from simply translating Taylorist labour methods, her efficiency processes serve to magnify their own imperfectability. Yet the idealistic aspirations that drove her processes did not die as Imagism declined in the 1920s; rather, they took on new forms, which notably accounted for the integration of multiple Images: the narrative of modernist poetry as applied science endured in the Objectivist movement and through the process of systematisation.

Objectification as systematisation

In the early 1930s a second wave of modernist poets arose, and one principal coterie – including Louis Zukofsky, Charles Reznikoff and Basil Bunting – selected the descriptor 'Objectivist' for themselves. Due in part to Ezra Pound's common influence, the Objectivists inherited many poetic principles from the Imagists. However, their poetics also compensated for some of the discrepancies noted between the Imagists' theory and praxis. In the February 1931 special Objectivist issue of *Poetry Magazine*, Zukofsky replaced the singular ideal of the Image with a pair of governing concepts, 'sincerity' and 'objectification', which refer to the parts and wholes of their new poetics. Another of the Objectivists' progenitors, William Carlos Williams, famously describes the poem as a 'machine made of words. pruned to a perfect economy'. He captures the common value of efficiency between the Imagists and Objectivists, but adds the sense that a poem is something assembled, or in other words *systematised* (Williams, 1969: 256).

For the engineer, integrating parts in a perfect systematic configuration remains an impossible task, but one that he or she is trained to attempt. In most machines, significant energy losses occur at the points of contact between parts. Accordingly, the process of systematisation involves techniques and technologies that assemble, insulate, lubricate, dampen, bond and coordinate such parts. Whereas an ideally optimised part would result in perfect efficiency, ideally systematised parts would convey energy between themselves without loss, achieving what I will refer to as perfect *sufficiency*. Williams' metaphor suggests that the process of assembling a sufficient mechanism might also manifest in poetry, and, as will be shown, the Objectivists' readers do find a variety of clever techniques (and technologies of a sort) employed to systematise two or more components.

Although he does not name it, Taylor suggests the concept of sufficiency frequently in his testimony, for example when he speaks of labourers as integrated parts that must be synchronised such that 'every elementary movement of every man has to have its appointed time, its proper time in which it ought to be done' (Taylor, 1975: 799). He

refuses the distinction between man and machine and suggests that both can, and should, be managed by empirically derived formulae. He asserts the ideal of sufficiency, but he foreswears the process by which it is achieved. He claims that 'the opinions of workmen count for nothing; the opinions of foremen count for nothing. These laws control both sides' (785). Here, by laws, he refers to the scientific laws obtained by studying the 'controlled' workmen. The adjudicators of Taylor's commission questioned him thoroughly on the dubious claim that a law might govern a worker without an intervening (and self-interested) manager. 'A code of laws is an inanimate thing and cannot decide anything', argued the legal councillor to the panel of labour commissioners, W.O. Thompson, but the obdurate Taylor disavowed his control over his employees' labour processes (804). He argued as if when the proper components – mechanical and human – are arranged according to the attendant 'laws', the system springs into being without tinkering or management.

When describing the two main tenets of the Objectivist in his flagship essay, Zukofsky strikes an uncompromising tone, similar to Taylor's. However, he is more forthcoming with the poem's manager and identifies Charles Reznikoff as their new school's most exemplary practitioner. Just as H.D. exemplified Imagism, Reznikoff published a number of volumes of poetry that correspond closely with Zukofsky's poetics and which allow us to examine the movement's 'science' of assembling 'machines'. In 1934, Reznikoff published *Jerusalem the Golden*, but he had written many of its 79 poems around the peak of Zukofsky's theoretical production, including the poem 'Hellenist', which Zukofsky believed to exemplify his theory because its parts were in 'perfect rest, complete appreciation. This rested totality may be called objectification – the apprehension satisfied completely as to the appearance of the art form as an object' (1931: 273–274). The manner of 'apprehension' that Zukofsky describes indicates that the poem's reader cannot help but perceive it as an undivided unit; it is a machine whose parts become subsumed by the whole. 'Rested' implies that the 'totality' suffers no interactions with its context. In the parlance of thermodynamics, an apprehensible totality is a closed and non-entropic system; nothing gets in, and nothing gets out.

Although Zukofsky prescribes satisfied apprehension and rested totality as the end of an Objectivist poem, Reznikoff approaches those qualities only in time and through engineering processes. In the four-line poem '30: Rhetoric', rather than present an immediately and wholly apprehensible image, Reznikoff gradually assembles parts into a whole:

> These streets, crowded an hour ago are empty –
> what crows that followed the armies of old
> will be the scavengers?
> The winds of night.
>
> (Reznikoff, 2005: 99)

In the first line, 'crowded' and 'empty' present a before and after, a multiplicity and a totality. In other words, Reznikoff represents the extremes of the process of systematisation, which correspond to applied science's bookends, matter and ideal. Using the copula 'are', he seems to pass over the intervening process, but his dash leaves the equation in limbo. The following lines enact a similar transformation, differentiable 'crows' to conceivably continuous 'winds', but this second transformation occurs across

a strange interrogative conjunction. By asking 'what?', and not 'which?', Reznikoff delays the metaphor of crows *as winds* and leaves the former image incomplete. Apart from the 'what', the crows might exist as their own complete image. In fact, the second and fourth lines are so independently complete that the 'what' seems superfluous to their otherwise paratactic relationship. By situating the crows behind the armies and yet making them incomplete by the superfluous interrogative pronoun, Reznikoff establishes the necessity of the abstract 'winds' to imbue the crows with their complete meaning. Reciprocally, the abstract winds suffuse the scenes of the battlefield and the street and thereby merge their contexts.

These layered effects make it clear that Reznikoff's central aim is to accomplish sufficiency by way of, and not independent of, many constituent parts. As readers we might imagine an engineer arranging components and at last binding them with a bolt. Reznikoff's subtle grammatical games resist the reader's inclination to consider 'streets', 'crows' and 'winds' as images in themselves or else as symbols of one another. Only with the poem's question satisfied, do any individual components function grammatically; only when the battlefield and streets conduct the winds of night as metaphorical crows, can the poem achieve sufficiency. Poetic systematisation, then, is marked by the meticulous arrangement of parts such that an elegant grammatical closure activates their functions.

While in '30: Rhetoric' Reznikoff aspired to apprehension by way of assembly, in the poem '66', he proceeds towards a rested totality, but his process of insulating the scene from its context exposes that end as impracticable:

> If there is a scheme,
> perhaps this too is in the scheme,
> as when a subway car turns on a switch,
> the wheels screeching against the rails,
> and the lights go out –
> but are on again in a moment.
>
> (Reznikoff, 2005: 107)

Reznikoff cordons his poem's content off from its environment, offering no hint of the subway system's context. The system's rails maintain the car's trajectory and thereby isolate the unfolding images from a more expansive imaginative landscape. Indeed, the car presumably hurtles through a subterranean void, opaque and impermeable earth walls above, below and to the sides. Reznikoff names this closed subway a 'scheme', a term which we may consider synonymous with a sufficient system. Although clearly isolated, the lights go out, disrupting the train's internal continuity, and the 'switch' of the tracks explicitly identifies a specific, if minute and momentary, site of unrest. Reznikoff adroitly reinforces the stark totality of the 'scheme' *by* imaging the discontinuity of the 'switch'. To demonstrate its totality, the scheme suppresses this diminutive contrast. Reznikoff's poem begins and ends as a closed system while including a difference, and so it leads its readers to end where they began, to enact a psychic loop, to circumscribe, to insulate and thus to achieve totality.

Although the poem may initially seem to have attained its ideal, Reznikoff's process actually underscores the 'scheme's' fiction. To express sufficiency, Reznikoff includes an instance of openness in the 'switch' – 'this too is in the scheme'. He sacrifices totality

momentarily so as to more effectively formulate the assembly process over the course of the poem. His poem is profoundly disunited at the 'switch', but united at its end. Accordingly, readers 'apprehend' the scheme variously: now in pieces, now as a whole. Yet, this is not an exception to the poem's rule, but rather the very basis of Reznikoff's processes. He initially establishes the poem's conditional mood with the conjunction 'if', and, having given that condition, he images an aberration of a scheme; in fact, he only renders the portion of the scheme that is unattainable.

Reznikoff's process is not one which contrives imaginary trains that speed along without entropy, but real trains whose severe discontinuities the system must overcome in time. Zukofsky's product-oriented ideals actually inspire process-oriented poems, which contend with their objects' imperfections. Scientific analogues to Zukofsky's ideals certainly existed: in *The Physicists: The History of a Scientific Community in Modern America* (Kevles, 1995), Daniel Kevles describes the development of particle accelerators (beginning in 1931), which impel high-energy particles, at speeds approaching that of light, controlled by electromagnetic fields, and measured with precise instruments that allow scientists to adopt idealised formulae. Such apparatuses are nearly perfectly efficient and nearly perfectly sufficient. By comparison, Reznikoff's subway involves a crude projectile whose parts rattle, squeal and lurch and demand maintenance. Moreover, the former is the object of elite theoretical scientists, and the latter is the object of common engineers; the collider pertains to the idealised product of theory-derived formulae, whereas the subway pertains to a flawed process of interminable maintenance. Consequently, Reznikoff's engineering mode concerns itself with his subway system's divergence from the ideal, and not with the ideal of projectile motion itself.

Reznikoff's scientific processes dramatise the pursuit of the ideal of sufficiency, but those same processes disparage a wholly sufficient poetic system. The influence of the Objectivists' scientific theories helps to explain the centralised and yet fraught principles that mark much of Reznikoff's work, and these inquiries also corroborate biographical accounts of his aesthetic. In *A Menorah for Athena* (Fredman, 2001), Stephen Fredman remarks on Reznikoff's creative situation of Jewishness amidst secular modernity: Reznikoff's relationship to Zukofsky's ideals was tempered by his 'position of betweenness' (6). In mediating 'Hebraism and Hellenism' and 'Judaism and modernism' Reznikoff could aim towards ideally united totals, but his poems' contents would largely attend to a world in pieces (6–7). By striving for an ideal like sufficiency through protracted assembly and insulation processes, Reznikoff actually focuses his poems on sufficiency's lack. The ambition to attain sufficiency seems to align Reznikoff's theoretical motivation with Taylor's, but whereas (the idealist) Taylor often presents his systems as if, without mediation, they proceed from pre-existing scientific laws, (the engineer) Reznikoff foregrounds his system's messy assembly process.

Although H.D. and Reznikoff subscribed to their associates' theories, their roles as poets led them, like scientific managers, to perform mediating processes. They respond to idealised poetics in much the same way that engineers respond to scientific ideals, through processes of iterative improvement but without hope of realising the ideal. Theirs was a twofold rejection of the poem as an ideal product: firstly, by dramatising iterative improvement in their poems, they rejected the assumption that a poem is a completed, atemporal product; secondly, they rejected the possibility of expressing any ideal – whether of product *or* process. Taylor and the utter finality he perceived in

scientific 'laws' models the former belief particularly well, but the latter is perhaps best demonstrated in the indefatigable tradition of tinkerers who have attempted to create perpetual motion.

Poetic ideals and perpetual motion

> Oh ye seekers after perpetual motion, how many vain chimeras have you pursued? Go and take your place with the alchemists.
>
> Leonardo da Vinci, 1494

In 1920, *Popular Science Magazine* vilified the machine that could run forever. Tinkerers, philosophers and dreamers had rejected da Vinci's warning, and the fanciful pursuit of motion without end had endured into the twentieth century. Enthusiasm was perhaps at its apex, despite the developments of science, which had grown more adept since the Renaissance in their refutation of such devices. Notably the First (1850) and Second (1854) Laws of Thermodynamics state that, within a closed system, energy cannot be created and entropy (disorder) inevitably increases. In other words, machines never accomplish perfect efficiency or perfect sufficiency. Yet schemers abounded in spite of these definitive laws of which da Vinci had been unaware. Devices featured in *Popular Science* included mechanisms that produced buoyancy under water, electricity from magnets and torque from pendula. As if describing a weed, Philip Rowland writes 'the old fallacy rises again', but the 'insidious' inventions were not eradicated in 1920 either (Rowland, 1920: 26–27). Today the US patent office is compelled to reject all applications for perpetual motion machines (without a working model) due to their abundance ('Utility', 2014: 706.03).

The conjoined histories of perpetual motion and perfect efficiency have largely been recorded by sceptics who, like da Vinci, disparaged those whom they perceived as foolhardy dilettantes. Henry Dircks published one notable volume, *Perpetuum Mobile; or, Search for Self-Motive Power*, in 1861 and in it scorned those whom da Vinci names 'seekers'. The exasperated Dircks appeals to a force external to science to explain perpetual motion's monomaniacal enthusiasts:

> we cannot but feel surprised how the idea of a self-motive mechanical power should have originated, or at what period it could have been called into existence. As emanating from the fruitful fancy of the poet or romancer, it may readily be conceived.
>
> (Dircks, 1861: xi)

Indeed, the monomania that can accompany the dream of perfect efficiency seems equally present in technical and poetical contexts. Pound's descent into fascism (and its attendant ideology of economic efficiency) has hardly gone unmarked by literary critics. Yet, Pound's monomania continues to fascinate because it accompanies his poetical genius. The dream of perfectly efficient expression or of fascism seems apposite to an intellect far inferior to Pound's. Similarly, Dircks cannot but wonder at English inventor and Marquess, Edward Somerset, who was fascinated with perpetual motion, but was intelligent enough to invent one of the first steam engines (xxxvi). This ailment to which

even – or especially – the 'genius' is susceptible, should lead us to wonder what distinguishes the engineer-poet from the 'seeker' and the idealist.

If the modernist poet, like the engineer, attempts to conform materials to certain impossible ideals, and if such ideals may be approached through the processes of applied science, then we may ask one more question: How does the engineer-poet determine when to stop iterating? When is a machine or a poem *efficient enough*? Why not an interminable catalogue of violets, violets, violets? The processes of optimisation and systematisation in themselves suggest no end short of perfection, rather a system of perpetual incremental improvement; their insatiate governing ideals should drive the poet on. Yet even the most stolidly 'efficient' poets bring their fancies to an end, and this remarkably unscientific decision allows us to demarcate two major roles in scientific modernist poetry. On the one hand, idealists regard poems as though their governing ideals may be accomplished, and, since ideals like perfect efficiency defy expression, they inevitably cloak their failure in hyperbole and rhetoric. On the other hand, engineer-poets enact a number of scientific processes that deliberately underscore the futility of their task.

This crucial distinction has largely gone unidentified because literary scholars too have become enamoured of modernity's fascinating ideals, or – to extend the metaphor – enamoured of modernity's perpetual motion machines. Finding no 'working example', their studies have instead settled upon scientific 'seekers' such as Pound and Taylor and their theories. By studying both the theoretical scientific ideal *and* its complementary application, interdisciplinary literary critics gain a vivid lexicon for describing the techniques through which poets mitigate the inadequacy of language to idealised expression: insulating, lubricating, dampening, bonding and stream-lining. We have plumbed the depths of theoretical science and found its diction and method to have forcefully influenced modernist poetry, but is it not time to read the scientific processes of poetry – and, perhaps, the poetry of scientific process?

Disclosure statement

No potential conflict of interest was reported by the author.

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