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‘AND HERE WE ARE!’ SCIENCE AND MEANING IN THE POETRY OF ANNE CLUYSENAAR

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Abstract

In a perceptive academic article published early in her career, the linguist and poet Anne Cluysenaar challenged poets to engage strongly with science so as to stimulate their imaginations by freeing them from inadequate interpretations of the world. This challenge requires poets to find means of engaging with the core of scientific practice in ways that are sufficiently intense as to appropriate into their subjective interactions with the world the apparently objective knowledge that science provides. The present article explores and analyses how Cluysenaar’s own engagement with science influenced her creative writing and assesses whether the challenges she identified were met in her own poetry. Cluysenaar’s poetry shows particularly knowledgeable interaction with evolutionary theory, genetics, the origins of consciousness and geology, all of which are linked through her awareness of ‘deep time’. Her poetry exemplifies how, through serious study and interaction with scientists, a poet can appropriate science with intensity and discernment such that it becomes an integral part of her awareness of the world. Her eloquent writing provides for the reader intelligible and subtle connections between the apparently objective world of science and the subjective experiences of life. At the same time, the poems sensitively keep a perspective on the findings of science through inclusion of expression of feelings, ethical concerns and a willingness to value other means of knowing. Her poetry shows how science greatly enriched her imagination and her life, that science mattered personally to her and hence that it can matter personally to us.

Keywords Anne Cluysenaar, consciousness, deep time, evolution, genetics, geology, Alfred Russel Wallace.

The academic linguist and poet Anne Cluysenaar published a perceptive article over forty years ago that discussed an intellectual crisis at that time whereby the non-scientist could 'easily begin to feel himself afloat amongst systems of communication, description and value whose relationship to any "reality" have become increasingly provisional and problematic. ("How is it possible for light to be both wave and particle?").'[1] However, after demonstrating a knowledge of modern physics based on diligent study, Cluysenaar pointed out that:

> The world of science is colourless, soundless, tasteless, and if it even makes sense to say so, emotionless . . . this nature leaves something important unaccounted for . . . only natural language *can* deal with this central area . . . the sciences cannot . . . yet if the wisdom we derive from science is to be of any value, it must be of value *to us*, and our values and perceptions form the privileged subject-matter of natural languages.[2]

Here she showed clear awareness, well before the publication of her major volumes of poetry, of the benefits of an engagement with science strong enough to allow the appropriation of its findings into subjective experience. Cluysenaar regarded both the language of science and ordinary language as tentative, noting that 'we cannot contrast our systems with an independent reality . . . the scientific and non-scientific modes of seeing the rainbow are just that – different modes, not truth versus lie' – so that natural languages, and hence poetry, can retain their value whatever the advances in science.[3] However, she emphasises that to regain confidence poets need to engage strongly with such advances, good knowledge of which can stimulate their imaginations by freeing them from inadequate interpretations of the world: 'The result should be, ultimately, to release our imaginations from pedestrian domestic verse and equally pedestrian mythologies, for example from the literalities (as opposed to the insights) of religion and from crude notions of space and time.'[4] Cluysenaar's preference was for a unified literary-scientific culture of the type favoured by C. P. Snow, whose seminal book *The Two Cultures and the Scientific Revolution* (1959), to which she specifically refers, had been published just over a decade before.[5] She challenges poets to contribute to such a culture by an appropriation of science that is sufficiently intense and discerning to become an integrated part of their representation of subjective experience.

It would appear that Cluysenaar's vision of a culture in which poetry and science coexist in a creative, mutually valued relationship is still unfulfilled. For example, the poet and academic Ian Gregson recently contrasted the high status of science in contemporary society with the lower status of poetry: 'contemporary sensibility feels an affinity with science which it does not feel with poetry . . . there's a sort of equation chic . . . even its incomprehensibility arouses fascination'.[6] Such a low estimation of the value of poetry is consonant with a widespread assessment in our contemporary secular society that scientific accounts of the world have an authority to which all other forms of representation must ultimately defer. In popular culture this is especially apparent in the great influence of the much oversimplified, reductionist attitudes promoted by scientific new-atheism.[7] From the perspective of academic literary criticism, the extent of the 'assimilation of intellectual life within scientific models' has been lamented by Drew Milne, who suggests that: 'The delimitation of rationality according to models of scientificity has entered cultural cognition more deeply than C. P. Snow imagined possible.'[8]

A certain tension between the disciplines of poetry and science has been apparent since at least the time of the Western Enlightenment. Indeed, in an extensive historical account of the role of the poetic imagination, Malcolm Guite has argued that the early modern poet John Davies anticipated that views of the world were about to be subject to profound changes shortly before the Enlightenment and the associated beginnings of modern science.[9] Expressed simply, these changes were to include an emphasis on reason rather than feeling, and on the objective rather than the subjective. Guite writes that Davies in his poetry was 'criticising bleak reductionism before it had really got into full swing'.[10] However, early modern interactions between poetry and science were constructive and fruitful. For example, John Donne was fascinated by the opportunities that the new science of mapping, the presentation in two dimensions of our three-dimensional world, could provide for implying a hidden, other-worldly dimension to the world as directly perceived: 'As west and east / In all flat maps (and I am one) are one, / So death doth touch the resurrection.'[11] In an historical study of science and poetry, Mary Midgley has noted how Wordsworth and Coleridge in particular made great efforts to emphasise the lack of fundamental conflict between thought and feeling.[12] Guite has argued that one of Coleridge's key ideas was that 'The poet, as much as the

philosopher or the scientist, is concerned with helping us to look beyond surfaces at what is really there', though Coleridge was also well aware of the limitations of mechanical views of the universe such as that of Newton.[13] In the second half of the nineteenth century and throughout much of the twentieth century, poets continued to respond to scientific developments. During these periods, the influence of Darwin's evolutionary theory is apparent in the work of a number of poets, and from the early twentieth century there have been significant poetic responses to aspects of the revolution in physics, such as Einstein's theory of relativity and Heisenberg's uncertainty principle.[14] Yet the intensity of the constructive engagement, or at least the perceived intensity, seems diminished in the most recent decades. For example, despite the task of addressing the 'cultural split' between poetry and science being a declared major concern of Guite's historical study, engagement with science is much less addressed in his discussion of more recent poetry. Furthermore, a major theme of Midgley's study is the need for a re-balancing of the roles of poetry and science in contemporary cultural life.

John Holmes has observed that before 2006 'published collections of essays on literature and science barely discussed modern poetry at all' despite significant research activity.[15] This deficit began to be redressed with the publication of Robert Crawford's *Contemporary Poetry and Contemporary Science* (2006) and Holmes's *Science in Modern Poetry: New Directions* (2012), both of which collected substantial discussions of the interactions of poets with a wide range of science.[16] The types of interactions and engagements themselves also show great variety. For example, some poets have had an interest in the acoustic possibilities of scientific language without being greatly concerned with the precise meaning of the adopted terminology. Others have focused on science, or perhaps more frequently on technology and engineering, as a source of new metaphorical descriptions of important aspects of human experience. Crawford's own poetry shows that metaphors drawing on science, technology and engineering can provide great enrichment of our apprehension of our human situation.[17] Rather fewer poets have shown a profound engagement with the content of science itself, though there are important contributions such as the work of the Australian poet Judith Wright.[18] In view of the significance of science, technology and engineering in everyday life it would be surprising if most poets writing today did not in some way reflect the corresponding

ubiquity of technical terms in everyday language. However, use of technical terminology or other allusions to scientific concepts does not necessarily involve engagement with science itself, for it may rather be a poetic encounter with what Rónán McDonald has termed a 'dispersed cultural legacy' arising from science.[19] A prerequisite for real engagement with science is a substantial commitment of time and effort in understanding its activities; gaining knowledge of science from popularisations and gleaning understanding from items 'reported in the press' can give a false sense of achievement, for such sources often lack both depth and accuracy.[20]

That real engagement with the content of science may be lacking in recent poetry is, ironically, indicated by one of the most innovative and valuable features of Crawford's book. Crawford arranged meetings in which scientists discussed their work with poets, and his book includes poems written in response to these encounters, accompanied by commentary by the scientists. Some of these, such as Paul Muldoon's 'Once I Looked into Your Eyes', written after an encounter with magnetic resonance imaging expert Warren S. Warren, show profound engagement with the science discussed.[21] However, if engagement of this type were typical there would likely not have been a need to arrange such encounters. Another indication of weak engagement is that the academic poetry-science sub-discipline predominantly involves literature experts: for example, none of the contributors to Holmes's volume appears to have a scientific education and professional scientific experience. It is therefore refreshing that three of the contributors to Crawford's volume have strong scientific credentials, one of them being accomplished as both a scientist (medicine) and a poet, Miroslav Holub. The most distinguished scientifically is Jocelyn Bell Burnell, one of the world's leading astronomers and the discoverer of pulsars. Burnell's essay shows a broad and profound understanding of poetry, but she notes two significant limitations of work relating to her own scientific discipline. First, that 'Some poets (Robert Frost, Carl Sandberg, Diane Ackerman, for example) frequently write on astronomical themes, but the majority appear to write only one or two poems.' Secondly, 'There are many poems which use astronomical topics as a novel way of illustrating or illuminating human dilemmas but there are few, I feel, that really engage with modern astrophysics.'[22] Aspects of Burnell's assessment of weak engagement are echoed by psychiatrist Kay Redfield Jamison, who observes that 'While most

contemporary poets are broadly familiar with the principles of psychoanalysis, and many literary critics have incorporated psychoanalytical theories into their teaching and writings, the science of psychology has moved far beyond this body of work.'[23]

The reasons for the limitations that Burnell, Jamison and others have brought to attention require consideration if poetry is to engage more fully with modern science. Some of the most obvious are that understanding modern science often requires sophisticated, specialised conceptual and mathematical skills, and has a degree of complexity that greatly exceeds that which existed in earlier science. Another is the great speed of important advances, which for some aspects of physics and biology can mean that findings which are only a few months old may already have been superseded.[24] However, such limitations can be overcome with appropriate diligence, at least in principle. Of more concern is that the very structure of science may pose fundamental problems of understanding for those outside its disciplines. This problem may be explored by considering science as a *practice*, a 'coherent and complex form of socially established cooperative human activity', as described by the philosopher Alasdair MacIntyre.[25] Typical features of such a practice include an overall purpose or goal, 'internal goods', 'external goods', virtues which promote ethical conduct, and institutions that sustain continuity and coherence. Knowledge of most of these features is accessible to those outside the practice, including in the case of science an appreciation of its goal of increased knowledge, benefit from external goods such as technological outcomes, understanding of virtues essential to scientific activities such as honesty and openness, and awareness of the role of institutions such as universities and research centres. However, according to MacIntyre, internal goods are most readily, and in some cases only, available to those participating in a practice. For science, such internal goods include the experience of finding an elegant mathematical description of a phenomenon or of creating an ingenious practical approach for an investigation. Excellence in such matters may be appreciated by other practitioners on the basis of their comparable experiences but it may be very difficult for those outside the practice to truly value them. Internal goods also include *tacit knowledge*, the intuitive understanding that is acquired by personal actions. This type of knowledge can also be very difficult to convey to others: in Michael Polanyi's words, 'we can know more than we can tell', though some kind of shared experience can aid

communication.[26] The existence of tacit knowledge shows the difficulty of depersonalising knowledge, and hence of attaining full objectivity, even in the case of science.[27]

Insight into what can be achieved with greater understanding of science can be found by considering the work of the small number of accomplished scientists who are also accomplished poets, such as the astronomer Rebecca Elson. Elson's professional engagement allowed her to incorporate what is normally considered objective scientific knowledge into her representation of subjective experience of the world. A simple example occurs in the last lines of her poem about a child with a balloon, which speak of 'A little bit of pure Big Bang, / Bobbing at the end of her string', a reference to the creation of helium at the start of cosmological time.[28] Her work also includes beautiful descriptions of complex theories, as when, in an account of relativity, she suggests: 'It's so much more a thing of pliancy, persuasion, / Where space might cup itself around a planet / Like your palm round a stone.'[29] These lines are a striking evocation of the curvature of space-time proposed by Einstein. Elson's familiarity with wider scientific knowledge also enabled her to bridge the objective-subjective divide when writing about other sciences, as in her poem 'Devonian Days', which both describes a wet holiday in south-west England and also reflects on the adaptation of life to dry land in the Devonian period: 'We didn't notice in our restlessness, / The webbed toes twitching in our socks, / the itch of evolution, / or its possibilities.'[30] At a more abstract level, her description of 'Everything collapsing into words, like wave functions, an object / chooses its value when it is named' could be an account of the writing of poetry, although it is included in a meditation on how science works.[31] In quantum mechanics, collapse connects the probabilistic wave function with specific observable properties. In ways such as these, Elson's poetry elegantly combines her scientific knowledge and her expression of subjective experience.

In a Welsh context, Dannie Abse successfully combined a career as a medical doctor with extensive and accomplished literary work – especially poetry, but also plays, novels and memoirs – while being aware that this could be a difficult synthesis: 'white coat and purple coat / few men can reconcile'.[32] Medicine is a practice with particularly clear 'internal goods', such as those associated with the treatment of illness, the alleviation of pain and care as death approaches. Sometimes Abse describes experiences that are essentially restricted to medical

professionals, such as the use of a stethoscope: 'Through it, / over young women's tense abdomens, / I have heard the sound of creation / and, in a dead man's chest, the silence / before creation began.'[33] As a doctor he also had a heightened awareness of the fragile, bodily nature of our lives, as expressed in his account of ill-fated brain surgery where the patient apparently cries, 'leave my soul alone, leave my soul alone'.[34] For a doctor, colours may be closely associated with acute medical conditions so that rainbows can have bleak connotations, as Abse writes in his poem 'Pathology of Colours': 'So in the simple blessing of a rainbow, / in the bevelled edge of a sunlit mirror, / I have seen, visible, Death's artefact / like a soldier's ribbon on a tunic tacked.'[35] This contrasts sharply with the discussion of rainbows that has often featured in assessments of the relationship between science and poetry, where the emphasis has been on whether scientific explanations in terms of reflection, refraction and dispersion diminish or enhance feelings of beauty and wonder when experiencing such phenomena.[36] Furthermore, achieving an appropriate balance between compassion and objectivity when dealing with serious illness is a characteristic challenge in the medical profession, and perhaps especially for a doctor with a poet's sensibilities. This conflict is movingly evoked in a description of Abse's examination of his own mother's X-ray: 'There are men who would open anything. / . . . / I am their slowcoach colleague, half afraid, incurious. / . . . / My eyes look / but don't want to; I still don't want to know.'[37] For a scientist, knowledge is always valuable, but this is not necessarily so from other perspectives.

Elson and Abse show throughout their poetic work that the access to internal goods which professional engagement provides allows an internalisation of scientific knowledge so that it becomes an integral part of the practitioner's subjective experiences. This leads to enriched poetic expression of scientific knowledge and new perspectives on other aspects of our human situation. Thus, the challenges to non-scientists are to find means of engaging with the core of scientific practice in ways that are sufficiently intense as to appropriate into their subjective interactions with the world the apparently objective knowledge that science provides. If ways can be found for approaching this goal they will have provided for themselves the basis for enriched expression that incorporates scientific insights. These are the challenges that Cluysenaar identified in her perceptive article in 1972. That these challenges remained important for her was shown nearly four decades

later when she drew attention to the significance of knowledge of the physical world for our personal perceptions in a long poem, 'Clay', stimulated by the ancient Mesopotamian poem *The Epic of Gilgamesh* and dedicated 'In memory of a student scribe, Mesopotamia c.2070 BC':

> If the student stands on the shore
> what does he see? There are oars
> and sails, but no sky-line tankers.
> His sky is possessed by birds.
> His world's not made, as ours is,
> of beings transformed from the sea
> to land and from land to sea.
> . . .
> His continents aren't adrift,
> his sun, the giver of life,
> not also his planet's doom,
> his space not entwining with time
> and his galaxies, hidden in blue,
> not rushing slowly apart
> to empty the darkness of light.[38]

A wealth of references to science and technology is apparent here, including the oil tankers that Cluysenaar would have frequently seen in the Bristol Channel; the evolution of life from the oceans to land; the theory of continental drift; relativity theory; and the expansion of the universe. None of these insights was available to the ancient student, so his perceptions of the human situation would have had a very different basis to those of a scientifically aware modern poet. The poem 'Clay' indicates how Cluysenaar's serious engagement with science influenced her creative writing. What follows in this article is an exploration and analysis of this engagement, and an assessment of whether the challenges she identified as a literary critic were met in her poetic output.

The influence of science on Cluysenaar's poetry is apparent even in the title of her 1982 volume reflecting on ancestry and relationships, *Double Helix*.[39] This gathers her mother's memoirs with letters, drawings and photographs, accompanied by Cluysenaar's reflections on their significance, and is the first readily accessible collection of her poems. A double helix describes the structure of DNA, the molecule

which links the heredity of all life on earth. Cluysenaar's title indicates that the work moves beyond the social considerations which are the usual focus of memoirs to include links to relationships that reach far into 'deep time', a key awareness throughout her writings, knowledge of which is dependent on modern scientific perspectives. Thus, a beautiful photograph (dated 1894) of her grandmother Dora holding her mother Sybil as an infant is accompanied on the facing page by a poem which begins:

> Letters and memoirs seem to tell me less
> than this luminous fossil – so strictly posed,
> a band of metal just visible at the neck,
> keeping the stance steady – this true image
> of a bond neither could afterwards recall.

And later in the poem this linking of a photograph and a fossil is reversed:

> Photographed in rock,
> the fragile shapes of our ancestors flow still
> on the drift of a tide turned these three million years.
> They settled just so, one day, one forgotten moment.
> I lay the two prints together.[40]

This is a strikingly original juxtaposition of two very different images of widely separated ancestors that are nevertheless seen as having a type of equivalence. A few lines later Cluysenaar considers her present task using the depositing of fossils as an analogy: 'The typewriter drops its silt into the silence.'[41] Her poem becomes a 'print' like the fossil and the photograph, an appropriate comparison for she regards language as 'the vehicle of "non-biological heredity"', connecting us through time.[42] This linking of the extremely distant past, the recent past and the present is a characteristic feature of Cluysenaar's writing in *Double Helix*. Thus, she later writes of a churchyard:

> Follow any one
> tombstone, it will lead through ancestral crowds
> into millions – beyond civilised man, and Man,
> to wordless creatures, down to the persistent
> minute beings whose efforts created us.[43]

These are perspectives that in their radical re-assessment of the timescales of memoir show a clear appropriation of modern science into her thinking: they are perspectives which were unavailable to the aforementioned Mesopotamian scribe.

Deep time remained an important concern throughout Cluysenaar's work, and her poetic vision also allowed her to project her scientific knowledge into an imagined future deep time, as in her poem 'Timeslips':

> This land will be covered over
> and our bones with it, fossils
> that may not be found, nor given
> a place in the species' history.[44]

Far into the future we will be prehistory and our significance will most likely no longer be apparent. From the perspective of scientific knowledge, our lifetimes, our existences 'now', are very short, just a moment between the deep time that preceded us and the deep time that will follow us. Yet, in *Double Helix* Cluysenaar also makes clear that there is much more to life and to relationships than science can account for:

> The touch of a head
> against ours, that we love, will change,
>
> beyond our physics, what goes on inside.[45]

Her view of the world is scientifically informed in a thoroughgoing way, but it is not in any sense reductionist. Rather, her objective knowledge of science is incorporated into representation of subjective experiences so that expressions such as 'minute beings whose efforts created *us*' and 'a head against *ours*' can have meanings at comparable levels. Already in *Double Helix* she shows how scientific knowledge can enrich our experiences by providing a vision of our part in the continuity of life on earth.

Cluysenaar's best-known engagement with science is her 2008 collection, *Batu-Angas: Envisioning Nature with Alfred Russel Wallace*.[46] Wallace was a nineteenth-century polymath famous for his work on evolution, particularly his independent discovery, in 1858, of the principle of natural selection that stimulated Charles Darwin to publish his own work. Wallace had close connections with Wales, having been

born in the Usk valley and as a young man living and working for several years in Neath.[47] Cluysenaar's engagement with Wallace's life and work was extensive and systematic, including close study of his writings, visits to natural history museums which held collections of his samples, and extensive discussions with leading scientific researchers. Such an approach, for which her previous engagement with physics was a forerunner, could be regarded as exemplary for other non-scientists wishing to understand and incorporate science into creative practice.

In the course of her studies, Cluysenaar came to see a difference between the intellectual driving force for Wallace's science, 'a strong desire to know the causes of things', and her passion as a poet 'for life itself, as it exists before me'.[48] Her enquiries caused her to re-evaluate 'the tenuous job of poet', suggesting that: 'Deep time stretches on either side of our present existence. Perhaps modern scientific insights need to be accompanied by arts capable of facing these dizzying perspectives in terms that enable us to keep our emotional balance.'[49] An important contribution of the poet to emotional balance in science can be a sensitivity to ethical issues. The differences in perspective between Wallace, the scientist, and Cluysenaar, the poet, find expression, for example, in their attitudes to killing. Wallace engaged in long expeditions, notably in the 'Malay Archipelago' (Indonesia), during which he collected representative samples of species for scientific study and for sale to English collectors. Cluysenaar expresses qualms about this:

> I find myself thinking of Wallace,
> a hunter shouldering his gun
> as the only means of touching.
> . . .
> I share the smell of blood
> while I reach for his understandings.[50]

Here she shows an imaginative understanding of the practical aspects of Wallace's scientific work, and her sharing 'the smell of blood' indicates a vividness strong enough to gain insight into the internal goods of his approach, whilst remaining tentative about accepting his methods and values. Such methods were also applied to large apes, such as orangutans of which Wallace shot fifteen specimens:

One full-grown male fell alive:
legs broken; hip, root of spine
shattered; bullets in neck and tongue.[51]

In this case, Cluysenaar notes that Wallace also recorded unease. However, there are also more subtle differences in perspective between the scientist and the poet shown, for example, in accounts of catching a beautiful clear-winged butterfly for the first time in the Amazon. Wallace describes the butterfly as his 'greatest treasure', but Cluysenaar is more circumspect:

This is the living form
of the rainforest's age, an art
grown of its interactions,
which now he has gathered up
into a triangle, dying,
that knowledge folded away.[52]

The phrase 'an art / grown of its interactions' is a fine description of the evolution of the beautiful butterfly by processes of natural selection, with 'interactions' hinting at the importance of local geographical conditions, which was a key feature of Wallace's work: he is known as the 'father' of evolutionary biogeography.[53] Yet, despite her knowledge of science, Cluysenaar's priorities remain those of a poet, and she is sensitive to a loss as the living creature is removed from its natural environment for study and eventual storage in a museum drawer. As a poet, she is concerned rather with life as it can be directly experienced and is aware of the value of each individual creature, however small. Such subjective sensibilities also lead her to speculate in a very personal way on the future of evolution:

I wish I could sense
in myself some transformation –
millions of years off, even –
something adequate to dimensions
not yet begun, or dreamt of.[54]

The innate possibilities that existed in inanimate matter gave rise to life, and life as we know it may have inherent possibilities beyond our

imagination. Here the poet again expresses an aspect of her vision of our individual parts in the continuity of life on earth.

Cluysenaar's characteristic achievements in *Batu-Angas* are dependent on her appropriation of Wallace's work so that it becomes assimilated into her own vision. She incorporates objective knowledge of his methods and evolutionary theories so that they become part of the subjective outlook she expresses, but at the same time she retains her poetic sensitivities and hence adds a human dimension, emotional balance, feelings, ethics, to the bare science.

Evolutionary theory has been one of the aspects of science that has had the most influence on modern poetry; for example, at least a third of Holmes's edited volume concerns responses to Darwin's writings, or at least responses to cultural resonances of Darwinism. Cluysenaar provides a more personal appropriation of evolution than is apparent in other poets. There are, however, intriguing parallels and contrasts with Ruth Padel's 2009 volume, *Darwin: A Life in Poems*, which likely was written at about the same time as *Batu-Angas*.[55] Both are concerned with interactions of the objective and the subjective, but in Padel's case the focus is on providing a biography of Darwin, situating his science in the context of his life. Both use the device of the incorporation of quotations to provide the voices of others: Wallace in the case of Cluysenaar; Darwin, his family and colleagues in the case of Padel. Wallace also features significantly in Padel's work, including an account of Darwin's receiving by post in 1858 his paper 'On the Tendency of Varieties to Depart Indefinitely from the Original Type' in which Wallace included his key phrase about natural selection, '"a struggle for existence", in which the weakest and least perfectly organized must always succumb'.[56] It was this which led to the presentation of the theories of both men at the Linnean Society on 1 July 1858, though neither was present in person.

Cluysenaar's initial interest in Wallace seems to have arisen from their shared associations with Wales, particularly the Usk region. However, he was a perceptive choice for a poet in another respect: unlike some prominent modern biologists he was not a reductionist materialist. Indeed, he thought that explanations other than natural selection were probably necessary to account for the origins of life, the origins of consciousness and the development of 'the higher intellectual and spiritual nature of man', the latter including ethics and particularly ideas of sanctity.[57] These remain topics of uncertainty

within evolutionary understanding, and Wallace's thoughts are consonant with some recent analyses, such as those of the philosopher Thomas Nagel, that see consciousness, cognition and value as posing serious problems for reductive materialist approaches to evolution. In surprisingly similar ways, both Wallace and Nagel suggest that something fundamental is missing: reductive materialism is false and evolutionary theory (for Nagel, even in its latest forms) is incomplete.[58] In the words of Wallace, with humankind 'a being had arisen who was no longer necessarily subject to change with the changing universe',[59] a being who could develop by advance of mind. It may be added that poetry can contribute to such advance of mind, and, as Cluysenaar has helped to show, the work of the poet in this regard can be substantial rather than tenuous, even regarding science.

Another aspect of science that strongly engaged Cluysenaar's fascination is geology, a subject apparent throughout her work and especially so in her 2011 collection, *Migrations*. The contents page of *Migrations* at times suggests a geology textbook rather than a book of poems: 'At Pantymaes Abandoned Quarry'; 'Shear-zone at Marloes Albion Sands'; 'At Tredomen Quarry; 'A Graptolite, *Didymograptus murchisoni*'; 'At the Glacier's Snout', and so forth. These titles indicate serious and systematic investigation of the rich geology of Wales, and the poems show that this included many field-trips. The geology of such sites brings together two of Cluysenaar's key themes: deep time and evolution.

To walk over rocks on a field-trip is to tread on ancient geographies, 'Over seas that are now rock. / Over mountains that once were deserts', so that our knowledge of the past is enhanced and our experience of the present becomes transformed:

> It seems that 'now',
> the word itself, becomes more and more
> strange to us with every step up the stream.[60]

By the phrase 'strange to *us*' the poet links objective knowledge of geological processes with its impact on personal experiences. The poems give us something that is often missing from geology textbooks, an account of such personal experiencing, as when fingertips sense the surface of a rock:

Runways. Rucks. Burrows.

Braille of what bred us
reading its own
present – the shallows,
the soft mud,
flowing tropical night.[61]

Again, the linking of the personal or subjective and the objective is apparent, connecting here 'what bred *us*' to the type of warm moist environment that is often viewed as a likely location for the origin of life, for geology can take us far enough back in time to confront the conundrum of how life began, a topic of great scientific interest and also a huge conceptual challenge. The latest theories suggest that the chemical process by which life emerged from inanimate matter and the simplest biological systems may be different instances of the same type of dynamically stable physicochemical process.[62] But, as Cluysenaar acknowledges, much is uncertain:

And now you slant it to show
wrinkles in the mud.
Chemical, bacterial? No-one knows.[63]

Also in this collection, Cluysenaar links the extremely distant past to the more recent past and the present. For example, while describing a search for geological features she moves mentally in time and remarks:

I have to imagine ghostlier
contacts: ancestors
whose palms may have leant there.[64]

These imagined 'ancestors' should be understood as her personal forebears rather than the hypothetical earlier humans of a textbook description. Her response to origins becomes even more personal as she reacts to a finding that her mitochondrial DNA indicated descent from a woman living 10,000 years ago in the region that is now Syria:

In my flesh, there's evidence
of her being. Her living trace
helps hold this pen. But for her

there's no way of teaching the earth
or its fibres, to hold her thought.[65]

Here there is an intimate linking of the objective findings of a genetic test and Cluysenaar's personal response to those findings, 'in *my* flesh'. Furthermore, the ancestor, 'her *living* trace', in a sense contributes to the writing of the poem even though she belonged to an age without the written word.

A theme running through Cluysenaar's work and linking her interest in time, evolution and relationships is that of how inert matter has developed to be aware of itself – 'Matter watching itself'– a controversial topic that continues to be of great scientific interest.[66] Alan Wallace goes so far as to suggest that 'Strictly speaking, at present there is no scientific evidence even for the existence of consciousness.'[67] As science is concerned with objectively measurable properties of the world, and as consciousness consists of qualitative, subjective awareness, consciousness lies, strictly speaking, outside the realm of science. Furthermore, if science is understood on the basis of reductive materialism it is difficult to consider consciousness as anything more than an epiphenomenon of the material world. However, this is also a problematic view, for science depends on the consciousness of its practitioners, and if this is considered an apparition then the validity of science itself must be questioned. Consequently, for practical purposes most scientific activities assume that consciousness exists.

If consciousness exists it must, from a modern scientific perspective, have arisen from inert matter and developed through a process of evolution. This is clearly a topic to which Cluysenaar has given much thought, for it is possible to find in her poetry reflections on each of the likely key stages in the development of consciousness, as well as considerations of its later psychological aspects. The first stages of life, perhaps of the form indicated by the earliest fossil remains, may have been:

independent ongoing life,
things quite unknown,
unconscious minds
feeding from tide to tide,
doodling grey stone.[68]

Here the curious, apparently paradoxical, phrase 'unconscious minds' indicates a supposed characteristic of a very primitive form of life, a

simple kind of responsiveness. At some later time something more sophisticated arose, perhaps in a creature as apparently insubstantial as an almost transparent shrimp: 'a film / of intentional matter'.[69] The 'intent' of such creatures may have been simply a matter of material survival. As higher forms of life evolved, there arose more complex creatures that could be described as:

> Aware, though not self-aware.
>
> I envy that! But at once
> a consciousness echoes in mine –
> one which discovered self
> as miracle, riches of isolation.[70]

The initial reference is to studies indicating that some modern creatures may be conscious of their environment but lacking an awareness of themselves. In the case of the bird of this poem's title, however, Cluysenaar may here be assuming too much; for although it is difficult to verify the nature of consciousness in other creatures, birds have been shown to have remarkable mental abilities.[71] Note also the personal 'I envy that!', and its retraction following reflection, showing her intimate involvement with the subject matter of the poem. Cluysenaar further considers the evolution of creatures with consciousness more like our own, though exactly when this arose is disputable, for fragmentary skeletons and skulls like those of 'Swanscombe Man', dated to about 400,000 years ago, provide scant evidence:

> This labelled cave
> is alien. Empty, like her three curved bones,
> of the real existence of consciousness. Which left
> no evidence, till words were fossilised in stone,
> or ink drawn fragile over skins or printed
> on destroyed forests.[72]

Here the near impossibility of tracing the development of early human-like consciousness is recognised, for subjective experiences leave no trace in the fossil record. It is only when art and other symbolic systems arise that more sophisticated forms of consciousness can be implied. Yet, an unknown, and probably unknowable process of development must have occurred, for the poet can exclaim: 'And here we are!'[73]

In our own case, consciousness appears not to be limited to us as individuals in isolation, for we can experience a mutuality of subjectivity in the presence of others, a mutuality of minds, as Cluysenaar describes in the poem 'Moon':

> All at once, it is good to stand
> unappalled together. To find that to be,
> just here, enjoying all this,
> is a thing human minds can do.[74]

As the theologian Dumitru Staniloae writes, 'every time a person is truly aware of someone else, this feeling does not belong to that one person only but is also experienced by the consciousness of the other', experiences that materialist approaches to science have trouble explaining.[75] We can also have a sense of presence-in-absence of those to whom we are, or have been, especially close, as Cluysenaar expresses in 'As a wind or an echo rebounds':

> Since your death, I wake every night
> at the same hour – some thought of yours
> able to seek me still,
> the way you used to greet me
> between written messages.[76]

Thus, persons in a relationship can in a sense transcend physical boundaries, move beyond the limitations of the 'hereness' of existence in the physical world.[77] Moreover, our subjectivity can even appear to extend to our surroundings, a kind of environmental mutuality of subjectivity, as evoked in 'There were dark leaves spread out':

> It seemed we were all – tree
> and air and bird and poppy and
> gravel even – composing together.[78]

Such identification with the natural environment around us is close to the idea of an 'ecological self' that was introduced by the Norwegian philosopher Arne Naess in the late 1980s.[79] Cluysenaar's poetry shows that such identification with the natural world was a vital part of her life in rural Wales.[80]

As Cluysenaar describes increasingly sophisticated aspects of consciousness, she moves from engagement with science to consideration of experiences that are more often the concerns of philosophers and theologians. This reflects the real conceptual difficulties in scientific approaches to self-consciousness, personal awareness and subjectivity. Science aims to be objective, third party, unattached to a specific viewpoint. Yet, the more detached the explanation of self-consciousness, the further it moves from an individual's first-person, subjective experiences of *I*.[81] It is genuinely difficult to understand how an objective description of *I* could be formulated. We do, however, have subjective, inside knowledge, and poetry is a powerful way of exploring such awareness.[82] This is most certainly an aspect of the human situation where the approaches of poetry and science are complementary.

In this way, Cluysenaar's engagement with some of the greatest challenges to modern science can lead beyond the limits of scientific explanation. Considerations of the limitations of science, and its personal significance, often lead to questions about the relationship of science and faith, and Cluysenaar's views on faith seem to have changed considerably during the course of her writing career. As has been observed, when writing in the 1970s she saw that one of the benefits of poets engaging with science was the possibility of a release 'from the literalities (as opposed to the insights) of religion'. In the same essay she wrote, whilst considering negative reactions to science: 'God is not dead, he never existed. But by bringing up children within a framework of religious pieties, whose basic message may be valuable but whose terms are outworn we allow the traumatic shock to reproduce itself again and again even in the later part of the twentieth century.'[83] Yet, during the 1990s she carried out a profound study of the work of the seventeenth-century Christian metaphysical poet Henry Vaughan, who also had close connections with the Usk valley, leading to a major sequence of poems, 'Vaughan Variations', and an edited selection of Vaughan's poems.[84] Cluysenaar's response to Vaughan's poems has been the subject of a recent detailed study by Jeremy Hooker.[85] In 'Vaughan Variations' Cluysenaar writes that 'I have no prayers for the dead / or the living', indicating that she did not share Vaughan's faith.[86] However, quoting from Cluysenaar's 'Introduction' to the *Selected Poems*, Hooker writes of Vaughan as a shamanic figure, 'one who, following his or her experience of personal disintegration, seeks to

become a bridge for others between the material world and the world of the spirit' and adds that 'Henry Vaughan was such a "bridge" for Anne Cluysenaar'.[87] Even so, he writes that 'She approaches him through language, through metaphor, and through a shared love of nature; she does not speak of God.'[88]

However, several of Cluysenaar's later poems seem to describe mystical experiences:

> As if, eyes open, I'd fallen
> asleep.
> . . .
> But, to think or express it,
> that's not possible.[89]

A friend and colleague was to write that 'Her sensibility was essentially religious, wholly and seriously alert to life in a way rarely observed in others.'[90] Nevertheless, her poetry shows that she remained sceptical of the practices and dogmas of organised religion, writing for example in a poem subtitled 'Tintern Abbey, grisaille': 'They gave up the story of Christ / for translucent tracery.'[91] Late in her life she became a Quaker, that most undogmatic and unhierarchical of religious societies that emphasises the importance of personal religious experience, hence constituting an experiential approach to faith that is consonant with Cluysenaar's approach to science. She summarised her mature views on the relationship between faith and science in an interview:

> I was thinking a good deal about evolution and the opposition some people feel between religious experience and scientific discovery. I haven't felt such an opposition, probably because being bilingual and a linguist I know that human languages . . . can't possibly embody ultimate reality . . . If scientific discovery suggests that certain religious dogmas, taken literally, must be false, this should not lead us to abandon such direct numinous experience as we may have . . . We come out of reality so we embody it in our selves and should be able to sense it.[92]

Cluysenaar's approaches to both science and faith are in accord with a need recently expressed by Rowan Williams for 'a metaphysics that thinks of matter itself as invariably and necessarily communicative', so

that matter and meaning are more intimately connected than is often assumed.[93] Cluysenaar characteristically expresses her concern in more evolutionary language: 'in the present century, it may be more important than ever to understand how the functionings of matter have enabled humanity to emerge not only physically but also intellectually and spiritually'.[94]

Cluysenaar's mature assessment of the relationship of faith and pure science is in broad agreement with that of R. S. Thomas, for he also saw no fundamental conflict between the two, as he observed in a 1990 interview: 'If pure science is an approach to ultimate reality, it can differ from religion only in some of its methods.'[95] Thomas is best known as a modern poet of faith of international significance, but he also had a sustained interest in science for many years, as indicated by the titles of some of his collections of poetry, such as *Laboratories of the Spirit* (1975) and *Frequencies* (1978). In his poetry of the 1970s and 1980s he consciously sought to address science, explaining in the same interview that, 'owing to the enormous part science and technology play in our lives, a divorce of poetry from them would be injurious to the development of poetry and would alienate people from it, as has already occurred to some degree'.[96] This motivation is similar to that expounded by Cluysenaar in her essay 'Post-culture: pre-culture?', but with a more explicit concern for the effect on readers of poetry. An additional impulse for engagement arose from Thomas's priestly role, for he had a serious concern about the effect on his congregation of common misunderstandings of the nature of science, observing: 'Many former worshippers have lost their faith because of the popular but over-simple presentation of science and technology. R.S. would attack these dogmas quite consistently, seeking to counteract their injurious influence on the majority of people.'[97] Thomas here shows a prescient awareness of the effects of the simplifications of scientific new-atheism which would reach a peak of influence in the first decade of the twenty-first century.

Thomas undertook serious personal study of science, particularly physics, through reading and discussion with scientists. Both his prose and his poetry consequently show a good understanding of the nature of scientific endeavour, including insight into the way that mathematics allows scientists to express themselves without words. His overall assessment of the contribution of pure science to knowledge is positive, but Thomas's poetry does not demonstrate as thoroughgoing an appropriation of science into the subjective outlook of his poems as

Cluysenaar's does. His primary concerns instead relate to the dangers that arise from unwise use of such knowledge.[98] First, the dangers of scientism, of seeing the world only in terms of science, even to the extent of displacing religion: 'They have exchanged / their vestments for white coats.'[99] This concern clearly arose from his pastoral responsibilities: a concise summary of his outlook on this point might be that pure science is valuable but it cannot offer salvation. Secondly, the dangers of practical application of science, for he confessed that: 'Yes, I am, generally speaking, anti-technology . . . The main criticism is that the machine is de-humanizing. It also insulates man from natural processes.'[100] This is a recurrent theme throughout his writing, occurring even in an early poem (1952) about a poor hill farmer acquiring a tractor: 'He's a new man now, part of the machine, / His nerves of metal and his blood oil.'[101] R. S. Thomas's generic idea of 'the machine' has the implication of a technological state of mind which is pervasive and can include a tendency to violence: he was a pacifist and a supporter of the Campaign for Nuclear Disarmament. Ethical anxiety about science's technological uses is much less apparent in Cluysenaar's work, for her primary concern is with the essentials of pure science.

Pure science permeates Cluysenaar's writing from the perceptive essay 'Post-culture: pre-culture?' (1972) to the final entries in her diary poems *Touching Distances* (2014). In her essay she described the challenges to poets of appropriating science with intensity and discernment such that it could become an integral part of their subjective awareness of the world. Through serious study and interaction with scientists she engaged with the practice of science at a depth that gave her an intimate appreciation of its structure and outcomes, including a sensitivity to its internal goods. This enriched her own life, as she described of her approach to Wallace's work:

> Reading his books, seeing and handling his specimens, talking with biologists engaged in their own current research (sometimes derived in part from Wallace's own), enriched my sense of what could be seen on our own small farm in the Welsh borders and deepened my enjoyment of life.[102]

This appropriation of science is eloquently expressed in her poetry so that she provides for the reader intelligible and subtle connections between the apparently objective world of science and the subjective

experiences of life. The poems sensitively keep a perspective on the extraordinary findings of science through inclusion of expression of feelings, ethical concerns and a willingness to acknowledge the reality of mystical experiences. Her poetry makes a significant contribution to her vision of a unified literary-scientific culture by showing how science can be both understood and in a sense personally possessed, as she incorporated it into her own awareness and showed that it mattered to *her*. Cluysenaar thus shows how science can matter to *us*, and it really does give us a unique opportunity, as her late poem about the search for the Higgs boson describes:

> In us,
> for a while at least, the stuff of stars
> gets a glimpse of its own precarious life.[103]

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[1] Anne Cluysenaar, 'Post-culture: pre-culture?', in Michael Schmidt and Grevel Lindop (eds), *British Poetry Since 1960* (Oxford: Carcanet, 1972), pp. 215–32: p. 217. Anne Cluysenaar was born in 1936 and died in 2014. She worked at academic institutions in Ireland, Scotland and England before moving to the Usk valley in Wales, where for more than twenty years she focused on writing poetry and teaching creative writing.

[2] Cluysenaar, 'Post-culture: pre-culture?', p. 222.
[3] Cluysenaar, 'Post-culture: pre-culture?', p. 222.
[4] Cluysenaar, 'Post-culture: pre-culture?', p. 223.
[5] Cluysenaar, 'Post-culture: pre-culture?', pp. 216, 229–30. C. P. Snow, *The Two Cultures and the Scientific Revolution* (Cambridge: Cambridge University Press, 1959).
[6] Ian Gregson, 'The Irrelevance of Poetry', *Poetry Wales*, 51 (2015), 61–2: 62.
[7] As exemplified in the writings of Richard Dawkins, Daniel Dennett, Sam Harris and Christopher Hitchens. In the UK, the most influential text is Dawkins's *The God Delusion* (London: Bantam Press, 2006).
[8] Drew Milne, 'The art of wit and the Cambridge Science Park', in Robert Crawford (ed.), *Contemporary Poetry and Contemporary Science* (Oxford: Oxford University Press, 2006), pp. 170–87: p. 177.
[9] Malcolm Guite, *Faith, Hope and Poetry: Theology and the Poetic Imagination* (Farnham: Ashgate, 2012), p. 75.
[10] Guite, *Faith, Hope and Poetry*, p. 95.
[11] Guite, *Faith, Hope and Poetry*, pp. 105, 112.
[12] Mary Midgley, *Science and Poetry* (London: Routledge, 2006), p. 75.
[13] Guite, *Faith, Hope and Poetry*, pp. 164, 167.
[14] John Holmes, 'Introduction', in John Holmes (ed.), *Science in Modern Poetry: New Directions* (Liverpool: Liverpool University Press, 2012), pp. 1–15.
[15] John Holmes, 'Acknowledgements', in Holmes (ed.), *Science in Modern Poetry*, pp. x–xi: p. x.
[16] Crawford (ed.), *Contemporary Poetry and Contemporary Science*; Holmes (ed.), *Science in Modern Poetry*.
[17] Robert Crawford, *Selected Poems* (London: Cape Poetry, 2005). About a quarter of the poems in this volume refer to science, technology or engineering.
[18] John Holmes, 'From Bergson to Darwin: Evolutionary Biology in the Poetry of Judith Wright', in Holmes (ed.), *Science in Modern Poetry*, pp. 194–209.
[19] Rónán McDonald, '"Accidental Variations": Darwinian Traces in Yeats's Poetry', in Holmes (ed.), *Science in Modern Poetry*, pp. 151–66: p. 153.
[20] Peter Middleton, 'Cutting and Pasting: Language Writing and Molecular Biology', in Holmes (ed.), *Science in Modern Poetry*, pp. 38–54: p. 49.
[21] Paul Muldoon, 'Once I Looked into Your Eyes', in Crawford (ed.), *Contemporary Poetry and Contemporary Science*, p. 169.
[22] Jocelyn Bell Burnell, 'Astronomy and Poetry', in Crawford (ed.), *Contemporary Poetry and Contemporary Science*, pp. 125–40: pp. 126, 138.
[23] Kay Redfield Jamison, 'Psychology and Contemporary Poetry', in Crawford (ed.), *Contemporary Poetry and Contemporary Science*, pp. 191–203: p. 192.
[24] For example, following the production in 2015 by CERN's Large Hadron Collider of data indicating the possible existence of a new type of fundamental particle, over seventy proposed theoretical explanations were published. In 2016 the data were found to be a statistical blip. See Tia Ghose, 'What 2016 Holds for the Mysterious World of Physics', *Scientific American*, 5 January 2016, *www.scientificamerican.com/article/what-2016-holds-for-the-mysterious-world-of-physics/*, accessed 19 June 2017.
[25] Alasdair MacIntyre, *After Virtue*, 2nd edn (London: Duckworth, 1985), p. 187.
[26] Michael Polanyi, *The Tacit Dimension* (Chicago: University of Chicago Press, 2009), p. 4.
[27] Internal goods and tacit knowledge also exist for everyday activities. It is not easy to appreciate the internal goods of cycling unless one has actually ridden a bike, and the internal goods of a moderately complex activity such as the game of cricket can be difficult to understand without participation. Recognition of faces is a good example of tacit knowledge; we can recognise one face among thousands but have great difficulty describing faces accurately.

[28] 'Girl with a Balloon', in Rebecca Elson, *A Responsibility to Awe* (Manchester: Carcanet, 2001), p. 12.
[29] 'Explaining Relativity', in Elson, *A Responsibility to Awe*, p. 13.
[30] 'Devonian Days', in Elson, *A Responsibility to Awe*, p. 29.
[31] 'Brief Explanations', in Elson, *A Responsibility to Awe*, p. 86.
[32] 'White Coat, Purple Coat', in Dannie Abse, *Ask the Moon: New and Collected Poems 1948–2014* (London: Hutchinson, 2014), p. 119.
[33] 'The Stethoscope', in Abse, *Ask the Moon*, p. 118.
[34] 'In the Theatre', in Abse, *Ask the Moon*, p. 86.
[35] 'Pathology of Colours', in Abse, *Ask the Moon*, p. 50.
[36] Midgley, *Science and Poetry*, pp. 71–2, 78–9.
[37] 'X-ray', in Abse, *Ask the Moon*, pp. 125–6.
[38] 'Clay', in Anne Cluysenaar, *Migrations* (Blaenau Ffestiniog: Cinnamon, 2011), p. 60.
[39] Anne Cluysenaar and Sybil Hewat, *Double Helix* (Manchester: Carcanet, 1982).
[40] Cluysenaar and Hewat, *Double Helix*, p. 37.
[41] Cluysenaar and Hewat, *Double Helix*, p. 37.
[42] Anne Cluysenaar, *Introduction to Literary Stylistics* (London: Batsford, 1976), p. 26.
[43] '15 September – About the Church', in Cluysenaar and Hewat, *Double Helix*, p. 136.
[44] 'Timeslips', in Anne Cluysenaar, *Timeslips: New and Selected Poems* (Manchester: Carcanet, 1997), p. 108.
[45] Cluysenaar and Hewat, *Double Helix*, p. 126.
[46] Anne Cluysenaar, *Batu-Angas: Envisioning Nature with Alfred Russel Wallace* (Bridgend: Seren, 2008).
[47] R. Elwyn Hughes, 'Alfred Russel Wallace; Some Notes on the Welsh Connection', *The British Journal of the History of Science*, 22 (1989), 401–18. For a fuller account of Wallace's life see Andrew Berry (ed.), *Infinite Tropics: An Alfred Russel Wallace Anthology* (London: Verso, 2002), pp. 1–26.
[48] 'Foreword', in Cluysenaar, *Batu-Angas*, p. 7.
[49] 'Foreword', in Cluysenaar, *Batu-Angas*, p. 8.
[50] 'IV', in Cluysenaar, *Batu-Angas*, pp. 25–6.
[51] 'XX', in Cluysenaar, *Batu-Angas*, p. 64.
[52] 'VII', in Cluysenaar, *Batu-Angas*, p. 32.
[53] See Bernard Michaux, 'Alfred Russel Wallace, biogeographer', in Charles H. Smith and George Beccaloni (eds), *Natural Selection and Beyond: The Intellectual Legacy of Alfred Russel Wallace* (Oxford: Oxford University Press, 2008), pp. 166–85.
[54] 'XXIII', in Cluysenaar, *Batu-Angas*, p. 70.
[55] Ruth Padel, *Darwin: A Life in Poems* (2009: London: Vintage, 2010).
[56] Alfred Russel Wallace, 'The "Ternate Paper"', in Berry (ed.), *Infinite Tropics*, pp. 50–61: p. 56.
[57] Alfred Russel Wallace, '"A being apart": human evolution', in Berry (ed.), *Infinite Tropics*, pp. 175–211: pp. 175, 205, 209.
[58] Thomas Nagel, *Mind and Cosmos: Why the Materialist Neo-Darwinian Conception of Nature is Almost Certainly False* (Oxford: Oxford University Press, 2012).
[59] Wallace, '"A being apart": human evolution', p. 188.
[60] 'Up Gwrellech Stream', in Cluysenaar, *Migrations*, p. 40.
[61] 'On the Beach, Ogmore-By-Sea', in Cluysenaar, *Migrations*, p. 42.
[62] Addy Pross and Robert Pascal, 'The Origin of Life: What We Know, What We Can Know and What We Will Never Know', *Open Biology*, 3 (2013), *http://rsob.royalsocietypublishing.org/content/3/3/120190*, accessed 19 June 2017.
[63] 'At Pantymaes Abandoned Quarry', in Cluysenaar, *Migrations*, p. 30.
[64] 'Blackpool Valley, Forest of Dean', in Cluysenaar, *Migrations*, p. 37.

[65] 'Clay', in Cluysenaar, *Migrations*, pp. 50, 63.
[66] 'Quarry', in Cluysenaar, *Timeslips*, p. 103.
[67] B. Alan Wallace, *The Taboo of Subjectivity* (Oxford: Oxford University Press, 2000), p. 3.
[68] 'Leaving Sully Island', in Cluysenaar, *Migrations*, p. 29.
[69] 'January 3', in Cluysenaar, *Touching Distances: Diary Poems* (Blaenau Ffestiniog: Cinnamon Press, 2014), p. 24.
[70] 'The Bird', in Cluysenaar, *Migrations*, p. 24.
[71] Gavin R. Hunt, 'Manufacture and Use of Hook-Tools by New Caledonian Crows', *Nature*, 379 (1996), 249–51; Helmut Prior, Ariane Schwarz and Onur Güntürkün, 'Mirror-Induced Behaviour in the Magpie (*Pica pica*): Evidence of Self-Recognition', *PLoS Biology*, 6 (2008), 1642–50.
[72] 'Natural History', in Cluysenaar, *Timeslips*, p. 110.
[73] 'January 13: Hunting the Higgs', in Cluysenaar, *Touching Distances*, p. 77.
[74] 'Moon', in Cluysenaar, *Migrations*, p. 20.
[75] Dumitru Staniloae, *Theology and the Church* (Crestwood: St Vladimir's Seminary Press, 2003), p. 31.
[76] 'As a wind or an echo rebounds', in Cluysenaar, *Migrations*, p. 68.
[77] Christos Yannaras, *Person and Eros* (Brookline: Holy Cross Orthodox Press, 2007), p. 115.
[78] 'There were dark leaves spread out', in Cluysenaar, *Migrations*, p. 95.
[79] Arne Naess, *The Ecology of Wisdom: Writings by Arne Naess*, ed. Alan Drengson and Bill Duvall (Berkeley: Counterpoint, 2008), p. 82.
[80] Elucidation of the deep ecological roots apparent in much of Cluysenaar's poetry would be a rewarding study but is outside the scope of the present article.
[81] Thomas Nagel, 'What Is It Like to Be a Bat?', *The Philosophical Review*, 4 (1974), 435–50.
[82] Mutlu Konik Blasing, *Lyric Poetry: The Pain and the Pleasure of Words* (Princeton: Princeton University Press, 2007).
[83] Cluysenaar, 'Post-culture: pre-culture?', p. 217.
[84] 'Vaughan Variations', in Cluysenaar, *Timeslips*, pp. 127–62; Henry Vaughan, *Selected Poems*, ed. A. Cluysenaar (London: Society for Promoting Christian Knowledge, 2004).
[85] Jeremy Hooker, '"Vaughan Variations": Anne Cluysenaar in Conversation with Henry Vaughan', *Scintilla*, 19 (2016), 92–108.
[86] 'Vaughan Variations', in Cluysenaar, *Timeslips*, p. 130.
[87] Hooker, '"Vaughan Variations": Anne Cluysenaar in Conversation with Henry Vaughan', p. 104.
[88] Hooker, '"Vaughan Variations": Anne Cluysenaar in Conversation with Henry Vaughan', p. 107.
[89] 'As if, eyes open, I'd fallen', in Cluysenaar, *Migrations*, p. 88.
[90] Roger Hubank, 'Anne Cluysenaar', in Fiona Owen (ed.), *At Time's Edge: Remembering Anne Cluysenaar* (Vaughan Association, 2016), pp. 71–4: p. 74.
[91] 'A metaphor for this earth', in Cluysenaar, *Migrations*, p. 93.
[92] Fiona Owen, 'A New Sense of Balance: Anne Cluysenaar interviewed by Fiona Owen', *Planet*, 192 (2008), 46–51: 46–7.
[93] Rowan Williams, *The Edge of Words: God and the Habits of Language* (London: Bloomsbury, 2014), p. xi.
[94] 'Foreword', in Cluysenaar, *Batu-Angas*, p. 8.
[95] Ned Thomas and John Barnie, 'Probings: An Interview with R. S. Thomas', in William V. Davies (ed.), *Miraculous Simplicity: Essays on R. S. Thomas* (Fayetteville: University of Arkansas Press, 1993), pp. 21–46: p. 37.
[96] Thomas and Barnie, 'Probings', p. 37.
[97] R. S. Thomas, *Autobiographies* (London: J.M. Dent, 1997), p. 85. Here Thomas writes of himself in the third person.

[98] W. Richard Bowen, 'Imaginative expression of faith and science: the poetry of R. S. Thomas', in Dirk Evers, Michael Fuller, Anne Runehov and Knut-Willy Sæther (eds), *Issues in Science and Theology: Do Emotions Shape the World?* (Cham: Springer, 2016), pp. 235–47.

[99] 'Ritual', in R. S. Thomas, *Collected Poems 1945–1990* (London: J.M. Dent, 1993), p. 496.

[100] Thomas and Barnie, 'Probings', p. 37.

[101] 'Cynddylan on a Tractor', in Thomas, *Collected Poems 1945–1990*, p. 30.

[102] 'Foreword', in Cluysenaar, *Batu-Angas*, p. 9.

[103] 'January 13: Hunting the Higgs', in Cluysenaar, *Touching Distances*, p. 77.