

BOYLE LECTURE 2021

with Tom McLeish, “The Re-Discovery of Contemplation through Science: Boyle Lecture 2021”; Rowan Williams, “The Re-Discovery of Contemplation through Science: A Response to Tom McLeish”; Fraser N. Watts, “Discussion of the Boyle Lecture 2021”; and Tom McLeish, “Response to Boyle Lecture 2021 Panel and Participant Discussion .”

RESPONSE TO BOYLE LECTURE 2021 PANEL AND PARTICIPANT DISCUSSION

by Tom McLeish 

Abstract. The online panel discussion following the 2021 Boyle Lecture, “The Re-discovery of Contemplation through Science” was very rich, both in terms of the topics raised by the panel members, and the extensive list of questions and suggestions posed by the online participants. Here, I record some initial thoughts in response, grouped under the following headings: Overall Rationale and Purpose, Contemplative Methodologies in Scientific Insight and Broader Practice, Science Culture and Politics, Psychological and Meditative Consequences, Natural Theology of Old and New Kinds, New Atheism, Education, Christian Practice, and Lessons from the History of Science and Technology.

Keywords: contemplation; education in science and religion; history of science; natural theology; poetry and science; psychology; theology and science

The short online panel and participant discussion following the 2021 Boyle Lecture, *The Re-discovery of Contemplation through Science* (McLeish, this issue), was very rich, but attracted far more questions than could be handled at the time. Here is a set of very preliminary responses to the online questions, and to the panel discussion itself, summarized by Fraser Watts (this issue). To minimize a fragmentation of response, it seemed desirable to group the questions by nine subheadings under which they all seemed to fall, although naturally some aspects of discussion touch on more than one. These organizing topics are: Overall Rationale and Purpose, Contemplative Methodologies in Scientific Insight and Broader Practice, Science Culture and Politics, Psychological and Meditative

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Consequences, Natural Theology of Old and New Kinds, New Atheism, Education, Christian Practice, and Lessons from the History of Science and Technology. These sections begin with the corresponding set of on-line questions (followed by the questioner's name). The response to each collection of questions follows. They are mine, except where specifically indicated.

OVERALL RATIONALE AND PURPOSE

Why are we doing this? (Bonnie Zahl—from a young family member)

Is the word God a verb or a noun? (Martin Bassants)

Talk of “religion” and “science” (and any type of “relationship” or whatever) seems utterly unable to capture what you are saying. What categories, and modes of thinking, including contemplation, poetry, rhetoric, understanding could you recommend to us, especially to theologians and scientists (but to all of us really) to move towards a better understanding of God as creator and ourselves as part of creation. (Esgrid Sikahall)

Why do theologians refer to God as he? (Jack Martin)

What is truth? (Rebecca Nichol)

It is inspiring to receive such perceptive and deep “framing” questions stimulated by a discussion such as this one. They are salutary reminders that we tread on transcendent ground. Especially helpful is the bold and simple challenge from the young audience member. Keeping sight of the reason we are doing something is an important habit in science, theology, and everything really!

We are doing “this”—which I take to mean “a serious reappraisal of the way we think about science in human and societal context in the light of theology and the arts,” because it matters to being human, somehow, that we understand how our world works. This is not merely a question of “curiosity,” although it might start there, but goes deeper—to a sense of responsibility we have to each other and to our world, to treasure it. Another reason is the need to show directly, in the face of its unevincenced denial, that Christian faith is in fact a fruitful source of support for science in many ways (this is exactly why Robert Boyle started the series of lectures all those years ago). There is a misunderstanding that it has, and does still, limit and frustrate science; I wanted to show that this need not be the case at all. Rather, there is a need to explore and explain that science can be both God's gift and calling. Perhaps that process is part of finding out what “truth” means—after all “true” is a woodworking term, indicating when pieces are lined up or properly parallel. “True” has the sense of being in a right relationship with, and both theology and science working together aim to establish that sort of a “true-ness” between us and the

world, and therefore between those and Godself (the gender-neutral term that theologians now often use of God, by the way, Jack Martin). But to do that will require, as Esgrid already hints at, every mode of being human in expression and reception.

Martin Bassant's question turns us back to Coleridge's (and for that matter, Moses') experience of the divine, and of insight into the divine, at that radical moment in the Torah when God declares his substantiveness to be verbal: I AM (quoted and discussed in Guite 2012).

CONTEMPLATIVE METHODOLOGIES IN SCIENTIFIC INSIGHT AND BROADER PRACTICE

What kind of interaction do you suppose Dr. McLeish's beautiful insistence on the importance of "imagination" and "suddenness" of scientific solutions through sometimes unconventional modes of contemplation and reflection might have with Bernard Lonergan's understanding of "insight"? (Alexander Fogassy)

Within the theoretical areas of the sciences such as physics, chemistry, biology, etc., we have the process of the thought experiment. How do you see the contemplative and the imaginative and the poetic inspiring this process? (James Fowler)

How would you recommend the jobbing scientist under pressure of funding and publication, make room for the contemplative element of their vocation? (Roger Bretherton)

How can theological reflection seeking an understanding of the mind of God, through Biblical Poetry and Wisdom Literature inspire one's contemplative activity in the sciences? (James Fowler)

I was struck with contemplation as a way to think about the unseen side and the hidden nature of things as being obvious in art—Cubism aimed to reveal all the unseen sides of an object at once, via the imagination—and the network of fungi that biologists found empirically verified as the probable source of trees being able not to talk to each other but to make protective chemical signals. But in practice we might need to show that this is how many solutions are revealed even to the non-scientist, and on perhaps Buddhism is getting close to doing this. Is the western faith lagging in this and will people of no faith tolerate this approach in education? (Mary Lin Raisch)

An example of contemplation, from an unexpected source, is found in T. H. Huxley (quoted in Carroll 2006):

The student of Nature wonders the more and is astonished the less, the more conversant he becomes with her operations; but of all the perennial miracles she offers to his inspection, perhaps the most worthy of admiration is the development of a plant or of an animal from its embryo. Examine the recently laid egg of some common animal, such as a salamander or newt. It is a minute spheroid in which the best microscope will reveal nothing but

a structureless sac, enclosing a glairy fluid, holding granules in suspension. But strange possibilities lie dormant in that semi-fluid globule. Let a moderate supply of warmth reach its watery cradle, and the plastic matter undergoes changes so rapid, yet so steady and purpose-like in their succession, that one can only compare them to those operated by a skilled modeller upon a formless lump of clay. As with an invisible trowel, the mass is divided and subdivided into smaller and smaller portions, until it is reduced to an aggregation of granules not too large to build withal the finest fabrics of the nascent organism. And, then, it is as if a delicate finger traced out the line to be occupied by the spinal column, and moulded the contour of the body; pinching up the head at one end, the tail at the other, and fashioning flank and limb into due salamandrine proportions, in so artistic a way, that, after watching the process hour by hour, one is almost involuntarily possessed by the notion, that some more subtle aid to vision than an achromatic, would show the hidden artist, with his plan before him, striving with skillful manipulation to perfect his work. (Joshua Luke Roberts)

What about the wonder of science as a way of encouraging wider participation/enthusiasm? (Timothy Jarrold)

In your view of science as contemplation, what I have heard so far, are explicit appeals to the theology of Christianity. But since science is now a truly global practice, how would we incorporate in science as contemplation the views of other traditions (mindfulness etc. for example)? (Deepanwita Dasgupta)

Contemplation, in the mystical sense, means union with the transcendent or even a rapture. can we talk about a rapture in the case of contemplation through science? I'm asking because rational science often seems to dominate the man. (Paul Scarlat)

I think Astronomy is the way to go. Does the panel agree? (Jack Martin)

'Contemplative science': there is a story of nuclear physicists praying the Jesus Prayer as they pursued their research. (Elizabeth Theokritoff)

Could you say something about the use of language in the two *magisteria*, science and religion. Science will interpret a 'mystery' as an as-yet-unexplained phenomenon, whilst religion seems to protect mystery as a mystery, and would not want it explained, almost putting it off limits. (Paul Devonshire)

This set of questions pushes toward a deeper understanding of what "contemplation" might mean in science, and from where we might learn, or re-learn it. There are some very helpful and promising suggestions. Joshua Luke Roberts provides a lovely example from Huxley—writing like that witnesses to just the contemplative time, reflection, and long unrushed search for the right language through which to talk about science, that I have in mind as its contemplative practice and stance. Note carefully the "watching the process hour by hour"—how much time that scientists, or all of us for that matter, set aside for watching slow processes

in the natural world and reflecting on them. Boyle would most certainly approve.

But there is more. Here, Mary lin Raisch is helpful in pointing out an analogy with cubist art—the practice of holding different perspectives on an object at one and the same time. Huxley is doing this in real time by describing the visible aspects of the salamander egg in its early development and also creating and holding a mental image of the latent, potential animal, as well as the unknown present structures that must be present and hidden, which “code” for the later forms. Robert Grosseteste, the great thirteenth-century polymath to whom Rowan Williams referred in the discussion, put this aspect of contemplation in natural philosophy this way (he calls it “sollertia”):

Sollertia, then, is a penetrative power by which the vision of the mind does not rest on the surface of the thing seen, but penetrates it until it reaches a thing naturally linked to itself. In the same way as corporal vision, falling on a coloured object, does not rest there, but penetrates into the internal connectivity and integrity of the coloured object, from which connectivity its colour emerges, and again penetrates this connectivity until it reaches the elementary qualities from which the connectivity proceeds. (Southern 1986)

There is yet a third stage to this “contemplative methodology”—if I might term it so—that I am urging be recognized as more central and vital to science than it currently is. It is here that we come to the “insight” that I think (who can be quite sure with Lonergan?) lies behind the Jesuit philosopher/theologian Bernard Lonergan’s work (Lonergan 1957). When we spend a long time absorbing, paying attention to, a chosen focus of the world, perhaps through the perspective of a question, then accompany that with other material from the “periphery” of our attention, as discussed briefly by Rowan Williams (Watts, this issue), when all that is added to the mental imaginative re-creation of the unseen, hidden, structures that lie behind the perceived—then we might receive a token of “insight.” But although these glimpses into what really might make sense of the world are, according to Lonergan “two a penny,” the really worthwhile ones are not.

At this point the experience of the “wilderness” must come in. All of us must know the experience of trying everything we have talked about so far—the intense study, the attempt to find words, the adding of other ideas, the exercise of imagination—yet *still* the answer, the solution, the clarity of the way ahead, fails to materialize. We give up. We rest for a while, perhaps a long while. But our subconscious does not. When we are fortunate, a moment or rest the next day, week, year, or even decade (examples of all are recorded) allows the apparently effortless appearance of insight into our conscious mind (McLeish 2019). Those are the

little or not-so-little experiences that I was trying to urge scientists to share more publicly. There are examples everywhere (certainly in astronomy, Jack Martin, yes—but everywhere else too). Part of the reason that this takes time, I conjecture, is that scientific practice on its own is, paradoxically, not enough to generate the radically imaginative new ideas that intuit new scientific insight. Some of the material for these must come from elsewhere, including poetry, religious practice (from many traditions very possibly), music, exercise.... I researched and wrote about the commonalities in these experiences across the sciences and the arts and the humanities for the book *The Poetry and Music of Science* (McLeish 2019), and was astonished by the frequency I heard the same story of winning insight across all these disciplines.

The final experience of this story of insight feels like a gift at the time. That, in addition to the contemplative course through both focused attention and wilderness times, creates together a very strong analogy with religious contemplation. We might understand the reason for the story that Elizabeth Theokritoff gives us, or for the notion from Michael Faraday that Sunday was the ideal day for scientific experiments—the sabbath rest of our relationship with the world, perhaps?

SCIENCE CULTURE AND POLITICS

How does a democratisation and ‘poetising’ of science deal with the prevalent post-truth culture in which ‘truth is what I choose to believe’? (Andrew Jackson)

Science and religion/culture are each a birth right and common grounds or *lingua franca* among individuals. Esau either did not understand or value his birth right /lingua franca. While the Jacobs among us are happy to pick up the ball and run with it, what are we to do about our brothers and sisters who do not value what we value? Need we run away, go into exile, only later to appease and reconcile? (Dan Collinson)

On the subject of ‘layman’s science’, do you find encouragement in the growth of ‘citizen science’ projects? (Jennifer Brown)

I think I also agree with Prof. Ritchie’s point. In a world of science as contemplation, how would you draw the boundaries between science and pseudo-science? (Deepanwita Dasgupta)

Might some of the wider engagement in the science enterprise be stimulated by an appreciation of uncertainty? Science involves recognition and appraisal of uncertainty, as a dynamic process. (Andrew Briggs)

My MP chairs the All Parliamentary Group of Christian MPs. At a hustings event he confirmed his disbelief in human-caused climate change. He has previously disregarded opportunities to discuss his reservations with a local Professor with relevant expertise. How helpful is this with regard to public understanding of science? (Alan Ramagek)

These are deeply relevant and practical questions on hard-nosed consequences of the right (or the wrong) public framing of science. I could not be more ashamed, saddened, and frustrated to hear from Alan Ramagek of a Christian MP in a position of influence announcing against the weight of scientific evidence on climate change, and especially demonstrating an unwillingness to enter into dialogue with someone with expertise there. But taking up an opposed, moral high ground and casting anathemas is also not the way forward. We might recall the panel discussion with Dr. Richie, who helpfully pointed out the cherry-picked bits of science by which pseudo-science (like climate change denial) proceeds. The uncertainty to which Andrew Briggs draws our attention is important to discuss, and paradoxically perhaps, it is *through* an offered and open discussion of that uncertainty that the skeptics might be attracted into a center ground where there is something to play for. There is indeed a risk that in becoming more open with science allows those with prejudged conclusions to claim a sort of pretense to scientific justification, but the professional scientific community cannot pretend to be entirely innocent of confirmation bias, perhaps to a lesser extent. In any case, I would urge that this risk we must take, and learn to manage, rather than retain science in its professional closet.

The problem when science is not shared by the experts is that truth becomes, as Andrew Jackson reminds us, “what I choose to believe.” A more honestly shared *process* by which we come to know things, including the concomitant uncertainties, will, I believe, lead to less pseudo-science and anti-science, not more. Of course, I am not sure about that. But surely, it is worth a try?

PSYCHOLOGICAL AND MEDITATIVE CONSEQUENCES

It seems to me that contemplation is often viewed as similar to other states, such as mindfulness and reflection. Does the panel have any thoughts on the difference/similarity between contemplation, mindfulness and reflection? (Roger Bretherton)

The practice of *lectio divina* is very well known in dealing with the Holy Scripture. Is it possible to develop something analogical in dealing with the Book of Nature? (Frank Velic)

The original Sanskrit word for ‘mindfulness’ is Samyak Smriti—literally ‘complete memory’. (Deepanwita Dasgupta)

These insights might add some depth to the “hidden” or subconscious stages of insight that we discussed above. For the verification of scientific truth, there is a (relatively) clear method of approach, but for the deeper process of insight—the creation of fresh scientific ideas about the world in the first place, there is no method. The case of *lectio divina* to

which Frank Velic draws our attention, for example, contains the notion of reading from multiple perspectives. My own experience of science affirms that “reading” nature in just one way is typically insufficient to set create a pathway to insight and new knowledge. Perhaps, a more structured practice within science that drew on these traditions would be a way of instantiating the more recognized role of contemplation in science that I am recommending.

The more recent findings of cognitive neuroscience to which Fraser Watts draws attention in his contribution to the panel discussion (Watts, this issue) reflect the multiple sets of dual properties and modes of action that add detail to the summarizing dualism of “science” and “humanities” approaches. Iain McGilchrist (2009) warns against overdominance of either right, or particularly left-hemisphere brain activity. The entire arc of scientific programs is not contained in either close, symbolic, and analytic work (left hemisphere) or integrative, holistic, contextual (right hemisphere), but in the integration of the two. The neuroscience of meditation and meditators is itself still in early days, but there is accumulating strong evidence that regular meditative practice (which may include the extended periods of focused attention that science and poetry both require, as well as religious practice) are correlated with cortex development, and especially with the degree of cortical interconnection (via the corpus callosum) (Kurth et al. 2015). If true, this would, of course, be highly significant for the current discussion.

NATURAL THEOLOGY OF OLD AND NEW KINDS

What do you mean by natural theology? (James Fowler)

From proverbs 2:

indeed, if you call out for insight
and cry aloud for understanding,
and if you look for it as for silver
and search for it as for hidden treasure,
then you will understand the fear of the LORD
and find the knowledge of God.

And given the journey of the wise men—following the science (if you will)—bringing them to truth, a person—Jesus. To what extent is there a still a place for scientific truth leading directly to God? (Tim Craggs)

What Prof. McLeish is talking about—trying to see nature through God’s eyes—sounds remarkably like what the ascetic Fathers call ‘natural contemplation.’ And the formulation ‘seeing through God’s eyes’ helps explain why such contemplation is seen as requiring a prior transformation in ourselves. An interesting question is the extent to which a scientific engagement with the creation of which we are part can contribute to that process

of transformation—perhaps through deepening our awareness of our creaturehood? (Elizabeth Theokritoff)

Do you see it as an anthropological inspiration of the divine or merely seeing God within the confines of what you perceive nature to be? (James Fowler)

What is the methodology of looking with God into to the universe? Theologically, what are the spiritual disciplines of coming into alignment with the referent of God's gaze into the ever-creative creation as the birthplace of wisdom/understanding? (Kaley Casenhiser)

Kaley Casenhiser asks the key question—so how do we do this? With what spiritual disciplines? Her question makes me think that science itself might be the “spiritual discipline” that we seek, and that the answer is to recognize it as such, at least for those who practice it within a confessional calling. This may seem elitist and abstruse, but that is also, we recall, part of the problem of science currently—that it does not possess a “ladder” of engagement from the lay to the professional. Once that is added back in, then the enjoyment of knowledge of the world becomes a shared spiritual discipline. This response would also be consonant with Elizabeth Theokritoff's helpful pointer to the tradition of the ascetic Church Fathers. Gregory of Nyssa may, or may not, be usually identified with this group, but the intense way that contemplation of physical phenomena such as the flow of water against air, or the phases of the moon, align human with the image of the divine mind in, for example, *On the Soul and the Resurrection* is a helpful pointer (Schaff and Wace 1893).

I think that there are active and practical extensions of this, however. This is also implied by Tim Cragg's reminder from Proverbs, chapter 2, that Biblical wisdom is both practical, and lies (hidden) within the practice of science through its older name of “natural philosophy.” For example, churches are natural local and global agents of “creation care” as a result of scientific knowledge about anthropogenic effects on the planet. Kaley's own work at the Creation Care Collective is, I think, a very good example (<https://creationcarecollective.com/growingtogether/>). Her hint of an ingredient of the answer within her question—the “spiritual” discipline that corresponds to a co-creaturely gaze into nature—suggests another direction, that of the third person of the Trinity. It is not merely that we are created in God's image that allows us to invest meaning in this aligned, Divine gaze, but that we are “temples” of the same Spirit.¹ This is surely the guarantee for Coleridge's sanctification of the creative imagination as “little I AMs.” The point is made again by Malcolm Guite (2012) in contrasting Milton and Virgil in the connection, and disconnection, respectively, that they could claim with the foundational events of the distant past:

For Virgil writing the Aeneid, there is an unbridgeable gap between the urbane Roman poet and the events of the heroic age he is describing. But, when Milton comes to describe the Spirit of God moving over the face of the water in the beginning, he does so in the conviction that the very same Spirit is equally present in his mind.

Science becomes a Spiritual (with a large “S”) discipline in this light. Again, perhaps this helps us to see why there is a tradition in confessional scientists, from Copernicus to Faraday, who see doing science as a form of worship.

So, there are two ways in which we must respond to this extremely deep question: first I think is the step of *recognition* that science is (or can be) the spiritual discipline of being, in Coleridge’s words, a little I AM. Second, we need to let that insight drive a *transformation* of what science is, certainly for believers, but beyond us, the communities we affect. There is one, perhaps bold, suggestion that presents itself here that parallels Sarah Coakley’s analogous thinking into a *Théologie Totale*—a practice of academic theology that is *also* an act of worship and religious contemplation (Coakley 2013). Might we explore a “*Science Totale*,” a practice of science, even a methodology, that unashamedly includes practices we would affirm as worship, meditation, contemplation of a devotional nature *within* scientific work? At the very least, such new modes of approaching scientific reflection might open up new channels of imaginative creativity, in which the deep, even subconscious interplay of structures and dynamics of our representations of the world come together in new ways. It would also call on new sources of *desire*—energies that are necessary to drive all creative processes (McLeish 2019).

THE “NEW ATHEISM”

“Popular” science seems to be closely allied to a “new atheism”. Why do you think this is? (Gary Cliffe)

The way I look at it, science is a process; you make observations, and then develop theories — hypotheses if you like — to explain them (the World Around Us). Facts emerge, but the theories or new hypotheses are a human construct and in a constant state of flux. God doesn’t enter the process at all. (M E Bailey)

Doesn’t the conversation pantomime between the devout and the atheist need to be transcended? The crushing reality that ensues and the resulting understanding of the ‘nothingness’ that is exposed, this is the ‘something’ so powerful that can give meaning of life.

The internal monologue of the struggle with our ‘self’ which characterises so much of the scholarship from Aristotle to Aquinas and to the Enlightenment is not necessary.

I'm sure if Jesus was here right now, he would be saying: "You did what? You created what? A Church! No, No, that's not what I meant !!" As William James stated, a 'deflation at depth' is necessary for Humans to 'get out of the driving seat', in order to allow an understanding of the concept of 'there is a power greater than myself'. Discuss. (Andrew Meikle)

I wonder if M. E. Bailey helps to answer Gary Cliffe's question—he hints at the story, so often constructed in the "new atheism" (as well as the not-so-new to be honest), that the story of science is the story of a dawn-line slowly and inevitably traversing the world, replacing the darkness of "religious" explanations of the world with the light of scientific ones. Among many modern voices, a version of this idea lies behind August Comte's eras of civilization (Petit 2016). Of course, the problem with it is that it can only be supported by processing historical evidence through a cherry-picker already set to its color and size. It seems to me odd that it is ever claimed that fact of the ability to do science without a practicing belief in God is evidence of God's nonexistence. We do not claim this for agriculture, medicine, knitting . . . , after all. The sleight of hand here is to pretend that the "facts" of the world, "discovered" by science amount to all that there is. What we have been affirming in this discussion is that science, as all human activity, is *relational*. That relations between feeling, loving, fearing, suffering, and hoping beings exist, and between them and their material world, and that these relations require healing and care, is itself an observation that, while true, is not a scientific one. It is part of the framing of science. Rowan Williams (Watts, this issue) reminds us that we too often forget what it is to which we *choose* to pay attention. This is necessary to do science. It is necessary to achieve anything. But we should not forget that we are doing it, and that we need to pay attention to different things, and different aspects of the same thing, if we are to find the truth.

Andrew Meikle reminds us correctly that this exercise of taking multiple perspectives onto the world will involve a de-centering of self. This is another reason, in passing, that the *Book of Job*, is so relevant a foundation-text for the relational discipline that became science. However, I cannot agree that being the Church is not an appropriate response to Jesus. *Our* church may indeed leave a lot to be desired. But I believe that a radical community in which there is no male nor female, no slave no free, no Jew or Gentile, *that* sort of radical community that also "groans with all of creation" is to be the church that can affect the changes we have been discussing. For examples of the very positive changes in the way science is received and supported publicly when the church responds to this calling appropriately see the *ECLAS* project in the United Kingdom (<https://www.eclasproject.org>) or *Science for the Church* in the United States (<https://scienceforthechurch.org>).

EDUCATION

I tried as a middle school science teacher to excite my student's imagination. For example, I challenged them with the true statement of there only being one simple machine. Based on that information explain why there aren't eight simple machines instead of the six we are told about. Why isn't there a greater exposure to hermeneutics in education? (Richard Dube)

How could concepts such as creativity, imagination, joy of science, and their relation to Christian faith (looking WITH God) be combined into a module for teenagers at (UK) Sunday schools or (NL) midweek catechism sessions? (Jaap Den Doelder)

Talking about little leaps, can we have classic texts such as Faraday's History of the Candle, or Darwin's Origin of Species as readings on the Humanities side? (Deepanwita Dasgupta)

As an undergraduate scientist, "old science" seems full of poetry (Kekule's, Loewi, etc.) and a marvellously exciting process, while all the new fellows at my college just use machine learning or a set of bought assays!—is there hope for doing this excited poetic science even as technology advances? Google is unweaving the rainbow before we can look! (Ben Norris)

Might the ongoing and growing issue of Climate Change be a significant driver in persuading curriculum designers to move from their domain silos of separate subjects to a model where a range of disciplines are in respectful dialogue and bring their expertise to bear on the great existential threat? (Adrian Brown)

People like the panellists are part of the problem from a student's point of view—universities use A level & GCSE grades to accept students for their courses. Also, universities want the 'best' students! (Martin Bassants)

That experience of sudden 'insight'—the coming together of ideas when making connections and discovering congruence—is not exclusively an activity when reasoning across science and religion. Do you agree that what makes it so hard today for children in school—is that this activity of 'making connections' is excluded by the setup of the isolated science classroom. If yes—and if schools demand assessment—can we 'assess' ability to make connections? (Berry Billingsley)

I think the ladder analogy is really important. Climbing higher involves work and effort from a secure lower step. I have a concern that in science teaching we try to be inclusive by holding it up as 'easy'—with perhaps the accumulation of facts being the relatively simple and simplistic way to measure it. Do we need to get the idea across that you can have 'fun' as well as satisfaction from the hard as well as from the trivial. Not just in science, genuine thinking in any subject *is* hard as you need both knowledge and imagination (and thanks to Tom poetry!). And also challenging debate! (Chris Hudson)

In addition to what may need to be improved in teaching science in schools and universities, what could be done in seminaries and theological colleges

to improve the conversation and mutual learning between science and theology? (Guido de Graaff)

There are some wonderful examples of fresh, interdisciplinary, and radical teaching in these comments and questions that are worth simply sharing and celebrating, I think. I do know of some very successful science teaching that uses examples from the history of physics, for example, to teach the physics itself. There is every hope that, alongside a core curriculum of scientific knowledge, there will be room at every stage for an element of exploratory, even “playful” science, as Chris Hudson suggests, so that pupils will never have experience that would lead them to conclude that “science has no room for my imagination.” Berry Billingsley points to the experience of “insight” that may arise if this is done.

There is also a desperate need to develop post-16 curricula that do not “silo” young people into the strict A-level boxes against which Martin Bassants inveighs. Texts such as Faraday’s candle, or current political issues such as climate change, or the Romantic poetry of the rainbow are all examples through which humanities-learning students might be found ways to shape a dialogue of learning with science, and by which science-learning students might develop a maturity of language, writing, and history.

Finally, I am delighted to report in answer to Guido de Graff that, as part of the burgeoning cluster of projects that seek to explore both theological and practical ways in which the church can respond to science as a gift and vocation, rather than as a threat and distraction, there is a growing movement of “Science for Seminaries” projects. Often funded by one of the Templeton Foundations, weaving science naturally into existing modules in seminary courses, rather than as “bolt on” options, has been a successful model in the United States (<https://www.scienceforseminaries.org>) and now the United Kingdom (<https://www.eclasproject.org/science-for-seminaries/>). I have been teaching an annual “science and the church” unit for two ordination courses in the north of England, for example.

CHRISTIAN PRACTICE

Is part of the problem that Christians and many religious people have lost the art of contemplation? For example, Christianity in churches tends to represent God and what it offers as something to gain as if from a distance, rather than as closer to us than we are to ourselves, to half quote Augustine. To put it more epistemologically, Christianity has bought into the modern flip, in which truth is no longer thought to belong to the subjective realm, but the objective. (Mark Vernon)

What is the role of discursive reason, or “rational” intellect? In eastern traditions it is often seen as divisive and dissecting. That is, it understands by dividing into component parts. It is not a “clear” seeing but rather heavily

conditioned. Quite the opposite of “DIS-cove^{ry}”. In some sense this suggests that “imagination” is not an activity of the “self” but rather a quieting of the self. A move beyond conditioning into open awareness. The reason I ask is because as a scientist it seems the generation and imagination of hypothesis is too often confused with deep thinking which in turn is often quite the opposite of unconditioned sight. (Carlos Neira)

Especially in evangelical churches, contemplation is rather rare. The nearest opportunity, even permission, we get is corporate worship. In these same churches there is the alarming suspicion of science and the active rise of the tawdry conflict between science and faith, witnessed by the rise of heterodoxy of young-earth creationism. Isn't this a real and present danger to our Christian faith and witness? What coordinated steps can we take to provide resources to churches that actively include real science in the contemplation of corporate worship? (David Lee)

These comments and observations are so interesting, because they indicate that there is a forgetfulness of contemplation in (at least some) places in the church, as well as in science. As Mark Vernon suggests, this is not unconnected with the pretended dissection of subjective and objective that I tried to talk about in the lecture. Carlos Neira articulates beautifully the “in-betweenness” of contemplation in science that allows the generation of ideas rather than the routine of measurement and checking.

Perhaps, there are new avenues of prayer and spiritual contemplation that might be fed by the wonder of material contemplation? David Lee identifies some of the alarming consequences of theology and the church turning its back on science—the development of denialism and fundamentalism, what Rowan Williams has called a “faithless kind of faith.” It is also very damaging both inside and outside the church. Young Christians studying science can be psychologically damaged by the incompatible demands on them made by creationist church leaders, and the evidence-based science that they are learning about. And those seeking truth who might find it at the foot of the cross will never be allowed to get there if false but unscalable walls are placed in their way that reveal the church as publicly false, as Augustine famously warned (Augustine 1982, Book 1, chapter 19).

LESSONS FROM THE HISTORY OF SCIENCE AND TECHNOLOGY

Historians of science are also keen to think about practical science as well as what's sometimes thought of as ‘pure’ science. This involves awkward and apparently less spiritual things than Boyle talks about, such as money ... I wonder where technology fits into your account, and the practice of thinking/imaging with our hands? (Charlotte Sleigh)

Might I suggest (from my own experience) that Industrial Science (if such a thing is allowed as a definition) provides plenty of cases where awe, wonder

leads via creative technology development to results that might encourage the lay public in their faith in science. (Jaap Den Doelder)

Why do you think it was possible for early modern people like Newton, Boyle, etc. to transgress disciplinary boundaries (e.g., between theology and natural philosophy), in a way that we are not able to do in our society and universities today? (Pui Ip)

As both the lecture and the response tonight showed, there's a rich history of thought within the European Christian tradition that we can draw on to reclaim a contemplative, imaginative practice of science. If we aim to cultivate this kind of culture around science in multicultural societies with all kinds of complicated power dynamics at play, don't we need to cede some of our intellectual ground to thinkers from other traditions which have less of a stark divide between science and contemplation/religion in their recent history? (Jenna Freudenburg)

Religion and science have been so intertwined since the very earliest of days. Religion to understand ourselves and our creator; science to know ourselves in the great scheme of the Almighty. Why, how and when did religion and science become such "opponents" in the search for "truth"? When did the clear divide of what they are searching for become so blurred? The seemingly dogmatic argument in current times of "it is either science OR religion" ignores many beautiful characteristics of both disciplines. When will scientists and the public who proclaim every new discovery, by either disproving a former scientific statement or at least proving it not concrete as formerly claimed, as absolute truth come to realise it proves the opposite for the argument of science as the sole custodian of that trophy?

Ignoring the miracles of both leads to a far less enlightened world. (Matt Burrows)

Would you recommend the education of the medieval concepts of virtue ethics, development of habit to graduate students in the hard sciences? This education would include the practice and perfecting of scientific experimentation, interpretation, to the point that there is not only technical mastery and data interpretation, but also to passively let the data inspire us to generate novel scientific paradigms (to be Kuhnian). How would you paraphrase the medieval contemplative terminologies to contemporary science postgrad students? (Arvin Gouw)

John Keats' concept of 'negative capability' which has been given a more recent expression in popular culture thanks to Dust and the heroine Lyra's use of the alethiometer in Philip Pullman's *His Dark Materials'* trilogy (the irony of bringing these books up in a debate involving theology is not lost on me!) springs immediately to mind as having some possible bearing on the understanding of the contemplative disposition and how it opens us up and connects us to the universe. (Kersten Hall)

Jaap Den Doelder and Charlotte Sleight come at the question of technology from very different perspectives, and adding the essential historical insight into the entwining of industry and science, it is clear that we need

to reform our fragmented notion of “pure” and “applied,” just as much as we need to reconfigure and relate “science” and “humanities.” I am not sure that there are fundamental reasons why money, economy and industry should be less “spiritual” than science—we are the inheritors (in the West at least) of centuries of snobbism over the hierarchical structure within which philosophy and industry occupy an “upstairs” and a “downstairs,” respectively. That also needs to change.

As Jaap well knows—he is one of the great industrial scientists who taught me this (Read et al. 2011), there is every opportunity for healthy two-way flow of ideas in science between industry and academia. In fact, the fundamental piece of science on which we worked together—the relationship between the topological structure of branched polymers and the emergent properties of the viscoelastic fluids that they form—could only formulate its core-questions in the face of observations in an industrial setting. Yet they called on the deepest new imaginative work in statistical mechanics, which repeatedly called on exchange of samples, data, theories between university and industrial laboratories. Even more than that, I would claim that the project demanded the creation of a community of practice and trust that spanned disciplines and the normal public/private academic/industrial divisions. I am increasingly convinced that we ought to write that story up as a case study in how “pure” and “applied” dissolve! And Charlotte’s point about “thinking with our hands” is so very prescient—I think might open up new routes into contemplative practice in science and spirituality (e.g., I think of the “Messy Church” movement, <https://www.messychurch.org.uk>).

Pui Ip’s question is perhaps a little strange given that it is from someone, to someone else, who have both “transgressed disciplinary boundaries” in a way that he declares impossible (I do not claim for myself that I have done it successfully). But perhaps that indicates the answer: there *are* indeed institutional and cultural barriers to doing this; the rest is simply fear and lack of confidence. We live safely in our disciplinary silos of curricula, research topics, peer-review, professional organization, promotion criteria, journals, and so on. Quite a set of castle walls! But they do have doors in and people can walk through them. The more that do the better.

Jenna Freudenburg’s question turns our gaze not only on history but outside the Christian tradition, and is well-taken. There have perhaps been misguided or overinflated attempts in the past to relate, for example, modern physics to aspects of Eastern mysticism—I am thinking of *The Tau of Physics* (Capra 1975) and the like. But there is much more there of richness to absorb more gently. The “Ruist” tradition of China, for example (Berthrong 2003), contains clearer ideas of the embeddedness of human observers of nature *in* nature itself (the first of my four “turns”) than Western tradition, and poetry was always vital in Ruist cosmology, at the same time as clear a forerunner of science, and part of the same

historical tapestry of engagement with nature as the ancient Greek or Semitic texts to which we have referred.

At the same (tenth and eleventh century) time, the great Islamic tradition of science was preparing the critical assessment and development of Aristotle that inspired, of course, the twelfth-century scientific renaissance in the Latin West. There is much of relevance here to students today, as Arvin Gouw suggests. I might have developed, for example, the insight that emotion and reason go hand-in-hand in working within the liberal arts, including the mathematical arts of the medieval quadrivium (they termed them *aspectus* and *affectus*—see McLeish 2019). We need to teach our scientists not to be afraid of the emotional structure within the creative process of their work. And, equally ironically, Philip Pullman has (in Oxford theologian and contemporary of Darwin Aubrey Moore's words) "in the guise of a foe, done the service of a friend" in bringing a contemplative and poetic alternative framing of science.

I do not think we can simply fuse all kinds of "contemplation" into one without some more intricate reflection on what metaphysic and practice(s) attend different versions thereof. There are certainly family resemblances between all sorts of things in this area (secular cognitive therapy, Buddhist mindfulness, attention to "school studies," aesthetic "seeing" of art objects, scientific wonder at the natural world, and so on); but "contemplation" in the classic Christian sense does involve long-term commitment to particular practices of vulnerability and openness to God, including the enduring of inner "noise" and many psychic upheavals, and so on, en route to union with God. Above all, the major complication of sin cannot be left out of the Christian account of these matters, since sin—*ex hypothesi*—affects our senses and perceptions so profoundly. Hence, the great interest in early modern science (see, e.g., Peter Harrison's work in 2015) in whether science itself could overcome these sin problems.

In short, I do not think the rhetorical call to "contemplation in science" can, just by itself, overcome the profound issues of sin and blindness that those of us who are religious believe to be hugely problematic; nor can it short-circuit the commitments that much secular science has made to metaphysical adherences that stymie religious belief at the outset.

Having said that, I profoundly agree that learning how to "see" the world in the light of the divine infusion is the great invitation of Christianity, and hugely important to the scientific task too. But I fear there are no short cuts into this—which is why I am continuing to work intensively on "spiritual sensation" in the tradition and its many and conflicting interpretations.

NOTE

1. I am indebted to Rosie McLeish of Emmanuel College, Cambridge, for this point.

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