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Editor Martin Rogers

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SCIENCE AND CHRISTIANITY 3 SCIENCE, NATURE AND THE HUMAN SPIRIT

Kevin McCarthy

"The most beautiful experience we can have is the mysterious. It is the fundamental emotion that stands at the cradle of true art and true science. Whoever does not know it and can no longer wonder, no longer marvel, is as good as dead."

Albert Einstein

When you go out on a starry night in winter and look up at the heavens, what is your reaction? Do you see the twinkling stars and think of the light years separating them from us? Does your mind run to the magnitudes of brightness, the speed of the Earth's rotation, the immense nuclear reactions? Or do you gaze in wonder at the beauty of Creation? Is your heart filled with joy and a sense of mystery and reverence? We do not have to go very far back in history to find a time when these now mutually exclusive responses were undifferentiated. Even such a modern spirit as Copernicus was deeply sensitive to the wonder of creation:

*"In the centre of everything is the Sun. Nor could anyone have placed this luminary at any other, better point in this beautiful temple than that from which it can illuminate everything uniformly...Thus the Sun is pictured seated on his throne, ruling over the family of stars around him."*¹

Since early in the seventeenth century, encapsulated in Descartes' infamous declaration, we have been living in a dualistic universe, in which the intellect has been at odds with the emotions, in which science has been at war with religion. There is plenty of evidence to suggest that, as we move towards the end of the present age, a new complementariness is trying to emerge. In the greatest scientists, there has never been a dichotomy, as the quotation from Einstein above suggests, but it is clear that, if such a new harmony is emerging, its tones are not yet reaching the ears of most school pupils. It is the purpose of this paper to show how schools are continuing to perpetuate a scientifically out-of-date dualism, a divided thinking which provides an inadequate and partial picture of the world. I also hope to indicate both some general principles for a new synthesis and to provide some practical examples of how it might be implemented. Although I begin with science and focus for much of the time on its methods,

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what I am really concerned with here is the need to reconnect ourselves and our pupils with Nature as a source of wisdom, beauty and, most of all, spiritual truth. It seems to me to be a vital task of the age to restore a sense of oneness to children's experience, to show them that spiritual and scientific truths need not be at odds.

So first of all, what is the problem? In spite of the tremendous emphasis that has been placed on it in recent years, science fails to capture the minds and hearts of teenagers. In increasing numbers, they are turning away from its study post 16 and choosing other subjects. Yet at the same time there is an enormous interest amongst young people in all forms of environmental concern. Tiny tots draw attention to the waste of water in a running tap: nine year olds will tell you about the depletion of the ozone layer; teenagers are deeply concerned about pollution, animal testing. Programmes on television about remote, beautiful and threatened parts of the world attract huge popular audiences. In spite of some outstanding resources, notably those of SATIS (Science and Technology in Society), school science is somehow not perceived as related to these issues. Some part of the child is not being reached. The reason for this may well lie in the way in which science is being represented or mis-represented at school.

From an early age, children are introduced to a way of relating to the world which is given the special status of being called "scientific". Both at primary school and again at secondary transfer, this brings an initial sense of anticipation and excitement bordering on awe. For most children, however, awe seems to turn depressingly quickly into bore. This scientific method which, in the development of human thinking, is a very recent innovation demands first and foremost objectivity. In effect, we are saying to pupils, "To be real scientists, you must not allow yourselves to become involved in the experiment. You have to detach yourselves from what you are observing. What you discover are data: things which can be measured, weighed, sorted and counted. When you write

about what you have done, you must not appear on the scene: 'A test tube was taken....'. The passive detached note is the real voice of the true scientist. To discover the truth, you must be separate, unemotional, objective."

Real scientists, of course, have to perform experiments. They have to form hypotheses, which they then test in order to arrive at a theory. In order to satisfy Attainment Target 1 in the Order for Science, children as young as seven are expected to carry out investigations along these lines, ideally designing the "fair test" and controlling the variables themselves. A good example of this is an investigation of snails. To get the snails the teacher takes the class to some moist and damp corner at the edge of the school pond. Back in the classroom, the children are asked to explore the preferred path of a group of (presumably equally hungry, equally determined snails) as they negotiate a journey towards lettuce leaves placed equidistant around them. Between the snails and the food, however, are placed different and contrasting terrains: sand, ashes, blotting paper (imagine the effect of that on the snails' psyche!) and, of course, some damp soil. Not surprisingly, least of all to the children themselves, the intrepid snails shun the sand and head across the moisture to the waiting lettuce leaves. All this is watched, the progress measured, the times recorded. The whole process is then written up, the hypothesis confirmed. "It was concluded that snails prefer damp, moist conditions....." And the snails are, one hopes, in these enlightened environmentally correct times, safely returned to the damp, moist place from which they were taken in the first instance.

A similarly misguided spirit reigns in an experiment, beautifully photographed in a well-known "green" children's book on environmental issues. To demonstrate the toxic effect of acid rain, children are asked to take four identical healthy plants and to "water" them (the control plant being the lucky exception) with different concentrations of vinegar and dilute acid and to record the rate at which they perish.

Now all this is easy to ridicule but it all seems so limited. Small children have a much richer and wider response to the natural world and to allow as "scientific" only this peculiarly narrow way of experiencing the world is to do a grave disservice both to Nature and to the human spirit. It is wrong, too, because this kind of detachment, the playing with animals in this way, is liable to engender the wrong relationship with Nature. It separates us from the world and implies an unpleasant domination and manipulation of living things, as if they were no more than machines to be tested. Descartes used to slice off the end of live dogs in order to feel the pulsing of the blood. Is it really so alarmist to trace a similar mechanistic spirit at work in these latter day experiments?

Deeply embedded in school science is an out-dated mechanistic model of Nature. It is implicit in the experiments described above and it extends its influence, too, to images of the human form. The human body, for instance, is graphically presented in a peculiar style: the joints are drawn as high precision engineering; the eye is a camera; the ear a microphone and the brain a computer. The infinite complexity and beauty of the veins and arteries, for example, is shown exactly as if they were so many cables or wires, with the sheathing of the flex (the skin) stripped back.² We are machine men, random products of a chance universe, an irrelevant pollutant which the Earth could well do without. This is the depressing implicit and explicit message.

Yes, at the same time, there is a kind of scientific triumphalism in the text books, suggesting that there was once a time of ignorance and superstition during which mankind lived in ignorance, but "scientists now know...." or "science now tells us...", the implication being that little remains to be uncovered or explained. There is scant acknowledgement of the fact that "real" scientists, (ironically the very physicists whose mechanical model has been so enthusiastically taken up by the other scientific disciplines), stand in awe on the brink of particle

physics at the infinitely mysterious world that they uncover. There is a strange reluctance, for all the emphasis on investigation, to acknowledge the tentative state of all our knowledge. What is matter? What is light? What is the origin of life? How does the Earth regulate the composition of the atmosphere or the salinity of the sea at such a steady level? Such questions generally go unvoiced.

Science in school, too, seems to have very little interest in exploring or understanding its own history. It loses thereby, not only the opportunity to present some biographies of remarkable human beings, but also the sense of the impermanence of all our so-called certainties. This reluctance to own the unknown is reflected in the mission statement of science teaching, the National Curriculum Council's "A View of Science"³, where once more we find little mention of the unknown and no reference whatsoever to any element of wonder, mystery or beauty. The aim of teaching science would seem to be to enable pupils to "understand the function of machines and electrical devices, the effects of chemicals and drugs and the nutritional value of foods.." Children will need scientific literacy in order to "test advertising claims" and "deal with the issues of tomorrow", whatever that may mean. Is it churlish to detect a desperate groping for relevance in this strange grey-speak? What would a Renaissance scientist have made of this unintentionally bathetic *raison d'être*? There must be a deeper aim, surely, for introducing children to science than simply to produce better informed consumers.

I have spent some time characterising and perhaps caricaturing the current state of science teaching. To summarise: it is concerned exclusively with objectivity, with quantification with hypotheses and theories and models based on mechanistic assumptions. It treats the world as an inanimate product to be manipulated and explored. Above all it values clear, rational intellectual analysis.

Before going on to outline some of the ways in which science might open itself up, it is worth pausing to acknowledge that we all owe an enormous debt to this kind of science. It (or the technology that has flowed from it) has brought us vast improvements in medicine and agriculture and huge benefits in terms of creature comfort. There is little need, however, to spell out the damage which has come in its wake. Our children live in a world in which they feel threatened, not by nuclear extinction, but by the gradual deterioration and destruction of their environment. What they need now, more than at any other time in the Earth's history is a way of relating to the world which will enable them to care for it responsibly. The stark fact is that science teaching is not succeeding in this task. What is required, however, is not some Luddite rejection of science and technology, but a new opening up of science to complement, to make whole children's experience of the world. It follows from the description above that this "new" science will embrace and validate our subjective response to creation, our intuitive and imaginative insights. It will recognise and validate what Galileo relegated to secondary qualities: colours, tastes, impressions. It will accept that there is a genuine scientific path which rests on sensitive observation, allowing Nature's truths to speak and reveal themselves, as Goethe described in his long-neglected scientific works, and as Wordsworth echoed in Lyrical Ballads:

*"Think you, mid all this mighty sum
Of things forever speaking
That nothing of itself will come
But we must still be seeking?"*

This new science will have to interest itself in processes and metamorphoses, not least those of its own history. It will allow a spiritual, artistic and imaginative response to the world. In short, it will be a science of the heart and soul as well as of the intellect.

To approach the world of small children requires a recognition, almost entirely absent from current pedagogy, of the qualitative

difference of their consciousness. To put it simply, children see the world differently. They do not just have less sophisticated versions of our adult intelligence, but an entirely different mode of consciousness. To expect from them some dilute form of rational, objective experimentation is, at best, fruitless, at worst, damaging. As parents, we know that for the child of less than about nine, the trees speak to the wind; the animals converse freely both with one another and with sensitive humans; the processes of life are cared for by fairies, gnomes and goblins; plants smile; stars bow down; the sun is sad or happy. Even the comfortable distinctions we would make (or, perhaps, would have made prior to Lovelock's Gaia theory) between living and non-living things do not apply to children's consciousness. Many, for instance, understand fire and clouds to be alive.⁴ For many children, we are able to see by virtue of sight streaming out from our eyes. The world itself is filled with "a bath of light" and Nature, far from being "red in tooth and claw" in some Darwinian struggle for existence, actively co-operates to ensure balance and harmony. An eight year-old pondering the "out-breathing" of oxygen asks:

*"I wonder when the trees discovered they
could help us?"*

A nine-year old commenting on food chains in an eco-system observes

*"Because the birds eat the trees, there has to
be enough trees to feed the birds"*

Nature, for the young child is alive, purposeful, co-operative, accessible and communicative. We are perhaps reminded of ancient religions or of the culture of the North American Indians. Indeed, there is surely some sense in which infant school children pass through a phase of consciousness which is closely akin to the mythic or animistic stage of primitive cultures. They are twentieth century children, though, so what should our reaction be as teachers? The short answer must be, quite simply: Leave them there. It is a brief enough phase and one which

is vital to their development. We should leave them there and try, if we can to re-kindle from their glowing eyes the grey embers of our dull adult consciousness.

Far from seeking to deliver children prematurely, as it were into adult National Curriculum consciousness, we should feed their imagination with stories and myths, both from the past and from our own imagination. Perhaps we might consider something along the following lines:

*"Once upon a time, the Sun King
crossed the heavens daily, leaving his
Eastern Kingdom at dawn and crossing
the sky, looking down with joy at the
face of the green earth beneath. With
him went his daughter, Lucinda the
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The next night, she grew more bold and
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splendour, until at last, she was queen of
the night, just as fair and just as grand as
her father the sun....."*

The story goes on to show the pining journey of the pale moon through the morning lands in search of her lost father. Yes, it is geocentric and probably deeply sexist, but I think that it is a sound way of introducing children to one of the most accessible and endlessly beautiful processes, the waxing and waning of the moon. It does so, moreover, in a way which is entirely in keeping with the observable phenomena. The moon does appear higher, further from the sun and larger each evening and does wander the morning sky as it wanes. The point of communicating the facts in this way is that, in story form, the concept can be held pictorially, warmly and lovingly and, most important of all

in a mode (call it mythic or poetic) which is in tune with childhood consciousness. That such stories are potentially powerful, I have not the slightest doubt. As Rachel Carson puts it:

*"If I had influence with the good
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not half so important to know as to feel.
If facts are the seeds that later produce
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soil in which the seeds must grow."⁵*

The task, then, is to allow childhood its time and space and to try to enter it as adults with the same spirit of reverence as the child ("Unless you become as little children..."). We should draw them into the world through our love, not our knowledge and understanding. We need to cultivate our own sense of what is good and beautiful and mysterious in Nature. Point them towards the passing of the seasons. Celebrate the first snowdrop. Ask them to look for the bold new moon. And whatever happened to the nature table? A feather, a cone, a fragment of eggshell, a bird's nest, the skeleton of a mouse. All of these everyday objects are full of wonder and mystery or will be if they are seen with the help of an adult sensitive to their beauty.

Nourished in this way the child will reach the junior years in a more open and receptive frame. And what then? We need not abandon our stories, although we will almost certainly have to change their tone. In introducing geology, for example, without, in any way, losing scientific accuracy, we can enter imaginatively into the processes which must have shaped the embryonic Earth and describe that still young, teeming, unformed mass of ocean, barely differentiated from the land, with its heaving and shifting, its raising up of whole continents. Or, we can picture the still-flowing metals, the gold and silver, the copper and iron flowing literally like the "veins" of the Earth's body. Gaia, as the Greeks called her, has a life story.

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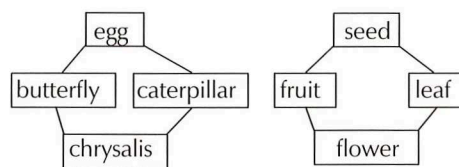
Nourished in this way the child will reach the junior years in a more open and receptive frame. And what then? We need not abandon our stories, although we will almost certainly have to change their tone. In introducing geology, for example, without, in any way, losing scientific accuracy, we can enter imaginatively into the processes which must have shaped the embryonic Earth and describe that still young, teeming, unformed mass of ocean, barely differentiated from the land, with its heaving and shifting, its raising up of whole continents. Or, we can picture the still-flowing metals, the gold and silver, the copper and iron flowing literally like the "veins" of the Earth's body. Gaia, as the Greeks called her, has a life story.

She is old now, tired and worn. She needs our help. Again, primitive spirituality can supply us with potent, poetic and yet scientifically sound images, like those of Chief Seattle:

"Teach your children that the Earth is our Mother. Whatever befalls the Earth, befalls the sons of the Earth.... This we know. The earth does not belong to man; man belongs to the Earth. All things are connected like the blood which unites one family."⁶

Introduced thus, the study of the igneous, sedimentary and metamorphic rocks; the shifting of the tectonic plates; the coming and going of the great Ice Ages can have something of the emotional drama of a biography. It also brings to the work an essential element of reverence and awe, a spiritual dimension otherwise lacking.

Another characteristic of new science, to which I alluded earlier was a renewed emphasis on process and metamorphosis. Once we begin to think of the Earth, and for that matter, plants and animals, as actually alive, then we necessarily begin to employ a new vocabulary. At secondary level, a good deal of biology is quite rightly concerned with life cycles. We are all familiar enough with diagrams such as these:



These stages can all too easily become mechanically memorised, as if there were no connection between each stage. Young teenagers are astonishingly unaware of natural processes and need, before anything else actually to open their eyes to the phenomena, simply to be taught to see and observe more clearly. (I will return to this when I speak of the place of art.) What is really interesting in these diagrams, though, is not the boxes, but the lines. Endlessly beautiful though the butterfly may be, a vast mystery lies in the transformation in the tomb of

the chrysalis. The form of the grubby, wriggling earthbound caterpillar is dissolved and gives way to the delicate, airy fragility of the butterfly. The same goes for the bee hive, where an extraordinary wisdom reigns, controlling the balance of the drones and workers, the foragers and nurse bees. The great Belgian poet and naturalist Maurice Maeterlinck provides an ideal account of the mysterious self-regulatory spirit of the hive in his "Life of the Bee"⁷, written in passionate poetic and yet strictly scientific prose which should be required reading for GCSE. Not to pause in a moment of awe and wonder in the face of such a miracle seems a denial of an essential aspect of the experience. What is mentioned here about the insect world applies equally to other cycles.

How much of the essential nature of water, for instance, do we miss by confining ourselves to its chemical quantities its "H₂Oness". Mention water and the imagination runs off into its myriad manifestations: as mist, frost, ice, lake, stream. Its living movement gives rise to compellingly complex and intricate forms in sand and cloud; its creatures, the jellyfish, snails and shell-fish are formed by its flow. All human cultures have held it in special regard as a religious symbol; cleansing, healing, dissolving, life-giving. It is more than a poetic fancy to describe water as the life-blood of the living earth, pulsing, eliminating, carrying nutrients to furthest reaches. In each of its manifestations, right down to the miracle of its anomalous expansion, water maintains the life of the Earth. We should be able to encompass all these facets in an expanded curriculum. In this way, and perhaps only in this way, we may be able to engender a deep-seated, loving relationship with nature, which is essential both for the Earth's survival and for our own spiritual well-being.

What, in practice, are some of the ways in which this reawakening of love can take place? How can we provide young people with experiences which will affect them, touch them, move them? We have yet to look at the role of other disciplines and space will permit only a cursory glance here. One of the greatest gifts we

can offer the young is the ability to watch. Really to see, rather than glimpse; really to observe rather than glance: for all sorts of reasons, this would seem to be a rapidly diminishing human capacity. Yet it is one of the hallmarks of the experimental scientist, of the poet, of the artist and of the mystic. For young people of all ages, it should not be difficult to provide periods of intense, quiet watching. One spring, I sent a class of fourteen year olds each week for a month to the nearby park to draw or paint their own chosen branch or twig and to catch in words the changing gesture and appearance of the unfolding bud. This was almost literally eye-opening. Art and literature are essential elements in this process. No matter what their ability, all pupils deserve the chance to explore and develop their feeling for the world through their own artistic or poetic experiments. The great artists also provide an infinite richness of material. Durer, Michaelangelo and Leonardo offer anatomical accuracy combined with a profound respect for the human form. Turner can provide another dimension for the study of light. Goethe, Thoreau, Wordsworth, some of the medieval mystics and a host of other writers have seen the world through spiritually awakened eyes and can lead us towards similar intuition.

A direct, first-hand relationship with Nature does not require a field trip to distant places. On the doorstep of most schools, there is abundant opportunity for such precise, loving, observation. If occasion allows, to venture into the heart of a great forest or to some wild landscape can be a life-changing, transforming experience. It need not only provide the raw data for a quantitative study. One of the saddest aspects of the humanities today is the way in which they have been infected with the same grey spirit of counting, measuring and weighing and all the trappings of pseudo science. There is a real fashion at present for the geography field trip to concern itself exclusively with a hypothesis testing exercise which involves calculating the angle of the banks and size of pebble at different points of beautiful Welsh streams. What richness of experience passes unacknowledged? What opportunities are missed? What spiritual

awareness would we develop in our pupils if we allowed field trips to contain an element of pilgrimage; a time for silence and listening; a time for reflection, for drawing or writing.

I cannot finish without saying something about trees, Nature's wisest and most eloquent spokesmen. I went recently to Wakehurst Place in Sussex. Below the house there is an outcrop of sandstone, quite different in quality from the rest of the landscape with ancient yews and holly twisting and insinuating their roots across the weather worn rock. Like all such special places, it is quite difficult of access and at first all attention must be focused on footholds. Then, quite suddenly there comes a series of little openings, damp, shady and yet possessing a deep power, silencing chatter, sending a shiver of anticipation along the spine. On the face of the sandstone are whole valleys of ferns and mosses, with here and there minute forests of birches which have somehow rooted themselves in a bonsai landscape; the living history of botany, with the "soil" of eroded rock and dead plant matter visibly in process of formation. And over the whole scene the brooding intense stillness of a sacred grove. Emerging from this experience (teacher to my roots!) I asked myself, 'Where does such experience fit in on the timetable?' I imagined the scientists there, counting the species and measuring the humidity, but that would not be a complete experience. Or, perhaps the art teacher might bring a group to draw or paint, but that would miss something, too. Just conceivably, an enlightened R.E. teacher, in search of an English bodhi tree might wander this way with a class. Somehow, the wholeness of this experience needs an education which embraces all three of these aspects. Art, science and religion seem infinitely distant from one another in the current educational landscape. And at what cost?

Most of this paper has addressed itself to science and its need to open itself up to direct, as well as imaginative, experience of the living power of Nature; to allow a qualitative, affective response; to focus on processes. Still to be fully explored is the corollary, the mirror image of this

account, looking at the role of R.E. There is a close parallel between, on the one hand, science and religion (in its denominational sense) and, on the other, nature and spirituality. The former represent all the power of amassed knowledge, the map of the known strength of orthodoxy and authority. In many people's minds, the words "spiritual" and "nature" conjure up a very different image; something first hand, authentic, untrammelled by rules and preconceptions; the real territory not just the map; living experience rather than report. Some R.E. teachers, taking their lead from the work of David Hay and others connected with REEP (Religious Experience and Education Project) are exploring the experiential dimension of religious education, finding ways in which to provide pupils with direct access to the sorts of feeling which characterise spiritual experience. There must be ways in which this kind of pioneering work can connect with a new science curriculum.

For there is, or could be, a great deal of common ground. Each subject has the opportunity of offering pupils direct, felt experience of the natural world in the ways outlined above. In doing so each can lead children in the direction of the divine. Taking the step towards belief must always, of course, required an individual act of faith. Still, nourished by a new awareness of nature as process, fired with the sense of human significance and purpose, pupils can potentially come simultaneously through their science and R.E. to a sense of God, not as some remote seventeenth century watchmaker who set the whole machine in motion, but as a God of our time, deeply involved in the Earth, in us and in all creation, suffering with us all the pain of change and evolution.

As we move into the next critical phase of the Earth's biography, knowledge and skills, facts and theories whether in science or religion will not suffice. The Earth is calling out for a new generation who care for her in the way that Chief Seattle describes, who are fired by love to take responsibility as only we humans can for cherishing our Mother in her old age. This is no

call for some romantic return. Sons and daughters of Adam and Eve, our children's eyes are open. They no longer live in an Eden of innocence or ignorance. They look to us to guide them into a new relationship with the world.

The crisis of science education, then, is, at heart, a spiritual crisis. It is a subject looking for its lost soul. A new science is emerging and a new spirituality, too, and after their three hundred year separation, they are each beginning to see that they have, after all, a lot in common. They have shared roots in direct, living experience of the divine wisdom of Creation. This movement is still in its infancy, but is nurtured by some of our finest minds.⁸

There is work to be done now restoring and healing the divisions we have allowed to develop. The Earth is calling for it; our children deserve it.

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