Science as Allegory

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The universe is God's choral poem, and mathematics is its rhyme. That is the thesis that I propose to expound and defend. Yet it is not a “thesis” at all, if the word “thesis” commits me to a certain kind of strict logical defense. I am not putting forward my thesis that mathematics is the rhyme of God's universe-poem as the endpoint of a deductive or inductive argument. Rather, it is a springboard for a program of exploration and reflection that turns upside-down some conventional ways of thinking about mathematics.

1. Open-endedness of metaphor

I don't exactly envision myself as repudiating the bulk of what has been said about philosophy of mathematics. Nor do I repudiate what I have written about the classification of the sciences and their relations to one another in Philosophy, Science, and the Sovereignty. of God (1976). But I have gone on an intellectual odyssey since the days when I taught mathematics. The odyssey has brought me to the place where I am less interested in explaining everything by assigning it to its pigeonhole. I am more interested in asking some questions and setting in motion a train of thinking that will “shake things up”. I have developed a considerable sympathy, if you will, for an approach like that in Wittgenstein's Remarks on the Foundations of Mathematics (1967), where things that we usually take for granted seem to become mysterious once more.

I have divided the course of my exposition into two parts. The first deals with the larger picture: the relation of mathematics to the sciences, and of the sciences to the whole of life. The second part deals with mathematics more in its own right. In both of these parts I shall be presupposing faith in the Christian God, not trying to persuade non-Christians to have such faith. In fact, I am not even trying to persuade Christians so much as to entice them.

Let me proceed, then. First, the universe is God's choral poem. I intend in saying this not to provide the ultimate key to the texture of our world, but to invite the use of a perspective. I want to stimulate your thinking and mine by the exploration of a metaphor and what it suggests.

2. The world personally structured

I have chosen this metaphor for several reasons. First and foremost, I wanted to suggest thereby the exhaustively personal character of the world that we live in. The world is a personal home for man, individually and collectively, because it is the product of the creating activity of our personal God. God who is an infinite person created the world and sustains it as a home suitable for men as finite persons. Christianity (along with its heretical sisters Islam, Judaism, Mormonism, etc.) is alone among religions in its insistence on a personal absolute. Polytheism has personal gods who are not absolute in their sovereignty. At the other extreme, Vedantic Hinduism, pantheism, Platonism, and the like have an absolute, all right, but the absolute is ultimately impersonal. Even among "Christian heresies," Mormonism is in danger of losing the absoluteness in a plurality of gods, while Islam and modern Judaism are in danger of losing personality in an abstract fate or legalism.

Modern scientism, if I may thus label it, is no better off within this pantheon of religions. The values of scientific method and technology have become ethical absolutes; physical law is the metaphysical impersonal absolute. These are absolutes, but they are ultimately impersonal. Hence, to sinful man's relief, they do not threaten to call him to account for rebellion, ingratitude, selfishness, or oppression. Modern man has made impersonal whatever absolutes he has left, because he has a guilty conscience. He is in flight from God.

I claim, then, that underlying much of the day-to-day work of modern science, there is an atmosphere, often only implicit, often unconscious or only half-conscious, of presupposing absolutes that are impersonal. The effects are more wide-spread than one might first suppose. When an American gets sick, he runs to the drug store or the doctor. As a second thought, if at all, he prays or runs to his pastor or church elder. Why? Partly, I suspect, because he has been educated to think that sickness is a biological process subject to undeviating impersonal laws. With respect to these laws, prayer is irrelevant. In practice, therefore, James 5:14-15 has ceased to exercise a controlling role in his life. This is but a tiny example of a pervasive problem in our culture. People sense that God has vanished from modern life. In the "important" decisions God is irrelevant, because what happens, happens under the control of the impersonal laws uncovered by natural sciences and social sciences.

Let me say briefly that I do not believe in such impersonal laws. There is no machinery, mathematical or otherwise, behind the visible phenomena of everyday life, holding everything in place. It is not machinery or Maxwell's equations that makes the universe tick. It is God. God rules the universe directly (cf. Ps. 104:14). God is so consistent and regular about it that we can plot his activity with mathematical equations. Let me put it another way. God rules the universe by his word (e.g., Ps. 33:6; Lam. 3:37-38). Because his word remains faithful and stable (Ps. 119:89-91), the doctor can act effectively and the drug we take has consistent effects. Elsewhere I have already defended this viewpoint of God's involvement in the world at some length (Poythress 1976). Because it is so alien to the thinking of modern man, I wish that I could take some time here to defend it again. But it seems to me more profitable at this time to develop my metaphor of poetry. As I develop and unpack the metaphor, you will perhaps be able to see how the predictive and integrative power of scientific laws is in fact a consequence of God's consistent involvement in ruling the world. "Law" is a personal regularity of action.

3. The world as linguistically structured

With the metaphor of poetry I achieve a second result. I invite us to consider the universe as language. Speaking, thinking, communicating, planning, proposing, commanding, understanding, and so on, are all deeply personal activities, and all are intertwined with language. The Bible invites us frequently to view God's activity from this point of view. God is the great king, ruling his realm by issuing verbal commands. Psalm 33, reflecting back on the account of creation in Genesis 1, summarizes thus: "By the word of the Lord the heavens were made, and all their host by the breath of his mouth" (33 :6). "For he spoke and it came to pass. He commanded, and it stood forth." (33:9).

Using one metaphor or perspective on God's activity in the world, we may say that everything that God does, he does by speaking. “Who has commanded and it came to pass, unless the Lord has ordained it? Is it not from the mouth of the Most High that good and evil come?” (Lam. 3:37-38). God's speech, of course, is not simply identical with the result in the created world. The trees, animals, and man himself are not a part of God, or a part of God's word, but rather a response to his word. Nevertheless, the response definitely corresponds to what God specifies. It matches. “God said, ‘Let there be light,’” and there was light - not a unicorn! The created world, as a result of God's speech, bears within it from top to bottom a kind of quasi- linguistic character. The created world is not a language in a narrow literal sense. But can we say that it is language-like in its structure and properties? Can a metaphorical or “poetic” extension of the idea of language illuminate the character of creation? Well, through God's act of creation, things in the world themselves become wordless voices to the praise of God. “The heavens are telling the glory of God, and the firmament proclaims his handiwork” (Ps. 19:1). The created universe may be thought of as a poem, embodying as a created thing the impress of God's kingly words of command, “Let such-and-such be so”. Creation is, metaphorically speaking, a “language” answering back to God's creative word. Or, better, individual created things are choral participants in a many-authored poem, with God as choirmaster.

4. The world shot-through with metaphor and analogy

Using the metaphor of the universe a poem has a third benefit. Namely, it draws attention to the pervasiveness of analogy and metaphor built into creation itself. Man, for one thing, is made “in the image of God”. Man is a metaphor for God, if you will. Man represents, on a created level, an analogue of the uncreated God. He lives, speaks, thinks, plans, makes moral judgments. God likewise lives, speaks, thinks, plans, makes moral judgments. But God is the source and standard for man in every respect, so that the two can never be equated. If man is a metaphor for God, the animals and lower creation are, perhaps, in certain ways a metaphor for man. Hence in the parables Jesus can take lessons from the growth of a seed or the lostness of a sheep and apply them to the human situation.

The universe is a poem, then, shot through with metaphors. As in any good poem, the metaphors interlock and form multidimensional patterns that enrich the mind by their richness. And man is a poet. He is a poet in the image of the great Poet-Creator. In "listening" to the universe as God's poem, he hears a chorus of voices: the voice of each created thing, and, corresponding to them, the original voice of God to which they are a response. So his interpretations of the great Poet's poem are in turn metaphors for the Poet's thinking.

I do not know whether what I am saying seems to you closer to serious philosophizing or closer to a free and rather fanciful flight of imagination. There was a time when I would have been prone to write off the above exploitation of a metaphor as not only imprecise (which it is), but fanciful, fictional, and therefore ultimately useless. I don't think so now. I agree with the theoreticians who advocate an "interaction theory" of metaphor (I. A. Richards 1936, Max Black 1962, Paul Ricoeur 1977, Marcus Hester 1967). According to this view, metaphor juxtaposes two domains of thought, and by so doing sets in motion a complex interaction of those domains that opens up a new way of looking at the world. I am trying to do this by saying, "Look at the world as God's choral poem". So bear with me.

I have said that man as the image of God is poetic interpreter of the poetry in creation. The scientific enterprise forms one aspect of this interpretive task. In fact, science can largely be understood in terms of work in creating, developing, exploring, testing, extending, modifying, enriching, and sometimes discarding a special species of metaphors, namely models.

What do I mean by a model? Well, let me start by defining metaphor as the genus. Model will be a species within the genus. One way of defining metaphor is to say that a metaphor is a piece of discourse that brings together and juxtaposes two distinct spheres of life, inviting us to explore the connections and analogies between them. Following Max Black (1962:38-47), we may label the topic or sphere of life about which the speaker wants to comment the "principal subject". The sphere of life juxtaposed with this in order to make the comment, we label the "subsidiary subject". Consider the metaphor is Hosea 10:11, "Ephraim is a trained heifer that loves to thresh". The principal subject is Ephraim, designating the northern kingdom of Israel. The subsidiary subject is agriculture, and more specifically the use of young cows in agricultural work.

Now a model is a special kind of metaphor where a detailed, <u>controlled</u> correspondence is set up between two spheres. The "principal subject" of the model is the thing or process in the world that is being modeled. The "subsidiary subject" is the known, easily manipulable thing used to do the model<u>ing</u>. The word "model", in fact, is often used to denote primarily the subsidiary subject; the principal subject then remains in the background. Models can be physical (a scale model of a ship), mechanical (pipes with water in them to represent electrical current; billiard balls to represent the molecules of a gas), or mathematical (Maxwell's equations).

Contemporary philosophers of science disagree about the role of models in science, and about whether models are theoretically dispensable. As you may guess, my sympathies are with those who see models as playing a vital and indispensable role (see Black, Kuhn, Hesse, Turbayne). I suspect, moreover, that it is impossible to have an effective mathematical model of something without having some "richer" context of interpretation to guide the creative use and application of the mathematics. Thus the Schrodinger equation is thought of as describing a density wave, and the operators in quantum mechanics are labeled suggestively to correlate them with idealized measurements.

I realize that scientific description and poetic description are often thought of as diametrically opposite to one another. But I am not the first to have suggested that they are both instances heavily exploiting the potentials of metaphor. The distinctiveness of scientific description is largely the distinctiveness of its special species of metaphor, the model. I have said that a model is a controlled metaphor, setting up a detailed correspondence. In fact, I believe that controlled, detailed correspondence is a matter of degree. There is a continuum, if you will, between science and poetry.

Moreover, in the early stages of the development of a scientific theory, the root metaphors being used are less controlled. Only over the course of at time do the scientists learn how to specify in detail those aspects of the subsidiary subject which are relevant to the model, versus those aspects which are irrelevant. In this connection, Max Black (1962:226) quotes some illuminating passages from the reflections by James Maxwell on the development of electromagnetic theory.

> The results of this simplification and reduction of experimental results may take the form of a purely mathematical formula or of a physical hypothesis. In the first case we entirely lose sight of the phenomena to be explained; and though we may trace out the consequences of given laws, we can never obtain more extended views of the connexions of the subject. If, on the other hand, we adopt a physical hypothesis, we see the phenomena only through a medium, and are liable to that blindness to facts and rashness in assumption which a partial explanation encourages.

The "blindness" and "rashness", I might point out, relate to the fact that the investigator is likely to overlook anything which his physical model leaves out, and to deduce consequences from aspects of the physical model which later prove to be disanalogous or irrelevant to the facts (the "principal subject") that it is intended to model. What will later be a strict "model" is at the beginning still an uncontrolled metaphor.

Maxwell continues:

> We must therefore discover some method of investigation which allows the mind at every step to lay hold of a clear physical conception, without being committed to any theory founded on the physical science from which that conception is borrowed, so that it is neither drawn aside from the subject in pursuit of analytical subtleties, nor carried beyond the truth by a favourite hypothesis. (Black 1962:226 from Maxwell 1890:155-156.)

For electromagnetic theory, Maxwell adopts the model of a frictionless fluid.

> By referring everything to the purely geometrical idea of the motion of an

> imaginary fluid, I hope to attain generality and precision, and to avoid the dangers arising from a premature theory professing to explain the cause of the phenomena. (Black 1962: 226-227 from Maxwell 1890:159-160.)

Maxwell's "generality and precision" arise from the power of the metaphor of a fluid to suggest a whole system of deductions. Using the metaphor of a fluid, a detailed correspondence is being set up between the mathematics on the one hand and electromagnetic phenomena on the other. Maxwell also speaks of the "dangers" of a "premature theory" to warn against extending the analogy beyond its proper sphere. He did not envision that we should ask about the heat, weight, color, boiling point, etc., of this fluid, as we might ask about an ordinary fluid. In the end, it is Maxwell's completed theory as a whole that specifies just what aspects of ordinary fluids are relevant. These aspects, and these alone, are to be used in reasoning about electromagnetism.

But a model always remains somewhat open-ended. Scientists are free later on to modify judgments about which aspects of ordinary fluids are relevant to electromagnetism, and what way they are relevant. For example, it appears that Maxwell himself, and Lord Kelvin even more, believed that electro-magnetic fluid (ether) defined motion and rest with respect to itself, just as ordinary fluid did. It remained for Einstein to challenge this aspect of the older model. And by proposing the interchangeability of mass and energy, Einstein also showed that the concept of weight, thought to be irrelevant by Maxwell, could be applied to the electromagnetic field.

A scientific model, then, is a kind of metaphor. It is an extended, controlled metaphor, selected out from the giant system of metaphors which is the universe, created by God as his poem. An extended, controlled, detailed metaphor is an allegory. A scientific model, therefore, is an <u>allegory</u> within the universe-poem. It is poetry choosing the allegorical mode of expression.

Science as allegory? Why should that sound odd? I'm not sure. It makes sense. A model is an extended, controlled, detailed metaphor, that is, an allegory. But what makes us think that science and allegory are not the same thing at all? I would suggest three possible reasons.

4.1 Prediction

The usual type of allegory has very limited, if any, predictive value. The allegorist puts a story together on one plane (the subsidiary subject) in text order to express truth on another plane (the principal subject). But stories in general <u>could</u> be put together in many other ways. The story is "artificially constructed". Yet isn't it true that Maxwell's fluid is also artificially constructed? For instance, Maxwell had to specify that the fluid was "frictionless". Moreover, the best of allegories do give insight about their principal subject (not <u>just</u> entertainment and repetition of what is known).

4.2 Difference in choice of subsidiary subject

Second, allegories typically use as their subsidiary subject stories about "ordinary life" focusing on persons and personal interaction. Contemporary scientific models, by contrast, typically use mechanical and mathematical models. This, perhaps, is getting closer to the points of most striking of difference. The abstract simplicity of scientific models makes them a more be a fitting starting point for controlled prediction. Yet the differences here can be exaggerated. Is it possible that an allegory like Pilgrim's Progress might be quite useful in giving insight on the basis of which to make psychological predictions about responses to the Christian message?

4.3 Value

Third, what about the question of reality? Does the modern West perhaps tend to think of scientific models not as models, metaphors, analogies of "reality", but as reality itself? The oddity of calling science allegory may be partly emotional. Allegory is today out of fashion. It is "mere" fiction, a "mere" idle imaginative fancy. Science, on the other hand, gets us to the rock-bottom truth about the nature of the universe. Haven't you been told that the sun "really" doesn't rise? That tables are "really" not solid, but dry bundles of protons, neutrons, and electrons surrounded mostly by empty space?

Well, I disagree with this modern viewpoint. I think that sciences furnish us with a set of useful analogies or allegories, not with "reality itself". Scientific models provide one perspective on the world, a highly useful perspective for certain limited and well-defined purposes. The "metaphors" of science do "hold true" to a large extent. As such, they truthfully describe aspects of the universal choral poem. They provide true statements about the world. But science does not provide the only kinds of metaphors or the only "true" perspective. I maintain, moreover, that the sun does rise and that tables are solid. People who think otherwise, under the influence of a so-called scientific worldview, are mesmerized by the power and impressive achievements of an allegory.

All this I say to provoke some reflection and reconsideration. But before you try to refute me or write me off as a medieval throwback, pause to consider, I think I can refute scientism, whereas scientism cannot refute me. First, scientism cannot refute me. I quietly accept all the triumphs of scientific explanation and technological invention as so many evidences of the coherence of God's choral poem. God has been careful and consistent in the construction of these allegories, and so we can use them to predict and invent.

On the other hand, I think that it is possible to refute scientism. That is, it is possible to refute the sort of view of the world naively thought to be implied by the discoveries of modern science. Ludwig Wittgenstein has already pointed the way. His argument goes as follows. Tables and such are paradigm cases of what it means to be "solid." One destroys the rules of the "language game" for the word "solid" if one forbids its use in the context of tables. Likewise, though the rising of the sun is perhaps not exactly a paradigm case of "rising," it is close enough to a paradigm to make problematic the meaning of "rising" when we start tampering with the "naïve" language about the sun. Now, atomic physics and solar astronomy are specialized "language games" parasitic on everyday language. To use them to abolish everyday language - or the potential for infinite varieties of metaphor - is to destroy the foundations of intelligibility. As Wittengenstein aphoristically put it, "I must not saw off the branch on which I am sitting" (1958 :27, #55).

Am I quibbling here? Does it really matter whether I treat a scientific model as gospel truth or as fruitful allegory? Well, it matters to me that we become aware of the fact that there are many <u>other</u> metaphors, along side of the standard ones used in current scientific models. These metaphors can be a source of insight and creative thinking. True statements can also derive from the stimulus provided by such alternative metaphors.

But it matters to me for another reason as well. To view the world ultimately in terms of the models of modern science is to view it ultimately mechanistically, impersonally. We too easily slip into a virtual denial of God's presence. The Bible's own presentation is different. God is the chief "reality" with which to reckon; he is the center of things.

There is yet another factor to consider, related to the hierarchical structure of creation. The cosmos, according to Genesis 1, is created with a certain hierarchical structure. The first three days of creation present us with the unfolding of three realms of activity, each including polar contrasts: (1) light and darkness, (2) heavenly and earthly waters, (3) sea and dry land, with vegetation on the land. The last three days present us with, "rulers" over these realms (though the correspondence is not perfect). (1) The heavenly bodies have charge over light and darkness (Gen. 1:18). (2) Birds and fish have charge respectively over heaven (1:20, 28; but cf. 1:22) and waters (1:20). (3) Land animals have charge over dry land and vegetation (1:30). Crowning all is man, created to have charge over everything under heaven (1:28-30). One can plot out a hierarchical structure roughly as in display 1. The lower orders find their explanation and purpose in their service to the higher.

Display 1

Hierarchical structure in creation, according to Genesis 1

GOD

MAN

Last three days:	Heavenly Bodies (sun, moon, stars)	Birds, Fish	Land Animals
First three days:	Light and Darkness	Heavenly space (e.g., clouds), Earth, Water	Vegetation, Dry Land

But modern science, or at least modern "scientism," dreams of completely reversing their hierarchical order by explaining not only animal life but man himself in terms of paradigms taken from the inorganic realm. Starting with mathematical or mechanical elements characterizing rocks just as much as men, it proposed to articulate the laws governing men. Man the personal is subjected to the impersonal in inanimate "laws," rather than subduing the impersonal and inanimate under himself.

But why not say that, instead of impersonal laws, what we have is the personal faithfulness of God (e.g., Jer. 31:35-36, 33:20)? Why not indeed imagine that when the winds blow, it is because God sends the hosts of angels to make them blow (more or less after the pattern of Ps. 104:3-4, cf. Heb. 1:7, Ps. 18:10, Ezek. 1:4ff)?[1] I am desirous, then, that we not be confined to mechanistic models, nor be seduced by them into forgetting that a mechanism implies a personal designer.

Before coming down to earth and talking about particularities of specific scientific models, I have still to mention three more insights to be gleaned from viewing the universe as God's poem.

5. The world utterly dependent on God

First, by speaking of God's poem, I mean to stress that the universe is utterly dependent on God, as a poem is dependent on its author. The poem exists, of course, there in print. It is not a part of the author or merely a dream in his mind (as if the universe were God's dream, destined to vanish when he wakes up). It is an object of his making. But what it is in every detail derives from its author. This is so even with an ordinary poem. But the universe-poem, I have said, is a <u>choral</u> poem. There are other speakers besides God. They each have a meaningful part of their own. At the same time, their meaning is found in their response to the all-comprehensive speech of God himself.

Colossians 1:16 and other passages tell us clearly that everything originated from God. There is no eternally existent prime matter or energy. God always was, but everything else had its origin and its being from Him. But that is not all. The universe is no clockwork, wound up and left to run. It is continuously superintended by God's personal activity.

> They [animals] all wait for you to give them their food in due season.
> When you give to them, they gather it up.
> When you open your hand, they are filled with good things.
> When you hide your face, they are dismayed.
> When you take away their breath, they die and return to their dust.
> When you send forth your Spirit, they are created; and you renew the face of the ground. (Ps. 104:27-30)

6. The world in development

A second, related concern expressed by the analogy of poetry is the concern to represent God's creation as a complex interplay of static and dynamic elements. God rested from creating on the seventh day. From then on, there is a stability and continuity in the hierarchical structure of created things. But, on the other hand, the mandate given to Adam to subdue the earth, involves vigorous dynamic processes. And God himself is involved in a continuous process of superintending and governing his creation, according to Psalm 104. One can say, then, that the poem is still in the process of being written. Only the first stanza was completed on the seventh day. The first stanza of a well constructed poem does, of course, set the tone and the general direction for what will come. One can make certain predictions about the rest of the poem, provided one knows something of its author. But within the parameters set by the first stanza, the poem still remains partly unwritten. Its writing, day by day of history, involves the continuous participation of the author. I believe that God as an all-wise author has planned the whole poem from the beginning (Eph. 1:11, Isa. 46:10-11). But the unfolding of history, that is, the writing of the stanzas, still has significance.

This way of viewing things puts a heavy stress on the dynamic developments. One could choose to stress the stability more by viewing the poem as already written, but in the process of being read and interpreted by man. The meaning of the poem, and above all the understanding of its meaning, is leg still a matter of an unfolding process.

7. The world surprisingly victorious over chaos

Whatever way one chooses to develop this analogy, it includes within it a reminder of a third truth about our world. There are mysteries and surprises. On the basis of the first stanza, or on the basis of the over-all structure of a poem, one may venture to predict an omitted word, or to predict the over-all direction of a stanza not yet read. One does so, on the basis of for analogy with what one already knows. But the analogies break down at points, and one may be surprised by new twists. Does the same hold true for our scientific models? I claim that it does. Take Maxwell's electromagnetic theory as an example. Maxwell provides us a model. It is a detailed analogy between equations for an ideal frictionless fluid and the phenomena of electromagnetism. But just what aspects of fluids are relevant? And to just what range of phenomena are they relevant? Both of these are open-ended questions; both can bring us surprises. Maxwell would have been surprised to find that global motion of ordinary fluids with respect to fixed space is a concept best abandoned in the case of electromagnetism. And he would have been surprised to see that his equations cannot be applied at the quantum scale without reinterpretation. Remember also that his theory was first developed to explain the interaction of electric charges and electric currents with magnetic fields. It was a pleasant surprise to find that the theory also encompassed the propagation of light.

What do I imply by this illustration? I would like us to obtain an appreciation for the limitations of our theories. Theories are always rooted in analogies. And we never know just how far the analogies will hold true. But, equally, I would like us to recover a sense of wonder at the degree to which the analogies do hold up, and do prove fruitful. Eugene Wigner, apparently not writing from a theistic point of view at all, speaks impressively of “The Unreasonable Effectiveness of Mathematics in the Natural Sciences” (1960):

> The first point is that the enormous usefulness of mathematics in the natural sciences is something bordering on the mysterious stand: and that there is no rational explanation for it. (p. 2).
>
> Certainly it is hard to believe that our reasoning power was brought, by Darwin's process of natural selection, to the perfection which it seems to possess. (p.3).
>
> It is not at all natural that "laws of nature" exist, much less that man is able to discover them (p. 5).

As a particular case of "unreasonable effectiveness," consider the special theory of relativity. This theory is mathematically the simplest possible theory in which the speed of light is constant under linear transformations of space-time coordinates. How could we dare to hope that the phenomena would match this simplicity? Or how could it be the case that P. A. M. Dirac could derive an equation virtually predicting the existence of the positron, simply in the course of trying to formulate mathematically a modification of the Schrodinger equation consistent with special relativity?

Well, my answer is that, indeed, it is surprising, but not unreasonable. God simply decided to create a universe shot through with analogies and allegories for the delight and use of man. Order is not unreasonable in God's creation. But it is a personal order. It is order, if you will, triumphing over a host of other alternatives that God might have selected for his "poem". It is a triumph over chaos. (I am here reflecting a bit on the language of Gen. 1:2. God created an original chaotic situation without using preexisting material. Subsequently, he subdued this chaos, "triumphing" over it for the sake of creating an ordered world suitable for human habitation.)

> In another context G. K. Chesterton expresses eloquently his appreciation for this triumph over chaos. The scene he presents is a dialogue between an anarchist poet and a poet of order. The anarchist has just complained about the sad, tired fact that when the train has passed Sloane Square, the next station must be Victoria. The hero Syme, the poet of order, replies: "...The rare, strange thing is to hit the mark; the gross, obvious thing is to miss it. We feel it is epical when man with one wild arrow strikes a distant bird. Is it not also epical when man with one wild engine strikes a distant station? Chaos is dull; because in chaos the train might indeed go anywhere, to Baker Street or to Baghdad. But man is a magician, and his whole magic is in this, that he does say Victoria, and lo! it is Victoria."
>
> "I tell you," went on Syme with passion, "that every time a train comes in I feel that it has broken past batteries of besiegers, and that man has won a battle against chaos. You say contemptuously that when one has left Sloane Square one must come to Victoria. I say that one might do a thousand things instead, and that whenever I really come there I have the sense of hairbreadth escape. And when I hear the guard shout out the word 'Victoria', it is not an unmeaning word. It is to me the cry of a herald announcing conquest. It is to me indeed 'Victoria'; it is the victory of Adam." (Chesterton 1960:9-10).

The train system is a triumph of man, as Syme says. But behind this stands the original triumph of God, who brought order out of chaos and who maintains order.

8. Newton's laws as allegory

Now I want to show how to approach a particular instance of science using the above poetic paradigm. I take Newton's laws of motion as my example.

Isaac Newton postulates

(1) that a body remains in its state of rest unless it is compelled to change that state by a force impressed on it;

(2) that the change of motion (the change of velocity times the mass of the body) is proportional to the force impressed;

(3) that to every action there is an equal and opposite reaction.

8.1 Newton's laws as surprising

Consider now the last of my implications from the poetic character of the universe. I have said that regularity in the universe constitutes triumph of order over chaos. I want now to show that Newton's laws are an example of this. The physicist and the engineer typically take Newton's laws for granted (or subtle modifications of them). The laws are “obvious,” is part of the texture of our thoughts. It is practically necessary to jump out of one's skin to go back to the sixteenth and seventeenth centuries. Before Newton “took over” the world, such things were not at all obvious. As long as people were still groping towards a solution, there seemed to be many possible answers. Only when one possible answer demonstrated its superior simplicity, accuracy, and efficacy did it manage to eliminate the others. Before Newton there were those who tried to account for motion in terms of an Aristotelian framework that invoked purposes and potentials. Others, including the early Newton himself, were attracted to Cartesian mechanism; they tried to account for all observable motions and changes in terms of underlying invisible mechanical linkages, involving no action at a distance. Moreover, Galileo's concept of inertia, further developed by Newton, had to triumph over the “obvious.” It was an “obvious” fact in those days that some substances (such as fire and smoke) had an innate tendency to move upwards, others to move downwards. All motions on earth had an “innate” tendency to stop (because of friction, we would now say).

Now, I want to reintroduce the surprise and wonder into Newton's laws. It is surprising, not “obvious,” that they are fruitful and illuminating. Why should God have created a world in which everything (not just a few things for which it might be convenient) has the constancy in rest or motion indicated by the first law? Some philosophers of science have argued that the first law boils down to a stipulative definition of “rest”. But the fact is that (1) such a “definition” does have some relation to our pre-scientific starting point in a vague, intuitive concept of rest; (2) this definition happens to be a tremendously fruitful generality. Why should it be possible to generalize so effectively?

Similarly, the second law of motion can be construed as a stipulative definition of "force." It gives a recipe for calculating net force on a material body. But again I can say, (1) such a definition does have some relation to our intuitive starting point in kinesthetic sense of muscle tension and exertion; (2) the vector law for addition of forces, the linear force law for springs, and the inverse square law for gravitation, all have a surprising simplicity, showing the "unreasonable" fruitfulness of the definition. God has chosen, in these cases, a world of extraordinarily simple order, order adapted to the mind of man. To use Chesterton's language, the train has arrived at Victoria.

8.2 Newton's laws as metaphor

I claimed earlier that scientific models are allegories within the texture of God's poem. It is easy to see that Newton's laws are a kind of "allegory." With the help of certain further contextual explanations, the laws jointly set up a detailed mapping or correlation between positions, velocities, forces, and masses on the one hand, and mathematca1 equations on the other. The correlation links one aspects of the universe to another, just as John Bunyan's allegory links the experiences of growth, temptation, and sin in the Christian life to the story of a pilgrimage.

8.3 Newton's laws as personal.

Consider next the personal character of God's poem. Can Newton's laws be seen as "personal" in some sense? If so, how? Of course, the laws are not about persons. But neither is all poetry. To say that poetry is personal is to suggest that poetry has authors and interpreters who are persons. It is, perhaps, also to suggest that poetic meaning itself is intelligible only in the context of persons, and that personal engagement is necessary on the part of the interpreter in order to discern, appreciate, and unfold the meaning.

To say, then, that Newton's laws are personal would be, first of all, to say that the formulators and interpreters of these laws are persons. On one level, this is trivial. Within the history of human science, human persons are indeed the formulators and interpreters of scientific laws. But many people think that the laws existed, even without being <u>formulated</u>, prior to the existence of any particular person. So the laws themselves, prior to human formulation, would <u>not</u> be in any sense personal.

As a biblical theist, I do not agree with this point of view. "Law" may indeed exist before there are created persons. But to have a "law", to have something that "holds", one must have a law-<u>giver</u>. God as a person must order the world, must triumph over chaos, must hold it to a pattern, if we are to say that a law holds. Of course, philosophers and others have denied that the analogy between God and a human law-giver, or between God and a human designer, artist, or creator, holds up this far. I cannot at this time follow the argument down to its roots (but cf. Stanley Jaki 1980). So I will content myself with saying that, through the Bible, God has opened my eyes to see that the kind of "law" and the kind of conformity to law that this world displays clearly reveal a personal, omnipotent, eternal creator (Rom 1:19-20). Not everyone admits this, but it is true.

There is, then, a law-giver. But we must distinguish between what God ordains on the one hand and what man as scientist guesses that he ordains on the other. Newton's laws, uttered by man, are not the law. They are an analogical imitation or replication of an aspect of God's law for the world.

I know, of course, that many scientists proceed about their business quite competently, without believing in God or invoking him (Laplace, "I have no need of that hypothesis"). Superficially, in the short run, they succeed. But they succeed because they live on borrowed capital. They know of God, as Rom. 1:18-20 points out, but hide the fact from themselves to save themselves from its psychic costs. They are like the hippy on an airplane ride who tells you that he doesn't trust anyone straight or anyone over thirty. He conceals from himself his reliance on the pilot. Likewise, scientists covertly rely on their knowledge that the universe-airplane is in good hands.

In fact, if the universe is not governed by a person, there is simply no intelligible reason why persons can say anything intelligible about how it is fact governed. Second, I observed above that poetry is personal in that it demands personal involvement for its interpretation and appreciation. Are Newton's laws analogous? It might seem that science in general and Newton's laws in particular are in this respect at the opposite pole from poetry. Much poetry talks directly about persons and much science talks in mechanistic metaphors. Hence the one demands a kind of personal involvement not characteristic of the other. But even within the sphere of poetry, the mode of personal involvement and commitment depends on the particular poetic sub genre in question. And poetry is not without demands for "objectivity." One does not simply pour into a poem one's own views and one's own emotions. Moreover, precisely in the context of philosophy of science, Michael Polanyi (1958) argues that all human knowledge whatsoever is "personal". There is no knowledge without commitment, without interests motivating the search and the learning, and without a tacit background of contexts of life making each particular statement meaningful.

Such, then, are the principal ways in which Newton's laws are personal. But I will risk going a bit farther, even though my arguments become more tenuous. I suggest that even the specific content of Newton's laws includes or at least suggests some quasi-personalistic overtones. A person's initial understanding of these laws, I claim, is mediated by the use of analogy with each person's broad personal experience as an individual in the world.

Let me begin with the occurrence of the word "body" in Newton's laws. The use of "body" to designate inanimate material things is much older than Newton. Yet I think that even that use of "body" is not without its quasi-personal overtones. Newton's laws would be impossible without a key assumption. That assumption is that for many practical purposes entities like planets, bullets, balls, and rocks can be treated as wholes, with an integrity of their own. And the sense that we have of the integrity of an inanimate thing is analogically related to the experience that we have of the integrity of our own body. The Oxford English Dictionary rightly designates this use of "body" as "transferred from the material part of man to matter generally . . ."

But the quasi-personification of "body" is more obvious when one looks at the rest of the language of Newton's laws. The body remains at "rest," analogous to a human being's experience of resting. Then it is "compelled", analogous to compulsion on a human being. It compelled by a "force", analogous to kinesthetic force of a man's hand on someone else. In the second; law, the concept of "mass" appeals to kinesthetic sense of heft. In the third law, the concept of action and reaction appeals at least vaguely to the analogy his of reciprocity and interchangeability in the activity of two human beings.

What we are encountering here is the fact that the subhuman and even inanimate world has been created by God "in the image of man." As human beings we have access to the inanimate world. Of course, this inanimate world is not something equal to us. It is not something actually, literally human, or animistic. But neither is it something alien to us, something that we cannot identify with. We are made "of the dust of the ground." That is an, observation not only, not even primarily, about atoms and molecules of our body, but about a kind of "kinship". It is not a mistake to quasi-personify material bodies. Rather it is good and <u>true</u>, provided we realize, as Newton did, the limited scope of the personification. At some level it is <u>necessary</u> to do something like this, because only so can we make anything intelligible to us. That which is absolutely alien has, by definition, no point of contact with us. Hence there can be no point of access to knowledge of it.

The combination of personification and quantification is what gave Newton's laws a kind of symbiotic power. The quantification reins in the flight of imagination involved in personification. Conversely the quasi-personification provides a poetic picture and framework to guide the interpretation of, and organization of the calculations, as well as their application to new types of phenomena.

One of the aspects of quasi-personification operates in a noteworthy way in the third law, namely the idea of transformation of point of view. One of our human abilities is the ability to step into someone else's shoes. We can imagine what it is like living and seeing the world from another person's standpoint. This represents a deeply personal and in fact interpersonal capacity. As single individuals we are able to harbor, in our minds and lives, shadow or projections of the views of other persons, and this is an important and necessary foundation for understanding of and participation in social (interpersonal) life.

Now Newton's third law requires a structured transformation between two viewpoints, both distinct from the starting ego-viewpoint of the scientist- observer. As with the other two laws, the observer must be able to transfer the quasi-personal language of rest, force, and impulsion from himself to inanimate bodies. He must know what it is consistently to adapt to a single "body's" viewpoint. That is, he must be able to hold in his intellectual grasp simultaneously all forces, velocities, and the mass of a single body. He must be able to distinguish them from other forces of other bodies. They are forces, velocities, and mass <u>from the perspective or viewpoint of</u> that body.

But now in the third law the observer is required in addition to become conscious explicitly of a transformation from one body's viewpoint to the viewpoint of another. Only if he knows how properly to make this shift will he be able intelligibly and correctly to use the third law as intended. The third law does not make proper sense if "action" and “reaction” are interpreted as two forces or impulsions acting simultaneously on a single body, or acting successively on a single body, or acting on two bodies successively, or acting on two bodies simultaneously, without the one body being the “source” for the force acting on the other. The two forces must, in a sense, be manifestations of the same structured phenomenon, but viewed from the perspective first of $body_1$ “feeling” the “compulsion” “exerted by” $body_2$, second of $body_2$ “feeling” the “compulsion” “exerted by” $body_1$. The model being used here is definitely the model familiar to everyone from his experience of shifting in his mind from the viewpoint and actions of one personal participant to the viewpoint and actions of the other.

Thus the formulation of Newton's laws appeals to personal experience and our personal ability to adopt others' viewpoints. The formulation itself depends on ultimately personal metaphors more than one might first expect. Of course, growing familiarity with and continued use of the laws “purifies” one's understanding of them. The individual words come to have technicized meanings under the constraints of quantifiability. The development of habit and routine makes consciousness of any quasi-personal connotations unnecessary or even counter-productive. But the quasi-personal aspects are, I believe, capable of being reactivated when one tries to apply and extend the theory beyond the area of the routine.

Newton's laws are far from being the only instance, or even the most of obvious instance, where quasi-personal associations are buried beneath the surface. One can detect quasi-personal connotations in many other places in scientific literature simply by focusing on the verbs and words semantically derived from verbs. The verbs often connote personal activity.

Listen, for instance, to Edward O. Wilson describe visual processing, using language not too remote from the industrial assembly line:

> Vision, for example, begins' its journey when the radiant energy of light triggers electrical activity in the approximately one hundred million primary light receptor cells that comprise the retina. Each cell records the level of brightness (or color) that touches it in each instant of time; the image transmitted through the lens is thus picked up as a pattern of electrical signals in the manner of a television camera. Behind the retina a million or so ganglion cells receive the signals and process them by a form of abstraction. Each cell receives information from a circular cluster of primary receptors in the retina. When a light-dark contrast of sufficient intensity divides the retinal cluster, the ganglion cell is activated. This information is then passed on to a region of the cerebral cortex low in the back of the head, where special cortical nerve cells reinterpret it (1978:74).

Or Feldman-Sears (1981:104) on wheat genetics:

> Hybridizations of this type are facilitated by the shared genome, which acts as a buffer, ensuring some fertility in the resulting hybrids. In such cases the different genomes, which are brought together from different parents, can exchange genetic material and form a new, mixed genome.

Or Rose (1981) on autoimmune diseases:

> Those that invade the body are usually held at bay by the body's immune defenses, an elaborate system that stands guard to intercept and destroy foreign cells. (p. 80)
>
> Instead of damaging the thyroid cells these antibodies stimulate them spurring the thyroid to make more hormones. The overproduction of thyroid hormones causes symptoms of restlessness, weight loss and palpitations. (p.82)
>
> They include macrophages, which take up antigens and present them to the lymphocytes in an appropriate way in order to initiate the immune response. The macrophages are also important phagocytic (scavenger) cells, engulfing and digesting invading microorganisms and other antigenic particles. (p. 82)

(Emphasis is mine.) Thus language with quasi-personal connotations is wide-spread in contemporary science.

8.4 Newton's laws as quasi-linguistic

Let us now return to Newton's laws and consider another possible aspect of the analogy with poetry. Can Newton's laws be considered as linguistic in structure? It is obvious that Newton's laws are in one sense a piece of language. Yet it is not the usual practice to consider them as at root linguistic in nature. They can be paraphrased in many ways in English, French, or some other language, as well as represented by mathematical formulas. Therefore, being able to identify them as Newton's laws does not depend on the specific from or mode of linguistic expression. Nevertheless, it ought to be possible to obtain insight into these or other laws by reflection on language, since God's speech lies behind any human attempt to express the regularities of God's “poem”.

I will here adopt a tagmemic theory (cf. Pike 1967, 1976, 1977) as a linguistic approach convenient for analyzing Newton's laws. There are several competing linguistic theories in the academic marketplace today, and tagmemic theory is not by any means the most popular. However, in addition to other strengths, it has the advantage of presupposing a personal world in which persons are irreducible participants (Pike 1976:108). This fits in with my earlier concerns for the personal character of the world.

8.4.1 Multiple perspectives

A second emphasis of tagmemic theory is that of multiple perspectives. Persons are capable of a multiplicity of perspectives (Pike 1976:122-123). Using various perspectives or frameworks as starting points, they are capable of producing more than one theory accounting for the same data. This immediately explains many otherwise very frustrating facts about the clash of different theories in the social sciences. For instance, it explains the apparent inability of the academic linguistic community as a whole to finally settle on a single theory as the “best”. Sociology, anthropology, economics, and psychology are similarly beset with a plurality of competing theories, no one of which, in modern times, has been able to drive the others totally from the field. As Kuhn (1970) observes, competing models for understanding a given scientific domain may both be able to explain a large number of facts. Moreover, by sufficient "enrichment" and ad hoc means, they can account even for anomalies.

Our first reaction may be to give thanks that the natural sciences do not produce the same kind of apparently permanent pluralism as exists in the social sciences. Except for times of "scientific revolution" studied by Kuhn, natural sciences tend to operate within the bounds of a single dominant model. Yet when we look more closely, we must admit that natural sciences also offer us at least some examples of multiple-perspective theories. Newtonian mechanics offers us the multiple perspectives in time and space defined by Galiliean relativity. Special relativity offers us the perspectives defined by Lorentz relativity. Quantum mechanics offers us the wave perspective and particle perspective, transformable into one another by means of the duality of the uncertainty relations and commutation relations. The theory of gases offers us the perspectives of thermodynamics and statistical kinetic theory. And mathematics? Well, that is for my next talk, but there are often choices between a more geometric or more algebraic approach.

Tagmemic theory, then, would ask whether the phenomena treated by Newton's laws could not also be treated some other way. Can we, say, reformulate Newton's laws? Can we reformulate them slightly by changing our coordinate system by a Galilean transformation? Can we reformulate them more radically by introducing generalized coordinates? Only many years after Newton did Lagrange determine a generalized formulation of the laws. For a system with n degrees measured by generalized coordinates q_1 ..., q_n, Newton's laws can be formulated

$$\frac{d}{dt}\left(\frac{\partial L}{\partial q_i}\right) - \left(\frac{\partial L}{\partial q_i}\right) = 0,$$

where L = T-V is the difference between the kinetic energy T and the potential energy V. Can we reformulate still more radically by replacing force by some other model, such as a geometric one (the general theory of relativity)? Or can we eliminate action at a distance (quantum mechanics)? Or can the model based on "force" and "compulsion" be replaced by a kind of "economic" model where "expense" is minimized (the theory of least or rather extremal action)? All the above transformations of perspective or uses of different models result in "successful" theories, which explain things. But in the process of trying out different models, there are bound to be many failures and dead ends. Nevertheless, even in our day we can still ask whether still other perspectives might result in useful insights or reformulations of laws of motion.

8.4.2 Contrast, variation, and distribution of a "law"

Now let me return to tagmemic theory, and derive a second tool for analyzing scientific laws. This second tool can give us a means of dealing with lop the limited nature as well as the reality of the knowledge embodied in a law. Tagmemic theory recognizes that there are units in language of various sizes and types. There are alphabetical letters, words, phrases, sentences, and so on. Each unit has a unity, integrity, and organization of its own, but it is also related to other units. According to tagmemics, our knowledge of a unit can be characterized by the intersection and interaction of three perspectives on the unit. These three are labeled the contrast, the variation, and the distribution of a unit (cf. Pike 1976:109, 112-113; 1977:2).

The contrast of a unit is its distinctiveness: what separates it from all other units. The variation of a unit is the range within which it may vary and still remain that unit. The distribution of a unit is the context or range of contexts in which it may occur. Thus, for the word "horse", its contrast is its distinctiveness over against other words, especially other nouns like cow, house, man, mountain. Its variation includes variation in pronunciation (sometimes "hoss") and variation in application (referring to various types of horses from time to time). Its distribution is like that of many nouns, though we do not expect to see it as the subject or a verb like "speak", "sell", etc. (For further exposition of contrast, variation, and distribution, see Poythress 1976:123-124, Pike 1977:1-3,1980.)

Now let us look at Newton's laws in terms of their contrast, variation, and distribution. Newton's laws contrast with other possible laws (such as the Aristotelian theory of innate potentials). They are meaningful, intelligible, testable partly in terms of such contrast. The most stringent tests involve more precise formulations like the inverse square law of gravitation, because this clearly contrasts with many other possible formulas for force, and with formulas that might relate the various other properties and spatial relationships between two (or more) bodies. Newton's three laws, by themselves, are not open to such stringent tests because they are quasi-definitional in nature.

Newton's laws also have variation. That is, they apply to a large number of different particular cases. Just to what extent they will apply to the very large, the very small, the very distant, etc., is not exactly known when they are first formulated. Hence the fact of variation expresses a limitation on the knowledge embodied in the laws. The laws are a "mere" generality (they do not give us the details of each system). And we do not know exactly how sweeping this generality will prove to be.

Finally, Newton's laws have distribution. They are distributed in many contexts. The context of ordinary language and ordinary experience is the tacit background from which the particular words and over-all model involved in the laws gain their meaning. Moreover, the laws are also distributed in the context of one another. They have the meaning that they do only when they operate together. Moreover, they have this particular meaning only so long as people are able to grasp what it means to go about measuring or calculating force, mass, velocity, and so on. The laws are dependent on a system of correlations between mathematics and standardized apparatuses for measurements of various kinds. Yet the apparatuses may change, be replaced, be restructured (replacing a spring clock with a pendulum clock or with an electric clock) without radical alteration of the purport of the laws.

We may say, then, that Newton's laws can be thought of as a particular piece of human poetry (more specifically allegory). These laws are a stanza of poetry interpreting an aspect of God's universe-poem. But on close inspection, it appears that this piece of poetry gains its significance from its interconnections with an interweaving with a larger and richer context of language. The stanza achieves its power as part of a group of stanzas. It is, moreover, one perspective out of many. We are able to adopt this single perspective, and simultaneously able tacitly to utilize a rich surrounding context defining its terms. By so doing we put Newton's laws effectively to work. Such is the unique gift of persons, of “poet-interpreters”.

Notes

[1]I am indebted to my colleague John M. Frame for this illustration.

[2]From Encyclopedia Brittanica, 15th ed., Macropedia Vol. 13 (Chicago: Benton, 1974), p. 19.

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