2. Matter in motion

The north east corner of Hyde Park in London is a very special place. Since perhaps the Great Reform rally of 1867, it has been a stronghold of free speech. It is known as “speakers' corner” and it's well worth a visit. If you feel brave enough, you can stand on a soap box, or more likely, a step ladder, and hold forth with any opinion you choose. A little less brave, and you can try challenging a speaker, they are always up for debate. Less brave still, and simply strolling amongst the clamour is a wondrous thing.

I went over once and counted the speakers. Of the 11, 6 were pushing some kind of religion, 2 were political, 2 were conspiracy theorists and 1 I simply couldn't understand. While writing about classical ancient philosophy, I couldn't help wondering what the balance was like in those Greek market squares over 2,000 years ago. Was Parmenides, for example, a highly respected commentator on the affairs of his day, or an embattled, imploring orator of the kind we see at speakers' corner?

I settle, in the absence of any evidence either way, with an image somewhere between these extremes. I imagine him highly respected by a relatively small number of people, regarded as a crank by many more. Monism is exactly the kind of thing you can imagine young followers struggling to grasp by various exercises in contemplation, while the old masters offer pithy and cryptic aphorisms. The “oneness” of everything is exactly the kind of intuitive truth that draws attention, but opens up great vistas of wild imagination. There is a pearl of truth in it.

The world is made of things, so there must be something that makes them things and not nothing. When I contemplate the fundamental nature of reality I automatically feel that all real things must have something in common. There must be something that makes a thing a thing and allows it, in theory, to interact with other things. However magnificently diverse the universe might be, I find it impossible to imagine that it doesn't have a fundamental oneness, a substance of which everything in the universe is made.

We can only conceive of this substance in the purest, abstract terms. In one sense, we see it all the time and nothing else, but in another sense, we never see it, only the forms that it takes. We call this universal substance “matter”. Our minds react differently and label the different forms that it takes. The different things we actually see are matter arranged and moving in different ways.

The early cosmologists seem to have grasped the oneness of the universe but assumed that the universal substance could be experienced in its pure form, water or fire for example. It was atomism that gave us the idea of matter in the abstract, that is to say, something that can only be experienced in the various forms that it takes. The early atomists also grasped that these forms could be expressed in some mathematical or geometrical way.

Was Pythagoras a respected commentator or market-place ranter? Again we don't know, but its fairly well established that his later followers were an exclusive sect. They not only used obscure and exclusive language, but positively encouraged a sense of elite isolation. There is evidence that they were consciously secretive and wrapped their philosophy up in mystical rituals and symbolism. Yet in all the esoteric ramblings there was a truth, another pearl worth extracting.

Because the world consists of matter in motion, it follows that we can understand a lot about the world through the relative quantities of matter and the trajectories of its motion. Mathematics, in its very simplest terms, is the quantitative relationships between things. Combined with the idea of atoms, the language of mathematics can describe the basic physical processes of the universe.

I recall once watching a Royal Society Christmas lecture entitled “unpeeling the cosmic onion”. The title stuck in my mind. The metaphor in English comes from the fact that while other vegetables often have a layer of skin you peel off, leaving the part you can use, the layers of an onion are themselves useful and it has one layer after another. As physicists explore the universe they do not discover the final substance. Instead, like peeling an onion, they find layers beneath layers, each having explanatory value in itself. There is no end product, but ever smaller levels of organisation.

Today, particle physicists, who are busy trying to smash tiny things open, talk about “fundamental” particles. These are the ones they currently can't open. They acknowledge that the universe may have impenetrably infinitesimal layers of organisation. There is no theoretical reason to assume that there is something absolutely fundamental. There has been talk of something called a “singularity”, which would be a piece of matter that was not just practically, but absolutely, indivisible. There is however, no really good reason to suppose that such a thing exists.

Meanwhile, some physicists allow their enthusiasm for mathematics to go too far. I heard one recently say that most modern particle physicists are secretly Platonists: they believe that the mathematical relationships they reveal are reality, while material things are merely shadows. I think he was overstating the case. Nevertheless, there is a tendency amongst modern scientists, physicists in particular, to mystify mathematics.

The cause of this is simply a philosophical deficit, a failure in the materialist imagination that may be going uncorrected in the training of scientists. We must remind students that mathematics is nothing but a way of describing the quantitative relationships between things. It is, as Jacob Bronowski was keen to point out, a language. It has a remarkable and surprising power to describe things, but it isn't magical and it isn't more real than the relations it describes. And furthermore, like any language, not everything it says is true.

In summary then, the universe consists of matter in motion, and we can understand a lot about how the universe works from the relative quantities and movements of matter. Mathematics is a powerful language to describe these quantities and movements, but we must be careful not to mystify its power. This brings me to a final remark concerning science: its paradigms and ideologies.

In the final phase of classical natural philosophy, the thoughts and observations of one man, Aristotle, were elevated into a grand, schematic dogma. By looking at the movement of objects in the sky he constructed a model of concentric spheres that also resembled an onion, one with the earth in the middle.

Dogmatism took hold and a church hierarchy, as well as a network of monastic and associated educational institutions, staked their reputations on it. People's livelihoods depended on it and they had the power to enforce conformity and the acquiescence of others. They also talked-up the authority of their founding “genius”. In short, a “paradigm” became an “ideology”, that is to say, a strong and persistent consensus became attached to real social and economic interests.

After Aristotle came Newton, and his model of the universe had a lot of gloriously precise mathematics on its side. It too evolved into a kind of “ideology”, with Newton as the infallible founding prophet. The lesson is clear. When dogmas take hold, they can stick to the reputations of institutions and the interests of professions. When this happens there is the danger of “ideology”. We should remain ever vigilant for the signs: rituals, symbolism, hype, conformity and the mystification of a founder's genius.

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