



## DARK MATTERS

BY DAVID LOWE

“There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy.” (*Hamlet*, Act I, scene V)

Just as in life, so it is with science. You think you understand all there is to understand. Everything is in its place, working in just the way you expect it to work, then all of a sudden you realize that you know nothing. As when your kids reach puberty or your best friend marries somebody you don't like. Physicists at the end of the 19th century thought that they had succeeded in explaining all there was to explain using classical notions. Everything was under control. Tick, tock went the world, as regular as clockwork.

There was just one little problem, which wasn't really a little problem but an enormous one. Yet scientists like you and me tend to prevaricate, as with the national debt or that radiator leaking in the bedroom: “We'll sort it out later; something will turn up.” Anyway, for their theories to work, physicists (those pompous-looking ones with big beards in old photographs) had to assume that “nothing”, that is to say “everything other than something”, was actually “something” and they called it the ether, a sort of universal all-permeating soup, in which matter floated like soggy croutons. The ether was the thing that allowed light to travel through a vacuum, but not sound. You can see the stars, but you can't hear them, a concept Pascal found terrifying. The ether also provided a frame of reference – turn right at the second galaxy; we're the third planet from the left. Then Einstein came along and showed us that postulating this mysterious ether wasn't necessary, but, in so doing, he did something to space and time that was almost impossible to understand. He showed us that what we thought was common sense didn't work anymore, because it was just an approximation for slow-moving bodies (compared to the speed of light). He further complicated things a few years later by telling us that gravity was just curved space. I'm not fat; space is just a little bit curved, especially around my stomach and the top of my thighs.

Then quantum mechanics told us that the very thing we were observing somehow depended on whether we were observing it or not. This reminds me of my wife,

strangely enough. “You don't look at me anymore; it's as if I don't exist.” And to top it all, scientists are now convinced that what we thought was everything is in fact only 96% of everything. We are not the centre of the universe and we are not even made of the same stuff as the other 96% of the universe. We're a minority. It's not as if you can't find your keys. You've got your keys: it's your house and your car that you can't find. You can look at this in a positive way – it's rather like being told that what we thought we had in the bank is actually only a small fraction of what we possess. Or you can look at this in a negative way – we know sod all about anything. So if we can't see it, then how do we know it's there? Because things we can see behave as if there's something there. In the 1970s, astronomers observed that the motion of galaxies, including our own Milky Way, seems to be violating the universal law of gravitation. They're spinning way too fast to survive more than a single rotation, yet we know that our galaxy has gone through dozens of rotations in its billions of years of life without being thrown apart. Galaxies are living fast but not dying young. My metaphor for understanding this is to imagine an old people's home where an extremely aged (but still alive) Keith Moon, Janis Joplin, Jimi Hendrix and friends potter about in relatively good shape. This only makes sense if “there are more things in heaven and earth than are dreamt of in your philosophy,” or in the case of the universe, there's more matter out there than we can see holding galaxies together with gravity. Astronomers call this substance “dark matter”. “Transparent matter” would be more appropriate, but not as dramatic-sounding, just as “Transparent Vader” doesn't sound as good as “Dark Vader” (actually it's Darth Vader in English).

Then there's another problem. If masses attract each other, then why doesn't the expansion of the universe start to slow down and even reverse? The contrary is observed. The expansion is speeding up. And whatever force is counteracting gravity and causing this acceleration is what physicists call “dark energy”. A mysterious type of energy in the universe that outweighs all the energies we know about and is totally incomprehensible – ironically, it's a bit like the ether. So there we are, dark matter and the even more bizarre dark energy make up 96% of everything.

I humbly take my hat off at this point and hide behind Socrates: “The only true wisdom is in knowing you know nothing.”