# THE MISSING MONOPOLES

**We seek him here, we seek him there,**
**Those Frenchies seek him everywhere.**
**Is he in heaven?—Is he in hell?**
**That demmed, elusive Pimpernel.**

Emmuska Orczy (1905)

**If the forces of electricity and magnetism are to exist in our world today then monopoles must be formed in the early Universe.**

John Barrow (2000)

**The trouble with these monopoles is the lack of any indication of their actual existence.**

Roger Penrose (2004)

Today I come with props. Just two magnets from the Dollar Tree on Sherman Way. He isn't here to see them.

A magnet may teach many lessons. Two teach even more. They teach that the two ends of each, not needing to be labeled N and S, are different. From bar magnets to a compass needle and the Earth itself, we find each magnet has two poles. Earth with a North Pole but no South Pole cannot be imagined. After all, one magnet cut in two just makes two smaller magnets and each has two poles.

Nonetheless in 1931 Dirac says that there must be *Monopoles*. His grounds are math mixed with a dash of beauty. Today the hottest theories say the early universe made many Monopoles and some must still exist today.

As Penrose says the problem is that they are missing. No one can find them. Not a one. Well, *maybe* one: the Valentine's Day Monopole, recorded at Stanford in 1982. No one has yet replicated this result. Demmed elusive? Not because they're small. Monopoles are big; too big, it's thought, to manufacture in a particle accelerator—though the LHC is on their trail.

That Monopoles are real is not lightly to be set aside or doubted. It arises from the concept of Duality. This says that for each electric object there is a magnetic object (and vice versa). The Monopole is the magnetic object that matches the electron. It's the fact that there *are* Monopoles that puts electric charge in packages of a specific size. In other words it makes charge quantized. Experiments show that charge *is* quantized. And there's much more; the concept of Duality is now entrenched. Polchinski says of it, 'The existence of a single structure that unifies such a broad range of physical and mathematical ideas, and many others as well, is unexpected and remarkable. Earlier I declined to define beauty,

but one can recognize it when one sees it, and here it is.'

Because so many share this view, the failure to find Monopoles becomes a problem for cosmology. Though care is needed in interpreting a negative result. For example, scientists discover species every day. When a new bacterium is found, or even a new insect, it is no surprise. But ten years ago a new species of *elephant's* identified. These elephants live on an island, Borneo, with 16 million people. If scientists can overlook an elephant in Borneo maybe they could miss a Monopole or two in space. Dirac doesn't need a lot of them. Even one in the whole universe would do.

At six it's shaping up to be a lovely evening. I unplug the coffee. Ten minutes later, leaning with the Metro curve, I feel that maybe I missed something. Physics sees this as a problem, but I can't discern how missing Monopoles can be a clue.