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Occasionally I still see references in the literature to the *Zeroth Law of Turbulence*. The existence of a zeroth law would seem to imply that there is at least a first law as well. But, so far as I know, there are no other laws of turbulence, and hence my question is purely rhetorical.

The so-called zeroth law is the fact the turbulent dissipation tends to a limit as the Reynolds number increases. Some people seem to be obsessed by the fact that this is equivalent to a finite dissipation limit as the viscosity tends to zero. Unfortunately, they become hypnotised by the zero viscosity and completely overlook the word 'limit'! This becomes translated into 'finite turbulent dissipation at zero viscosity' and is also referred to as the 'dissipation anomaly'. If this were true, then it certainly would be anomalous, to say the least. But it isn't true. Turbulent dissipation is ultimately, like all dissipation in fluid systems, the transformation of macroscopic kinetic energy into heat by the action of viscosity. No viscosity means no dissipation.

I do not wish to become hypnotised myself by this particular manifestation of folklore. I have written about it before in these blogs and will write about it again. Right now I wish to concentrate only on the oddity of the terminology: 'zeroth law'. Presumably it has been so named by analogy with the situation in thermodynamics, where the well-established first and second laws were later supplemented by both a third law and a zeroth law. The third law was part of the subject when I took my first degree but the zeroth law wasn't. It amounts essentially to a definition of temperature that provides a

basis for its measurement. I suppose that it became thought to be so fundamental that it really ought to precede the existing first and second laws.

However, if that was the case, then surely it would be better to name it something like 'The fundamental principle of thermodynamics'? The trouble with zeroth law is that zero means nothing. That is, when you don't have any of something, then you have zero.

It is a failure to recognise this that causes confusion about the calendar when a century changes. One needs to realize that there is no 'year zero'. Everything is zero to begin with. Then we start counting seconds, minutes, days and 365 days later we have achieved one year which we denote by '1'. When we reach ten years, we have completed a decade, and we can label that year by '10', with zero fulfilling its mathematical significance by giving us a symbol for '10'. Thus the year 10 is the last year of the decade, the year 100 is last year of the century, and the year 1000 is the last year of the millennium. Thus Year 2000 is the last year of the second millennium and Year 2001 is the first year of the third millennium. (I hope that digression made sense!)

In my view, the use of the term 'zeroth law' is lame in thermodynamics and doubly lame in turbulence, where we do not even have an agreed first law. It also reflects muddled thinking, based very largely on a failure to understand the mathematical concept of a limit, which ends up with the erroneous supposition that the infinite Reynolds number limit corresponds to the Euler equation. This amounts to a failure to recognize that the Euler equation throughout its entire life has been indomitably non-dissipative.

This will be my last blog of this year. I intend to resume posting in the new year. In the meantime, I hope that we shall all have a pleasant holiday.

