

Bad proofs and 'curate's egg' theories

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At about the time I took up my appointment at Edinburgh, I heard about a pure mathematician who wanted to be remembered for his bad proofs. Some years later I read his obituary in *The Times* and this fact was mentioned again. I had thought that I had kept the cutting but it seems not, so I'm afraid that I don't remember his name. But I do remember what was meant by the term 'bad proofs'. This man's view was that many proofs in mathematics have been polished by various hands over the years and he wanted to be remembered for his originality. His proofs would be unpolished and hence seen as original.

The choice of the word 'bad' is interesting, in view of its pejorative overtones. I would be inclined to think that the original proof would at least be valid and hence not to be described as bad. Perhaps, later more elegant versions of the proof would emphasise the unpolished nature of the original. Hence, perhaps 'rough' might be a better description. Presumably the word 'bad' was chosen to emphasise the paradoxical appearance of that statement. Well, at least he is being remembered for his quirky assertion about what he wanted to be remembered for.

For some time I have wondered whether there is an analogous term for turbulence theories. By which I mean attempts to solve the statistical closure problem. This was originally formulated by Reynolds for pipe flow, but as usual we will consider it here as applied to isotropic turbulence. Obviously 'bad' is no good, because we do not have the paradoxical

juxtaposition that we have with the word `proof', which in itself indicates success, which is certainly not bad. One obvious possibility would be `rough' but somehow that does not appeal. `Rough theories' does not sound good. In fact it sounds bad.

Recently I came up with the idea of the `curate's egg' theories, meaning `good in parts'. This saying stems from a cartoon which appeared in the British humorous magazine *Punch* in 1895. It shows a nervous curate breakfasting with the bishop. The bishop expresses concern that the curate's egg is not a good one. The curate, anxious not to make a fuss, bravely asserts that his egg is `good in parts'. The term passed into everyday speech and was still current when I was young. In the 1960s I was commuting regularly by train, and I would buy *Punch* to read on the journey. On one occasion there was a commemorative issue and a facsimile of the original cartoon was reproduced, so I was interested to see the origin of the phrase. We didn't have Google in those days!

The reason that I think that such a term might be helpful is that many members of the turbulence community seem to see a theory as being either right or wrong. And if it's deemed to be wrong, then it should be dismissed and never considered again. A striking example of this kind of thing arose a few years ago when I was trying to get a paper on the LET theory published (see #10 in the list of recent papers)) and it had gone to arbitration. The Associate Editor who was consulted turned the paper down because `this is the sort of stuff Kraichnan did and everybody has known for the last twenty years that it's wrong'.

This decision was easily overturned. The sheer idiocy of the proposition that, because one person had tackled a problem and failed, other people should be barred from making further attempts, ensured that. But what interests me is the fact that Kraichnan's work is reduced to `the sort of stuff' and regarded as `wrong'. This was done by someone who was an

applied mathematician and not a theoretical physicist. I am not a betting man, but I would put a small amount of money on the assumption that this referee had very little knowledge of Kraichnan's vast output, and was relying on hearsay for his opinion. I understand the difficulties facing anyone from an engineering background in trying to get to grips with this type of many-body or field theory although there are accessible treatments available. But if you are unable to understand this work in detail, then it is unlikely that you are qualified to referee it.

If we take an example from physics, in critical phenomena (e.g. the transition from para- to ferromagnetism) the subject was dominated by mean-field theory up until the late 1970s, when renormalization group (RG) was applied to critical phenomena. This does not mean that mean-field theory was immediately dismissed. In fact it is still taught in undergraduate courses. Prior to RG there was a balanced understanding of the limitations and successes of mean-field theory and no one ever thought of it as 'right', with the corollary that no one now dismisses it as simply 'wrong'.

I know what I would like to have for other subjects, such as cosmology, particle theory or indeed musical theory. I would like to be able to read a simple account which explains the state of play, without going into too much detail. That is what I intend to provide for statistical theories of turbulence in future posts. In my view, most theories of turbulence can be regarded as 'curate's eggs': they have both good and bad aspects. The important thing is that those working in the field of turbulence should have some understanding of the situation and should appreciate the importance of having further research in this area.