Heuristic is as heuristic does!

Heuristic is as heuristic does!
In the early years of my career, I would sometimes encounter the word `heuristic' in a mathematical theory. I understood that authors, when using this word, were in effect crossing their fingers behind their back and indicating that their work might not be entirely rigorous. But I found myself quite unable to understand precisely what the word meant.

Naturally I consulted a dictionary. It said:
1. Heuristic: serving or leading to find out.
2. (Of method, argument *etc)* depending on assumptions based on past experience.
3. Consisting of guided trial and error.

Well, number 2 looked the most relevant but was not really helpful. I still wasn't sure how I should interpret the word when I met it in an article. I found this mildly frustrating.

Some years later, I was working on the preparation of my book on the physics of turbulence, and I was considering the relationship between the work of Sam Edwards [1], and the later work of Novikov [2], on the introduction of random forcing to the Navier-Stokes equation. In discussing the paper by Edwards, Novikov made use of the word `heuristic' and this is what he said:

`However, the probability distribution density in functional space, has no clearcut mathematical meaning, so that the entire analysis in [*my reference [1], cited by Novikov as his reference [7]*] has a heuristic character (which does not detract from the value of this interesting paper).'

The point was that Edwards was working with the pdf while Novikov used the characteristic functional. So that while the

Edwards analysis led to the same result as the Novikov analysis, it was mathematically iffy. I felt, from this, that it was possible for me to understand how mathematicians used the word `heuristic', and since then I have become quite comfortable with it and sometimes use it myself.

That was progress of a kind. But with the passage of time I am no longer sure that Novikov was correct. The fact is that the Edwards analysis was carried out in a finite volume (a cube of side L), with the limit of infinite system volume being taken at the end of the calculation. In other words, I think that this analysis was mathematically well defined. So although I understand Novikov's use of the word heuristic, I no longer agree with the basis of his comments. I intend to return to the concept of the gulf between rigour in theoretical physics, on the one hand, and in mathematics on the other.

[1] S. F. Edwards. The statistical dynamics of homogeneous turbulence. J. Fluid Mech., 18:239, 1964.
[2] E. A. Novikov. Functionals and the random-force method in turbulence theory. Soviet Physics JETP, 20:1290, 1965.