Some comment on

"The glass-Jamming transition in dense granular matter", by C. Coulais, R. Candelier & O. Dauchot, a lecture at

Powders & Grains 2013

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Abstract :

A large number of works has been devoted to the study of large "non classic" fluctuations expected in the physics and mechanics of granular matter. This topics was developed after the introduction of the "Jamming" and "fragility" concepts as unifying modelling for glass-gels-and-granular materials in 1998. To the point of view of the above lecturers, this was a success. To the point of view f the commentator, this success is not real, since the concept of "jamming & fragility" splits into different problems as soon it is applied to separate real problem (glass transition, dense static flow of granular matter, jamming in gels jamming in frictionless grain matter,…, each one looking at some kind of phase transition. However, theory of phase transition has to relate different real phases, so they can be grouped into different class of some real classification (as 1st order or 2nd order phase transition), and split in subsection (which may depend on interaction dimensionality and space dimensionality as in 2nd order phase transition). On the contrary, when applied to granular matter problem, one can define many different bifurcations, which depend on the granular matter characteristics and the "flow", so that we do not know if the classification should be finite or infinite.

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It is a hard task to tell what shall remind about the concept of "fragility" and of "jamming" transition in granular matter. No doubt, this led indeed to a great deal of works, at least many more than those quoted in [1]. But, in the present comment, I will try and defend that I would have preferred less debate, and better understanding between each side, which is a necessity for building science freely…

Let me start 16 years ago, at the "Powders and Grains 97" meeting; this was not the starting point of the debates, but it was the time when physics & mechanical engineering teams started trying and discussing together on the validity of the so-called BCCW approach [2]. This discussion was not easy [3] at that time, since I could not publish the experiment [3] I brought with me to the meeting to test the theoretical hypotheses proposed in the BCCW approach. It took me two years, using also a new edition schemes to publish these results in 1999 through *Poudres & Grains*. This is not a correct way to show how science can use debate! And there is still some stress: one can feel still some unspoken perceptible nowadays.

Anyway, this experiment [3] among others led few physicists to propose the concept of the "fragility" of granular material [4,5] [1].

[1] To me, it would have been better to speak of the "fragility of the undergoing BCCW proposed theory"

This was about one year later Powders and Grains 97. I followed this story all along the time, through the different Powders and Grains meeting at least, and sometimes writing some feeling about the evolution of the works which I read on this topics, using PhD theses or after some important meetings [2, 5-11].

Articles /Ph.D theses that I chose to comment were often outstandingly written, and very clear; but they also seemed to me to be lacking impartiality, making their initial project pass in front of the obtained striking results, often contradicting the objective itself. For instance, this is the way I wrote [10] after Powders and Grains 2001 to try to make understand that the facts spoke about themselves and showed an orientation quite different that what “Powders and Grains 2001” articles really said. For a scientist, it is of no use to like these fantasies, and it is better to spot them as quickly as possible. I believe main conclusions in [10] are still valid.

In the same way, the other articles which I commented [6-9] were good, but reflected in my opinion a bad departure of the discussion, what I tried to say in my comments. But to write comments is always dangerous, especially in our current time, when we urge the scientists and the teachers to make noise, and to look like politicians or sellers for the worse to convince.

In these conditions, it is impossible to believe that we can hurt nobody, but the science has to say what it has to say, otherwise how assert its efficiency?

In the same way, we have to give up dead-end concepts, and focus on the good ideas, it is often better one way to be effective. It would be of no use "to deify" the circle as the perfect structure as Platon, or to reintroduce the theory of four elements of the ancient Greek scientific and alchemical philosophy, or that of four humors of the ancient Greek medicine... It is better to start all over again often.

This is why I am a little aware of the difficulty of this discussion.

In most of my analyses [9-10] this is just what I am trying to claim: works are good, but start from a dream which nobody wants to deny. In [6] I proposed to correct some error, and to bring to authors some further knowledge; it was rejected from the “scientific” literature; it is a pity, this shall not be the normal scientific habit.

Article [7] discusses a silo flow which can be seen as a percolation problem in 1d, as told by the workers. Everybody knows that such a model is not “really critical”; so why arguing only the possibility of a “critical” flow. It would be simpler to introduce main results of 1d percolation from a direct modelling; then one can extend the results and show how it can be more complex in 2d or 3d percolation. Furthermore, the modelling does not allow understanding why a 3d real flow can be lead to a 1d stoppage (percolation) flow…. Why to begin with the most complex notions. It is the opposite which we always make: we introduce the words, the sentences, as the mathematics, "in a natural way, then we generalize. The theorem of Goedel is there to remind us that our gibberish is incomplete, but it works; our gibberish will be complicated all the more as the concepts to be introduced will be hard. This shall produce non scientific Why explaining the silo flow starting from a complex object when it is just a simple object. If Einstein did the same with the

theory of special Relativity, or with the theory of Brownian motion, nobody would have been able to understand, nobody would have been able to use his theories.

It is much better understanding the complete analogy between the force propagation through the grains in a random static compressed pile at equilibrium and the transport of kinetic energy in a real compressed gas through collisions [11]; and the simpler, the better [11]. This should bring more benefits to science and education, rather than introducing complicate explanation as any politician does that argue the world is complicated, with a lot of cases, which is why he cannot observe really what he claims to be a good view (this is his way to promote his a good complicated dream). This was the main way church, religion and thinkers wanted to convince.

But following a dream is not a scientific option for any scientist, if it is not real. He shall understand the strategy of realness; and the simpler the better as soon there is no known exception. This strategy has been the better one likely, in science.

So, after this preliminary, I can comment paper [1].

Paper [1] is a paper aimed at defending the notion of jamming and of fragile objects as a unique topic. However, this becomes a challenge, since the notion diverges with concrete applications, depending on the field (glass, car jamming, silos, grains, statics or dynamics of real dry granular material, statics or dynamics of real wet granular material, statics or dynamics of real frictionless dry granular material, of gels….). This is told in the paper; but it remains confused. The notions which are introduced are not well compared from one problem to the other; how quantifying the main notion; how do they compare through each applications… Indeed, one feels also that this is still a possible option. The paper exemplifies different aspects, and show experimental data that show up different jumps, …. Is it really enough to claim the existence of a specific field. For instance, thesis are there to show that these notions mix different aspects, that each problem fall into a specific transition which is different from the others….

Can one defend the problem starting with the ideas developed in [4,5]. For me the answer is No likely. This is clearly demonstrated through my analyses of the works I quote in [2,3, 6-11]. Most of these works were published by authors defending the notions of “fragility and jamming”; their conclusion was rather positive for jamming, but they should have better concluded that their results can not fit mainly their initial aim/ “dream”, and they have to go further to study this dream, their own “dream”.

As told already, this can be understood also from paper [1] directly, since there is no real detailed description of method and measures that can exemplify real trends supporting this new area, with exact formula,… . Better, the conclusion at the end of the paper is a list of recommendations on major difficulties …..

I would have preferred that [1] starts with these difficulties, goes directly to the theses or to the layman literature to understand what these difficulties are. This would have been more understandable, so that the conclusion can be drawn.

However is this only a “real dream” as the “Graal” in ancient literature, or some real important facts to be discovered and studied? Future research in low gravity will perhaps tell us; at least this is why I have been supporting this field always, and has proposed to develop it in the ISS (space station) as a part of the VIP-Gran program. For me, it is the only location where the grain interactions are small enough to be able to discover such “giant fluctuations”, as I noted already in [10]. But this will require not only being able to see these fluctuations…, but probably also understand how they control the material. This will need to observe them and define what new form they will take: we know this is a hard task since we got already a similar problem/example with the granular gas concept and its hydrodynamics description [12]; it has taken more than 15 years to get a status of the real problem (1993-2013).

Indeed, as I told already, the jamming concept [5] and its “fragility” was proposed as a unifying view that can be applied to physics of glassy systems, granular matter, gels and other “soft matter”,… This comes from the fluctuations characteristics of mechanical properties, that may be specified …. However, the truth is often more complex that what we already know. This is probably true for granular materials as it is true for the universe: its complexity can be understood probably from what we know already, but we have also to track new concepts, new ideas, new measures, **and new modelling** and new way of thinking…

Our best we can do is to make science resisting to religious options (dreams). But it seems that this will become harder and harder, as science develops and separates in different fields with little inter-communication.

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