NANOPARTICLE, *QUO VADIS*?

Florence Gazeau – I am among those who believe and try to prove that nanotechnology opens up prospects for understanding, mastering and manipulating the living. Medicine and mankind will probably benefit from introducing into the body nanoparticles that will be able to fulfill different functions for repair, diagnosis or therapy. Still, nanoparticles are scary. Yet, rightly or wrongly, they evoke the inorganic, hard, foreign matter, an infinitely small alien infiltrating every nook and cranny of our cells, an undesirable and everlasting passenger that you cannot get rid of. Housed in our tissues, they could disturb our balance, deregulate our functions, interact with the most subtle biological processes. Then, how can we know and be sure and ask the right questions, find the ways and means to move forward? Somehow, unlike nano-toxicologists that observe the effect of nanoparticles on biological functions, in our team we chose to adopt the point of view of nanoparticles and conversely to study the effect of the biological environment on nanoparticles.

Let's take the example of metallic nanoparticles made of iron and gold. They are very interesting, being able to pinpoint heating very locally at an intracellular level at the right moment, thanks to an external light. But what I'm interested in is what happens to nanoparticles within the body, where and for how long do they stay in our organs? Do they lose their properties after a while, how are they managed by our biological functions, are they degraded and how, and if so, what happens to the degradation product? Of course, looking for a nanoparticle in a mouse is like looking for a needle in a haystack. Yet, thanks to electron microscopy, we can differentiate nanoparticles from the other cellular components by their metallic composition, their distinct shape, cubes, sticks, tubes or sunny-side up eggs, the yolk being gold and the white iron oxide. We see that the iron oxide, white, degrades relatively quickly, after a few months it has destroyed its magnetic properties, the ones useful for applications. Fortunately, it is recycled by proteins specialized in iron storage, the ferritins, which will store it in a disposable but non-toxic form. As for the gold nanoparticles, they will degrade very slowly, but nobody knows what happens with the liberated gold or the residual particles. One can wonder if it's more risky to store over a long period not readily degradable but not very reactive particles, or on the contrary rapidly degradable particles, our body having to deal with its degradation by-products. Here we are, it's all patience and length of time, we don't have definitive answers, but always new questions.

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