

FREE WILL

“You do have the ability to surprise yourself.”
Richard Bandler and John Grinder

The idea that motion is determined often produces fear, because we are taught to associate determinism with lack of freedom. On the other hand, we do experience freedom in our actions and call it *free will*. We know that it is necessary for our creativity and for our happiness. Therefore it seems that determinism is opposed to happiness.

But what precisely is free will? Much ink has been consumed trying to find a precise definition. One can try to define free will as the arbitrariness of the choice of initial conditions. However, initial conditions must themselves result from the evolution equations, so that there is in fact no freedom in their choice. One can try to define free will from the idea of unpredictability, or from similar properties, such as uncomputability. But these definitions face the same simple problem: whatever the definition, there is *no way* to prove experimentally that an action was performed freely. The possible definitions are useless. In short, because free will cannot be defined, it *cannot* be observed. (Psychologists also have a lot of additional data to support this conclusion, but that is another topic.)

No process that is *gradual* – in contrast to *sudden* – can be due to free will; gradual processes are described by time and are deterministic. In this sense, the question about free will becomes one about the existence of sudden changes in nature. This will be a recurring topic in the rest of this walk. Can nature surprise us? In everyday life, nature does not. Sudden changes are not observed. Of course, we still have to investigate this question in other domains, in the very small and in the very large. Indeed, we will change our opinion several times during our adventure, but the conclusion remains.

We note that the lack of surprises in everyday life is built deep into our nature: evolution has developed curiosity because everything that we discover is useful afterwards. If nature continually surprised us, curiosity would make no sense.

Many observations contradict the existence of surprises: in the beginning of our walk we defined time using the continuity of motion; later on we expressed this by saying that time is a consequence of the conservation of energy. Conservation is the opposite of surprise. By the way, a challenge remains: can you show that time would not be definable even if surprises existed only *rarely*?

Challenge 435 s

In summary, so far we have no evidence that surprises exist in nature. Time exists because nature is deterministic. Free will cannot be defined with the precision required by physics. Given that there are no sudden changes, there is only one consistent conclusion: free will is a *feeling*, in particular of independence of others, of independence from fear and of accepting the consequences of one's actions.* Free will is a strange name for a

* That free will is a feeling can also be confirmed by careful introspection. Indeed, the idea of free will always arises *after* an action has been started. It is a beautiful experiment to sit down in a quiet environment, with the intention to make, within an unspecified number of minutes, a small gesture, such as closing a hand. If you carefully observe, in all detail, what happens inside yourself around the very moment of decision, you find either a mechanism that led to the decision, or a diffuse, unclear mist. You never find free will. Such an experiment is a beautiful way to experience deeply the wonders of the self. Experiences of this kind might also be one of the origins of human spirituality, as they show the connection everybody has with the rest of nature.

Challenge 436 e



FIGURE 253 Daniel Bernoulli (1700–1782)

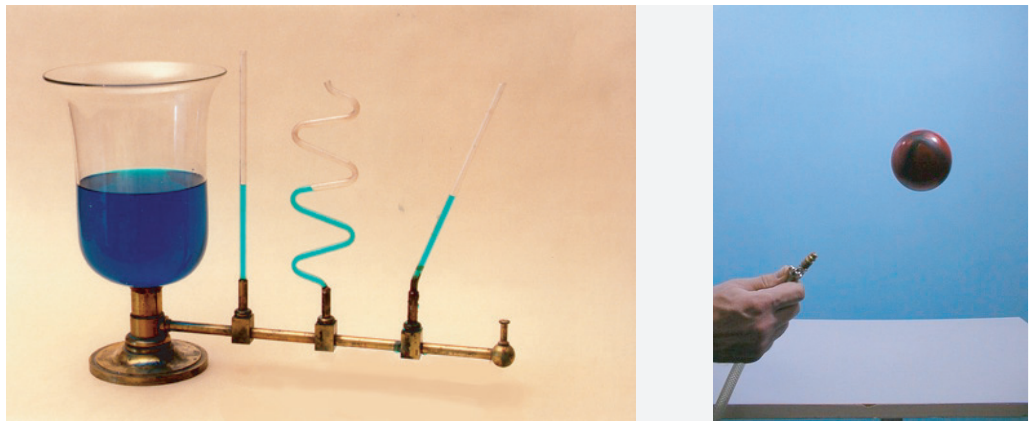
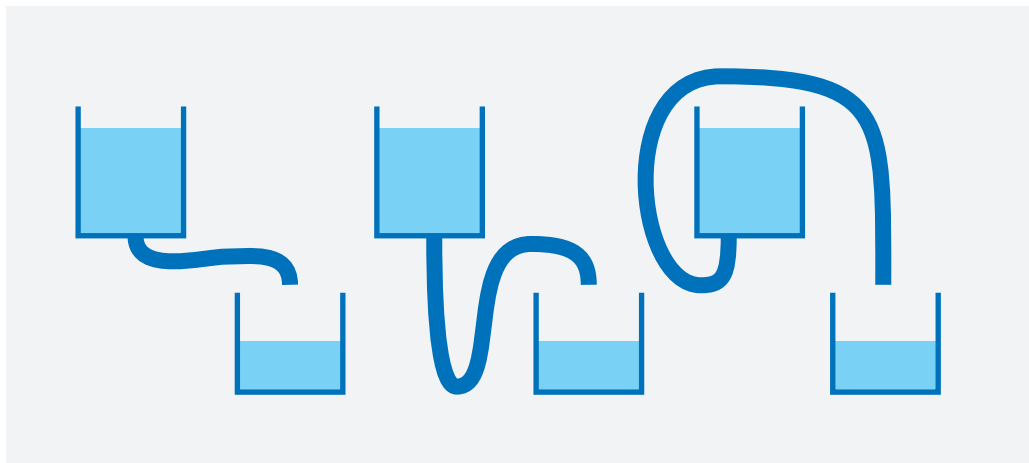


FIGURE 254 The hydrostatic and the hydrodynamic paradox (© IFE).



Challenge 588 s FIGURE 255 A puzzle: Which method of emptying a container is fastest? Does the method on the right-hand side work at all?

The air around us has a considerable pressure, of the order of 100 kPa. As a result, it is not easy to make a vacuum; indeed, everyday forces are often too weak to overcome air pressure. This is known for several centuries, as Figure 256 shows. Your favourite physics laboratory should possess a vacuum pump and a pair of (smaller) *Magdeburg*