

# THE DIRECTION OF TIME

The Moving Finger writes; and, having writ, Moves on....

Omar Khayyám (ca. 1100)

“Or towards it?”

“No, no, my dear Watson. The more deeply sunk impression is, of course, the hind wheel, upon which the weight rests. You perceive several places where it has passed across and obliterated the more shallow mark of the front one. It was undoubtedly heading away from the school.”

Arthur Conan Doyle (1904)

I shall use the phrase “time’s arrow” to express this one-way property of time which has no analogue in space.

Arthur Eddington (1928)

For us believing physicists, the distinction between past, present and future is only an illusion, however persistent.

Albert Einstein (1955)

Until we have a firm understanding of the flow of time, or incontrovertible evidence that it is indeed an illusion, then we will not know who we are, or what part we are playing in the great cosmic drama.

Paul Davies (1995)

It’s mind-boggling and at first I don’t believe it. But after reading maybe sixty articles and physics papers and some books, it’s inescapable. Everything about time is a question: Does it exist? If so, what is it? Does it flow? If so, one way or both? If one only, why? If two, why do we only see one? Did it have a beginning? If it did, then when? What was there before that? Will it ever end? There are too many questions without answers. They must wait. But I can’t push back the buzz. Time is a hot but hidden niche in physics. Seen from the outside it’s a scene of frenzied speculation. Even a brief history, as Hawking demonstrates, fills books.

Where to begin? Famous Persian poet and philosopher Khayyám offers solid ground. Time is; and it moves on. So I begin a briefing with the problem of its symmetry or lack thereof. By symmetry I mean its ordinary meaning; a face with symmetry’s the same both right and left. Does time have symmetry? Does it work both ways?

This stuff seems simple but it is confusing. Even Holmes can get it wrong. He

finds the missing teacher's cycle track. As he sees, the rear tire track runs over the front one. And, as he says, it would run over riding *from* the school. But it would run over riding *to* the school. The symmetry is right before his eyes; he doesn't see it. Or rather, as he's fond of chiding Watson, he sees it but he doesn't draw the logical conclusion: Whichever way he went, the teacher wasn't riding backwards. But then, as Chandler notes, 'Doyle made mistakes.'

The problem of time's symmetry is simple: Physics laws work backwards just like they do forwards. They are reversible. So, what's the problem? Well, that's not what we see. As Khayyám writes, what we see time-wise is a one-way street. We are swept along inexorably, so it seems. It's everybody's everyday experience. But physics says that everybody's wrong: It's even money either way.

Why then do events go one way only? Benjamin Button is a man who grows or one might say ungrows from death to birth. The movie, like Fitzgerald's story, follows how he deals with those around him whose ages change in a more usual direction. It's not time itself reversing. It is him. The classic is an egg unscrambling like a Button on a shorter scale. Outside the movies, though, it doesn't seem to work. Not ever. Why not? Once again I find that no one knows.

So time has an *Arrow*: Eggs break; cars rust; rocks fall; never the reverse. One can soon see if a silent movie runs the wrong way. But the laws of physics cannot say which way the movie plays.

"Foolish physicists!"

He lapses into silence.

For them it is a bitter pill. Physicists believe a good equation has deep meaning. It does what the witness swears to do: to tell the truth, the whole truth, nothing but the truth. Physicists have found this to be so so often that when faced with choosing to believe their eyes or their equations, they go with the math.

Contrary to their equations we go downstream. That our time flows in one direction is one of the most puzzling things about the universe that physics doesn't understand. Feynman says:

There should be somewhere in the works some kind of principle that uxles only make wuxles, and never vice versa, and [this] would be the thing that makes the whole phenomena of the world seem to go one way. But we have not found this yet.

The question in my mind is: What can he do with the Arrow? Rumor has it that, as it begins, the cosmos has *no* time. Does it then choose a direction? Does this help him find how it began? Only time will tell, I murmur to him. Then catch myself.