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From Here to Eternity

12.01.2000

Imagine a universe with no past or future, where time is an illusion and everyone is immortal. Welcome to that world, says physicist Julian Barbour

by Tim Folger

Time seems to stand still in South Newington, a secluded village ringed by rolling green hills about 20 miles north of Oxford, England. The 1,000-year-old baptismal font in the town's church, the thatch-roofed houses, and the tidy gardens along narrow lanes all appear unchanged by the passage of centuries. Standing on the roof of the church's bell tower on a warm, late-summer day, Julian Barbour, a theoretical physicist with some extraordinary notions about the nature of time, points to his home, known as College Farm, which borders the ancient church.

"It looks almost exactly as it did when it was built 340 years ago," says Barbour. "The barn is also from the 17th century. Virtually all the houses you see around are from about 1640 to 1720. The long, low house is the one I grew up in. That's my parents' house. It dates from about 1710 to 1720." The entire scene is so placid one can't help but imagine that Barbour's childhood home, as well as the village and the surrounding landscape, will remain unchanged for the next 340 years.

Such utter quiescence suits Barbour, who is convinced the static harmony of South Newington extends past the horizon to the universe at large. In his view, this moment and all it holds— Barbour himself, his American visitor, Earth, and everything beyond to the most distant galaxies— will never change. There is no past and no future. Indeed, time and motion are nothing more than illusions.

In Barbour's universe, every moment of every individual's life— birth, death, and everything in between— exists forever. "Each instant we live," Barbour says, "is, in essence, eternal." That means each and every one of us is immortal. Like the perpetually unmoving lovers in Keats's "Ode on a Grecian Urn," we are "for ever panting, and for ever young." We are also for ever aged and decrepit, on our deathbeds, in the dentist's chair, at Thanksgivings with our in-laws, and reading these words.

Barbour fully realizes how outrageous the notion of a world without time sounds. "I still have trouble accepting it," he says. But then, common sense has never been a reliable guide to understanding the universe— physicists have been confounding our perceptions since Copernicus first suggested that the sun does not revolve around Earth. After all, we don't feel the slightest movement as the spinning Earth hurtles through the void at some 67,000 miles per hour. Our sense of the passage of time, Barbour argues, is just as wrongheaded as the credo of the Flat Earth Society.

Barbour has been preoccupied with studying the basic properties of time for four decades. It's an issue he believes most theoretical physicists have ignored."Given what a fascinating thing time is, it's surprising how few physicists have made a serious attempt to study time and say exactly what it is," he says. "It's an unusual gap." At the outset Barbour didn't think he would have any fresh insights he could bring to the topic. "I don't regard myself as being at all talented. I struggle to do equations," he says, laughing. "But I just got very interested in the subject and found that very few people have really thought seriously about it."

Perhaps Barbour himself wouldn't have been able to devote nearly 40 years of his, well, time to the problem if it hadn't been for his unique background. Unlike most of his colleagues, he doesn't work at a university or a government lab— he is one of the world's few freelance theoretical physicists. Nevertheless, his credentials are solid, and prominent physicists take him— and his unconventional ideas— quite seriously.

"He has some wild ideas, but he definitely knows what he's talking about when it comes to these fundamental issues," says Carlo Rovelli, who works at the Center for Theoretical Physics in Luminy, France. Lee Smolin, a theoretical physicist at Pennsylvania State University, agrees: "Barbour is one of the few people I know who went out on their own and succeeded in doing several things that were important and would not have been easy to do in a conventional career."

After receiving his doctorate in physics from the University of Cologne in 1968, Barbour, who is now 63, decided he didn't want to follow a traditional academic career, with the inevitable pressure to publish or perish. So he supported his wife and four children by translating Russian scientific articles and worked on physics on the side, publishing scholarly papers every few years. Outside academia, he was free to explore his interest in time without worrying about tenure or funding for what might seem an arcane pursuit.

Until recently, Barbour's provocative work was little known beyond a rarefied circle of physicists. That changed earlier this year with the publication of his latest book, *The End of Time,* in which he presents his case for a universe where time, despite all appearances to the contrary, plays no role.

Barbour's central argument is that a mistaken belief in the reality of time prevents physicists from achieving their ultimate goal: the unification of the submicroscopic atomic world of quantum mechanics with the vast cosmic one of general relativity. The problem arises because each theory provides a radically different conception of time, and physicists simply don't know how to reconcile the two views. Until they do, they will never have one seamless theory of the universe comprising the very smallest objects to the very largest. And certain middling-sized objects— human beings— will never understand the true nature of time and existence.

What makes the two versions of time so different? Time in the quantum realm has no remarkable properties at all. In theories of quantum mechanics, time is essentially taken for granted; it simply regularly ticks away in the background, just as it does in our own lives. Like a clock at a sporting event, it provides an invisible framework in which events unfold. That's not the case in Einstein's general theory of relativity.

To describe the universe on the largest scale, Einstein had to weave time and space together into the very fabric of the universe. As a result, in general relativity, there is no invisible framework, no clock ticking outside the universe against which to measure events. How could there be? Time and space joined together have weird consequences: Space and time curve around stars and other massive bodies and make light bend away from straight-line paths. Near black holes, time seems to slow down or even come to a full stop.

Barbour is not alone in recognizing that the pictures of time in general relativity and quantum mechanics are fundamentally incompatible. Theoretical physicists around the world, spurred by Nobel dreams, sweat over the problem. But Barbour has taken perhaps the most unorthodox approach by proposing that the way to solve the conundrum is to leave time out of the equations that describe the universe entirely. He has been obsessed with this solution for more than 10 years, since he learned of a vexing mathematical tour de force by a young American physicist named Bryce DeWitt.

DeWitt, with the help of the eminent American physicist John Wheeler, developed an equation in 1967 that apparently melded quantum mechanics with general relativity. He did this by taking the principles from quantum mechanics that describe the interactions of atoms and molecules and applying them to the entire universe, a mind-bending feat not unlike trying to make a jockey's suit fit Michael Jordan.

Specifically, DeWitt hijacked the Schrödinger equation, named for the great Austrian physicist who created it. In its original form, the equation reveals how the arrangement of electrons determines the geometrical shapes of atoms and molecules. As modified by DeWitt, the equation describes different possible shapes for the entire universe and the position of everything in it. The key difference between Schrödinger's quantum and DeWitt's cosmic version of the equation— besides the scale of the things involved— is that atoms, over time, can interact with other atoms and change their energies. But the universe has nothing to interact with except itself and has only a fixed total energy. Because the energy of the universe doesn't change with time, the easiest of the many ways to solve what has become known as the Wheeler-DeWitt equation is to eliminate time.

Most physicists balk at that solution, believing it couldn't possibly describe the real universe. But a number of respected theorists, Barbour and Stephen Hawking among them, take DeWitt's work seriously. Barbour sees it as the best path to a real theory of everything, even with its staggering implication that we live in a universe without time, motion, or change of any kind.

Strolling in the meadows of oxford's Christ Church College with Julian Barbour, time and motion seem undeniable. Towering cumulus clouds float overhead, ferried by a gentle breeze. Children run and shout in the same field where Alice Liddell, the girl who inspired Lewis Carroll's *Alice's Adventures in Wonderland,* often played. How can there be no time, no movement? Barbour settles his tall, lean frame into the grass, readying himself for a long explanation to yet another skeptic. He begins with what seems a most straightforward proposition: Time is nothing but a measure of the changing positions of objects. A pendulum swings, the hands on a clock advance. Objects— and their positions— he argues, are therefore more fundamental than time. The universe at any given instant simply consists of many different objects in many different positions.

That sounds reasonable, as it should, coming from a thoughtful gentleman like Barbour. But the next part of his argument— the crux of his view— is much harder to swallow: Every possible configuration of the universe, past, present, and future, exists separately and eternally. We don't live in a single universe that passes through time. Instead, we— or many slightly different versions of ourselves— simultaneously inhabit a multitude of static, everlasting tableaux that include everything in the universe at any given moment. Barbour calls each of these possible still-life configurations a "Now." Every Now is a complete, self-contained, timeless, unchanging universe. We mistakenly perceive the Nows as fleeting, when in fact each one persists forever. Because the word *universe* seems too small to encompass all possible Nows, Barbour coined a new word for it: Platonia. The name honors the ancient Greek philosopher who argued that reality is composed of eternal and changeless forms, even though the physical world we perceive through our senses appears to be in constant flux.

Before allowing himself to be interrupted by the stream of questions he knows will come, Barbour continues to press his point. He likens his view of reality to a strip of movie film. Each frame captures one possible Now, which may include blades of grass, clouds in a blue sky, Julian Barbour, a baffled *Discover* writer, and distant galaxies. But nothing moves or changes in any one frame. And the frames— the past and future— don't disappear after they pass in front of the lens.

"This corresponds to the way you remember highlights of your life," Barbour says. "You remember very vividly certain scenes as snapshots. I remember once, very tragically, I had to go to a man who had shot himself. And I still have no difficulty in recalling the scene of opening the door just to where he was at the foot of the stairs and seeing him there with the gun and the blood. It's still imprinted as a photograph on my mind. Many other memories I have take that form. People have strong visual memories. If it's not just a snapshot, it might be a few stills of a movie you recall. Think of perhaps your most vivid memories. You don't think of them as just lasting a second. You see them as snapshots in your mind's eye, don't you? They don't fade— they don't seem to have any duration. They're just there, like the pages of a book. You wouldn't ask how many seconds a page lasts. It doesn't last a millisecond, or a second; it just is."

Barbour calmly awaits the inevitable sputtering objections.

Don't we then somehow shift from one "frame" to another?

No. There is no movement from one static arrangement of the universe to the next. Some configurations of the universe simply contain little patches of consciousness— people— with memories of what they call a past that are built into the Now. The illusion of motion occurs because many slightly different versions of us— none of which move at all— simultaneously inhabit universes with slightly different arrangements of matter. Each version of us sees a different frame— a unique, motionless, eternal Now. "My position is that we are never the same in any two instants," Barbour says. "Obviously, as macroscopic human beings, we don't change much from second to second. And there's no question that we're the same people. I mean only an extreme madman would deny that," he says reassuringly. "To that extent, it's true that we do move from one Now to another. But in what sense can you say we're moving? The way I see it, not exactly the same information content, but nearly the same information content, is present in many different Nows." Nothing really moves, he says.

"The information content or the consciousness that makes us aware of being ourselves, of having a certain identity, is just present in many different Nows. There are two things that distinguish my position from what people might just intuitively think. First of all, the Nows are not on one timeline. They're just there. And second, there is nothing corresponding to motion. I'm taking a very radical position on that. I'm saying the Nows are really like snapshots. The impression of motion only arises because the snapshots have got an extraordinarily special structure." We are part of that special structure.

For all the apparent complexity of his scheme, Barbour believes that it provides the simplest way to merge quantum mechanics and relativity into a single theory of the universe. Like all physicists, he strongly believes that mathematically elegant explanations tend to be true, even if they conflict with common sense. "I think the approach I'm proposing does deserve to be taken seriously," he says. "It would be extremely rash and stupid to say it's definitely right, but there's an inner logic to these ideas. They're very natural. If we want to put quantum mechanics and general relativity together, what is the simplest way that could be done? I believe it is the way I've proposed. And I believe it is essentially the way that Bryce DeWitt discovered in 1967 when he found his infamous equation."

Barbour stands and brushes some grass from his pants. He has to meet his wife, Verena, for dinner and looks at his watch, grinning as he does so. "This is what comes of saying there is no time— I have to pull my own leg sometimes," he says.

Walking to a fashionable new restaurant on Oxford's old High Street, Barbour talks about how his ideas have changed his perceptions of the world. "I think it's completely wrong to say that the world was created in the Big Bang and that it was the unique creation event." Barbour hastens to add that there exists an eternal Now that contains the Big Bang, but he sees it as just one of an infinite array of Nows existing alongside this instant on High Street. "Immortality is all around us," he says. "Our task is to recognize it."

How does the physics community react to such ideas? Physicists who know Barbour's work agree that it shouldn't be dismissed out of hand. At a physics conference in Spain, Barbour conducted an informal poll. He asked how many of the physicists believed that time would not be a part of a final, complete description of the universe. A majority were inclined to agree.

Don Page, a cosmologist at the University of Alberta in Edmonton who frequently collaborates with Stephen Hawking, raised his hand that day. "I think Julian's work clears up a lot of misconceptions," says Page. "Physicists might not need time as much as we might have thought before. He is really questioning the basic nature of time, its nonexistence. You can't make technical advances if you're stuck in a conceptual muddle." Strangely enough, Page feels that Barbour might actually be too *conservative.* When physicists finally iron out a new theory of the universe, Page suspects that time won't be the only casualty. "I think space will go too," he says cryptically.

Like Page, Carlo Rovelli applauds Barbour for forcing physicists to think about things they may have taken for granted. "It's time to go back to the big questions," he says. "We need a new way to think about the world. There are major philosophical challenges, and Julian is a part of that."Barbour, meanwhile, is still developing his theory. With Niall Ó Murchadha, an Irish physicist, he is attempting to formulate a modification of general relativity in which not only time but also distance plays no role. In particular, his theory would predict that the universe, being static, is not expanding. The main evidence that physicists have for the expansion— the pervasive stretching of the spectra of light from distant galaxies known as the cosmic redshift— would instead be explained by the gravitational effects of neutron stars and black holes.

"If you want the wildly optimistic scenario," he says, "in which the Irishman and I develop this theory, make this prediction, and it turns out to agree with observations, then we would really be in the big time."

The parish church next to Barbour's home contains some of the rarest murals in England. One painting, completed in about 1340, shows the murder of Thomas à Becket, the 12th-century archbishop whose beliefs clashed with those of King Henry II. The mural captures the instant when a knight's sword cleaves Becket's skull. Blood spurts from the gash. If Barbour's theory is correct, then the moment of Becket's martyrdom still exists as an eternal Now in some configuration of the universe, as do our own deaths. But in Barbour's cosmos, the hour of our death is not an end; it is but one of the numberless components of an inconceivably vast, frozen structure. All the experiences we've ever had and ever will have lie forever fixed, set like crystalline facets in some infinite, immortal jewel. Our friends, our parents, our children, are always there. In many ways it's a beautiful and comforting vision. But the question still nags: Could it possibly be true? Only time will tell.

Is There Life After Death?

Julian Barbour is convinced we are all immortal. Unfortunately, in a timeless universe immortality does not come with the same kind of perks that it does on Mount Olympus. In Barbour's vision, we are not like Greek gods who remain forever young. We still have to buy life insurance, and we will certainly seem to age and die. And instead of life after death, there is life alongside death. "We're always locked within one Now," Barbour says. We do not pass through time. Instead, each new instant is an entirely different universe. In all of these universes, nothing ever moves or ages, since time is not present in any of them. One universe might contain you as a baby staring at your mother's face. In that universe you will never move from that one, still scene. In yet another universe, you'll be forever just one breath away from death. All of those universes, and infinitely many more, exist permanently, side by side, in a cosmos of unimaginable size and variety. So there is not one immortal you, but many: the toddler, the cool dude, the codger. The tragedy— or perhaps it's a blessing— is that no one version recognizes its own immortality. Would you really want to be 14 for eternity, waiting for your civics class to end?

As odd as this vision of a timeless world might seem, Barbour believes there is something stranger still to ponder: the very fact of our existence. "Creation and the fact that anything is— this for me is the complete mystery," he says. "The fact that we are here is totally mysterious."
— *T.F.*

Web Resources:

Barbour's home page: www.julianbarbour.com.For a brief biography and an online interview with Barbour, see www.edge.org/3rd_culture/bios/barbour.html.