INFINITE POTENTIAL
SHOW TITLE: GENERIC SHOW
EPISODE #101
DATE: 3/17/20
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00:00:28	DAVID BOHM	People talked about the world, and I said, "Where does it end?" and, uh, uh...
	MALE	And what answer did they give?
	DAVID BOHM	Well, they-I never, uh, I don't remember. It wasn't terribly convincing I suppose. [LAUGH]
	DR. DAVID C. SCHRUM	It was, uh, a night, and we were walking under the stars, black sky, and he looked up to the stars, and he said, "Ordinarily, when we look to the sky and look to the stars, we think of stars as objects far out and vast spaces between them." He said, "There's another way we can look at it. We can look at the vacuum at the emptiness instead as a planum, as infinitely full rather than infinitely empty. And that the material objects themselves are like little bubbles, little vacancies in this vast sea."
00:01:25	DR. DAVID C. SCHRUM	So David Bohm, in a sense, was using that view to have me look at the stars and to have a sense of the night sky all of a sudden in a different way, as one whole living organism and these little bits that we call matter as sort to just little holes in it.
	DR. DAVID C. SCHRUM	He often mentioned just one other aspect of this, that this planum, in a cubic centimeter of the planum, there's more, uh, energy matter than in the entire visible

		universe.
00:02:11	ANNOUNCER	David Bohm was one of the 20th century's most brilliant thinkers, a physicist, philosopher, explorer of consciousness, the man Einstein called his spiritual son, and the Dalai Lama his science guru. Bohm suffered rejection from the physics community who seemed unable to accept his ideas, and exile at the hands of the American government, having been falsely accused, despite being acquitted, of being a communist. Bohm displayed a rare and maverick intelligence, daring to peer into a world considered forbidden, a non-divided universe where everything is interconnected, including ourselves.
00:03:02	ANNOUNCER	This is Bohm's remarkable story, the story of his life and his explorations in physics, philosophy, and consciousness, and a search for unity and wholeness at the crossroads of science and spirituality.
00:04:06	ANNOUNCER	Since the dawn of man, humanity has been haunted with fundamental questions about the nature of existence. Who are we? Where did we come from? What is our purpose? What is reality?
	ANNOUNCER	Our ancient ancestors saw spirit in everything and as the ultimate source of everything. A sense of mystery was present. The quest for knowledge through science and spirituality were not separated.
00:04:47	H.H. THE DALAI LAMA	Buddha himself expressed to his follower, monks, scholars should not accept his vision out of faith but rather further investigation

		and experiment. Therefore, uh, we trained that way. Always why, why, why, why, where? Not easily say yes. [LAUGH]
	ANNOUNCER	While the big questions remain the same, science and spirituality have grown far apart. The world has fragmented. For many, life has lost its meaning, its purpose.
	ANNOUNCER	Classical physics promoted mechanism by suggesting that everything should be predictable and controllable. To see three-dimensional space as absolute, time as a singular linear progression, and our sensory experiences as reality itself.
00:05:51	ANNOUNCER	But when one begins to understand the true nature of reality and our place within it, these assumptions become obstacles.
	ANNOUNCER	The early 20th century witnessed fundamental breakthroughs, enabling mankind to perceive the nature of reality in a radically different way. Those breakthroughs were the birth of relativity and quantum theory.
	DR. SHANTENA AUGUSTO SABBADINI	I believe that quantum physics, when we understand it in a-in a philosophically more meaningful way like Bohm was trying to do, like I'm trying to do, like many people are trying to do, I think it-it's a revolution. It has radical implication, uh, about how we live our life, how we interact with the earth, how we interact with each other, and that revolution is unfinished.
00:07:00	ANNOUNCER	Quantum theory was born around

		1900. 1905 saw Einstein's theory of relativity. Then in 1925, Heisenberg looked into the heart of nature and created quantum mechanics. This was followed by Niels Bohr's Copenhagen interpretation, then quantum field theory. This was followed decades later by the famous theory of everything, and scientists started to believe that the end of physics was in sight.
	DR. F. DAVID PEAT	1980s and 1990s, we give a like to something, approach called the theory of everything that was going to resolve everything, but it somehow didn't quite work out. There's something missing. Maybe we should look wider.
00:07:44	ANNOUNCER	And so physicists started to look again at the ideas of David Bohm. Forgotten for decades, could Bohm's ideas now hold the key to unravelling the mysteries of the universe? This film will look at the answers. But first, let's ask ourselves the basic question, what is quantum physics? Quantum physics is the description of the smallest things in the universe, the things that we do not see in our everyday world of space and time. Such as atoms, molecules, and the tiny invisible particles which form the entire underlying structure of the universe. One grain of sand contains more atoms than all the sand on all the beaches on the planet. Quantum physics is also the basis for multibillion-dollar industries.
00:08:44	ANNOUNCER	Every time you turn on your mobile or tablet, you are invoking the fundamental laws of the universe.

		It's a world that defies any description that is limited to ordinary space and time. The relationship of objects is not determined by their relative positions but by relationships existing at a deeper quantum level that cannot be understood in our everyday world. It's a mysterious place where relative space collapses, linear time ceases to be. It's a timeless world, eternal. It's the intangible all manifest that infuses all life. Everything in the known universe emerges from it. Everything we are and everything we do is dependent on it.
00:09:41	ANNOUNCER	While all this is incredible, the scientific orthodoxy had not been able to successfully reconcile the two big breakthroughs of the early 19th century, quantum mechanics and general relativity into a unified theory. And so physics remained polarized. Its chief protagonist, Niels Bohr on one side and Albert Einstein on the other, unable to agree on what constitutes the true nature of reality.
	DR. JAN WALLECZEK	Quantum mechanics is really about explaining the properties of the microscopic world, the-the materials our bodies are made up, our brains are made up at a very microscopic level. General relativity, or relativity theory in general, um, is about explaining the largest cosmic dimension, space time, gravity, the whole macroscopic order of the cosmos. And so you can imagine that the-at the-the macroscopic cosmic level needs to be connected to the super subatomic quantum level.

00:10:48	DR. JAN WALLECZEK	How can this be done? And the two theories describing these two realms, uh, really can't do that. And they have not been compatible with each other, you know, since their inception. And since quantum mechanics was developed, there was a tension between the two.
	DAVID BOHM	My interests moved more toward understanding the fundamentals of physics and quantum mechanics and relativity, and I became especially interested in how these two-these fundamental theories are not clear, that their basic ideas are unclear, and they contradict each other.
	MALE	Bohm was thinking very deeply about that and said, okay, it's not-we don't need a new idea. We don't need a new theory. We don't need a new bit of mathematics, which everybody else was trying. What we need is a radically new order to physics. That's what we need, a new order.
00:11:45	DAVID BOHM	With that absolute contradiction of the two basic theories, I said there was only-we could try to find out what they had in common. Now what they have in common is what I call undivided wholeness.
	MALE	So his idea that the whole is contained in each of the parts and the parts in the whole, and my feeling is that that gave an insight to Bohm that this world we live in, you know, is-is all hard and fast, the expected order, this is it, the order. This is really just a surface order. It's-it's not-it's not a deep profound order, and that something lies underneath

		it, which he called the implicate order. So the implicate order is not so much just out of objects but a process. It's a process of constant movement, constant unfolding and enfolding. So what we see is-is our explicate world is really the result of a process, a process of unfolding and enfolding. So the explicate order comes out of the implicate.
00:12:40	PROFESSOR BASIL HILEY	David Bohm was dealing with general ideas. Uh, he would be dealing with philosophical ideas. We would go into language. Is language in-language limiting the way we can express these ideas? He would go into biology and say, "Look, this is the way biological systems develop." The nitrous surely more organic, and yet we're trying to do in our quantum mechanics is to make it mechanical. Perhaps we should move into that area and say that there is a more organic way of thinking about life in general. And then ultimately, he became very fascinated with the role of consciousness in all of this. Where does consciousness come in? What is thought? What is thinking? And he would be discussing those and writing very profoundly about those ideas.
00:13:34	ANNOUNCER	It was David Bohm who joined the dots. He provides both an elegant and coherent view of reality, allowing for something much more subtle to enter in which manifest reality unfolds from a deeper order, suggesting that everything is internally related to everything else and that each part of the cosmos contains the whole universe and unfolds into our perception of

		reality.
00:14:09	DR. DAVID C. SCHRUM	This sense of mystery in life, it takes the power away from our verbal intellectual framework. We still know how to think, we still see the world, uh, in a certain way, but it doesn't have the same power to grip us because we are entering the mystery of actuality.
	DR. SHANTENA AUGUSTO SABBADINI	That's the key, that's the deepest hidden level of reality, the gate of all wonders.
	ANNOUNCER	Exploring the philosophical implications of both physics and consciousness, Bohm's questioning of the scientific orthodoxy was the expression of a rare and maverick intelligence in which much of his most important contributions were expressions of inner feelings, which date back to his early unhappy childhood in Wilkes-Barre, Pennsylvania.
00:15:14	ANNOUNCER	David was born in Wilkes-Barre on December 20, 1917, a coal mining town, once the energy supplier of the world. It had been hit by a serious economic slump caused in large part by the declining use of coal as a source of fuel in industry.
	DAVID BOHM	There was a great deal of unemployment and suffering, and people were out of jobs, and banks were failing, and people were talking about things getting very bad, you know, even revolution. And, uh, then Roosevelt came in, and he produced all these new measures which gave people hope, you see, and I think they lifted things up a little bit and gave

		people some hope that at least it would get better.
00:16:01	ANNOUNCER	His mother was hospitalized on several occasions for mental illness. And his father was distant and disapproved of his son's interest in science, hoping instead that David would one day take over the family business. Life for the young David was not ideal.
	DR. F. DAVID PEAT	Bohm was sort of unhappy. He was unhappy at home, unhappy with his father and the used furniture sales shop, and Bohm, uh, the ambition was that Bohm would own the biggest used furniture sales shop in Wilkes-Barre, Pennsylvania. Bohn didn't want to do that. He wanted to explore ideas, and-and his father wasn't very happy about that. And he felt he lived in a rather brutal world. But one day, he got a hold of a science fiction story called "The Skylark of Space" about a boy who travels up to other planets in a spaceship. That was his dream. If I can go to other planets, they'll be ideal worlds. So for him, this world we live in, this world of space and time is sort of imperfect. It's an illusion. And beyond that is a much deeper reality.
00:17:01	DR. F. DAVID PEAT	That was his school vision. And then as he grows up and becomes older, that becomes his vision of what he called the implicate order. That beyond the everyday Newtonian worldview, there's a much deeper order he called the implicate order. And that was what he was groping towards, how do we uncover this deeper order of the world?

	ANNOUNCER	His fragile nature caused him to be always in search of security until one day with a group of friends, he was forced to cross a stream by means of stepping stones.
	DAVID BOHM	I was with some boys, and we were in the mountains near Wilkes-Barre, crossing a rather rapidly flowing stream, and there were a lot of rocks we had to cross. And they were really far apart and very small, and you couldn't just step across them. And I felt very apprehensive. I was in a new situation. But I suddenly realized you have to jump from one to the other without stopping in between, that were you in a state of movement, everything on one rock would then move to the next. And whereas I usually thought of going for one step to another, uh, I was mapping out the steps.
00:18:10	DAVID BOHM	But after that, I felt I-that-that now I'd made it it made a deep impression on me that this theme has recurred a lot in my work, you know, that, uh, your consciousness is going moment by moment of awareness and not, uh, and not mapped out.
	ANNOUNCER	Despite his father's disapproval of his interest in science, the young Bohm proved to be an exceptional student, writing his unified theory of the cosmos, one that integrated mind and matter while still at school.
	DAVID BOHM	I think this was combined with some tendency to feel-want to go beyond limits, you see. When I was in the small city of Wilkes-Barre, you see

		that the nearest towns around that were called Ashley, Sugar Notch, and-and Warrior Run. [LAUGH] So that's all I knew. I mean I didn't know them, but I knew about them. So, um, we went for a ride beyond Warrior Run; it seemed like going beyond the-the world, you see.
00:19:12	ANNOUNCER	Having finished high school, the young Bohm moved to Penn State University where he graduated with a physics degree. His exceptional ability in mathematics and physics secured him a scholarship to move to Cal Tech in California. There he met with Robert Oppenheimer, who was sufficiently impressed with Bohm to arrange for him to transfer to the University of Berkeley where Oppenheimer headed up the physics department.
	PROFESSOR BASIL HILEY	He became a student of Oppenheimer to do a PhD. And this was just before Oppenheimer went off to set up Los Alamos, the nuclear facility. So one day when Oppenheimer was going off to Los Alamos, Bohm would have liked to have joined him, but he couldn't get clearance partly because he'd, uh, joined the communist party of America for nine months, and then what he was joining it for was to try and see if he could find people so he could discuss Hagel with them, he finally wanted-and didn't even know who Hagel was, so he got totally disinterested and didn’t go again.
00:20:24	PROFESSOR BASIL HILEY	But because of actually paying a fee, he got smeared with communism t-uh, trait. But he said to Oppenheimer just before Oppenheimer went, "What am I going to do about

		my PhD?" He said, "I can't write this thesis because the papers have been classified." And Oppenheimer said, "Oh, okay, just let's get the papers. I'll give you a PhD." And so he left Oppenheimer with a PhD, but as it were, this was a back door.
00:20:54	ANNOUNCER	With a sense of rejection from his own father, Bohm had sought father figures, and it was clear that Robert Oppenheimer was to fulfill that role.
	DR. F. DAVID PEAT	He was a father figure to Bohm and a father figure that's going to ul-ultimately, uh, do damage to him.
	ANNOUNCER	Far away from the narrow constraints of Wilkes-Barre, Bohm enjoyed his new social and cultural life. He actively explored philosophical, social, and political ideas and their wider implications as physical theories. But little did Bohm know that his early philosophical idealism coupled with unfolding global unease would have a dramatic impact on the trajectory that his life would take from now on.
00:21:42	DR. F. DAVID PEAT	The Americans were building the atom bomb. The Germans and the Russians are at war, and it's our duty to help the Russians. And many scientists, including Oppenheimer, felt we should turn to the president and suggest maybe we should-we should tell the Russians what we're doing. And in fact, the President of the United States at that time was in agreement with that, but it was Churchill who overruled him and said, "Are you crazy?" You know. "Don't tell the

		Russians anything." But that was it. There was a sympathy, maybe the Russians should know a little bit of what we're doing. So maybe there was sympathy amongst some of Oppenheimer's students.
00:22:13	ANNOUNCER	Oppenheimer had gathered around him a circle of exceptional research students. Oppenheimer himself supported communist organizations and groups. For Bohm, politics and physics were inseparable. And he soon discovered that several of Oppenheimer's students were interested in what they termed the Russian experiment in which a Marxist society would lead to the transformation of the individual. This idea also played into Bohm's work in physics where he saw parallels between the movement of electrons and the possibility of individual human freedom. This led Bohm to one of his most important early discoveries, the theory of the plasma in metals.
00:23:02	DR. F. DAVID PEAT	A plasma is called a four-stated matter. There-there's gases, there's-there's liquids, there's solids, and the fourth state is like a gas in which the gas is a charged particle. So it would be a bit like what happens around the sun. You have a gas of charged particles. And in a metal, the idea was a metal, you'd have a-a lattice where on the-the nuclei in the lattice are charged, an electron runs through those, a gas of electrons running through, and, uh, uh, Bohm's idea was can I like-can I look at the gas? Can I find a theory for this gas? What he found was that, um, that the extent to which, uh, an electron

		participated in this gas, it became relatively fl-free. So it went back to his old idea about the Russian experiment. To what extent, if I am a member of the collective, can I have individual freedom? It seems a paradox. If I'm a member of the collective, then I-I don't have freedom. I'm part of the group. But he found an extent to which, uh, an electron participated in the plasma, it became free. It became free of the interaction with other electrons.
00:24:02	DR. F. DAVID PEAT	So he began to see, yes, within the plasma, within the collective, there can be individual freedom. So it was both a theory of the plasma in metals and a theory of-of-of freedom in the collective.
	PROFESSOR BASIL HILEY	Now having set up that plasma physics, he was recognized by the people in Berkeley, and he was offered a job at Princeton University. Remember, Einstein was at the Advanced Study Institute, but he was offered a job at Princeton because they thought him a very talented young American physicist.
	DR. F. DAVID PEAT	He went to Princeton, and he took a room in a house next door to Einstein. So he would met Einstein, they become close, he would go to Einstein, in the evening Einstein would have, you know, German ex-patriates over playing the cello, violin, have concerts, and he would go to those and talked a lot to Einstein. Einstein said that he felt Bohm was his spiritual son.
00:24:55	MAUREEN	It's a big place, and they went to

	DOOLAN	their rooms, and they formed quite a community, you know. Einstein would play the violin in the evenings, and, you know, Jacob, uh, Bronowski would visit. I mean it- it must have been very sort of stimulating for David Bohm, this- this boy from Wilkes-Barre. [LAUGH]
00:25:18	ANNOUNCER	In this period, Bohm also wrote a standard textbook on quantum theory which presented the orthodox Copenhagen interpretation of the theory as outlined by Niels Bohr.
	PROFESSOR BASIL HILEY	He then was asked to give a course on quantum mechanics. And he gave an orthodox course on quantum mechanics. At the end of the course, he thought, well, I don't really understand this quantum mechanics, so he said, the best thing to do if you don't understand something is to write a book. So he then wrote a book which he entitled "Quantum Theory," which has a reputation of being one of the best books on quantum theory at the time. He was describing standard quantum mechanics, Bohr's point of view, he was trying to defend Bohr's point of view, had a lot of discussions about Bohr's point of view as well as some very interesting applications of quantum mechanics.
00:26:17	PROFESSOR BASIL HILEY	And it was there by looking at Bohr that he became very interested in this notion of wholeness. A notion which he carried into much more general situations as he got clearer and clearer how wholeness was arising in the quantum structure itself.

	ANNOUNCER	However, Bohm began to feel that something was not quite right about Niels Bohr's interpretation, believing that it placed a limit on what could be said about the quantum world.
00:26:55	ANNOUNCER	As we have seen, the quantum domain is the subatomic realm, the world of the smallest things in the universe, all that is invisible to the naked eye.
	ANNOUNCER	Since the 1920s, there has been one experiment which it is said puts one up against all the paradoxes and mysteries of nature 100 percent. The experiment is the famous double-slit experiment. If we fire electrons through two slits, they start as particles, but instead of creating two distinct bands on the wall on the other side, they in fact create an interference pattern like waves.
00:27:43	ANNOUNCER	In an effort to decode this mystery, physicists decided to put a measuring detector by one slit, but when they did, the electrons did not produce any interference pattern. The act of observing collapsed the wave pattern.
	ANNOUNCER	This mystery cuts to the heart of why Bohm began to differ in his views from Niels Bohr. Both Bohr and Bohm agreed in the essential wholeness of quantum theory, but Bohr believed the quantum world to be unanalyzable. That there can be no layer of reality beyond quantum statistics.
00:27:28	PROFESSOR BASIL HILEY	Bohr had this idea that we could not say anything about the underlying reality, and people have

		taken that also to mean that there may not be an underlying reality. Einstein completely disagreed with his point of view. He thought there must be an underlying reality, and this underlying reality would produce the effects we actually see in our instruments. Now the question then was what is that underlying reality?
00:28:56	PAAVO PYLLKKANEN	Bohm was saying, yes, we can talk about quantum objects, we can talk about the quantum world, but it-the quantum world is radically different from the classical world.
	PROFESSOR BASIL HILEY	What Bohm did when he came along was to be influenced by-by Einstein in a way that he also felt that there was something underlying the statistical features.
	ANNOUNCER	Bohm felt that something mysterious was happening, and the key for Bohm is that what we observe as distinct and separate in our everyday world of space and time is in fact connected and not separate at the deeper quantum level because they are part of a single system where separation does not exist.
00:29:45	ANNOUNCER	But while Bohm continued to be preoccupied with such questions, his communist leanings coupled with concerns of Los Alamos about possible leaks of classified information to the Russians was to impact dramatically on his life within physics and ultimately his own view of the scientific orthodoxy.
	PROFESSOR BASIL HILEY	McCarthyism had suddenly come back to the fore with the Korean War. And-and McCarthy was trying to get

		people to testify against colleagues at Berkeley and Los Alamos. And David Bohm was asked to testify, and he refused.
00:30:27	DR. F. DAVID PEAT	He was asked to give names. He refused to give names. And, uh, the, uh, as a result of that, he was arrested for contempt of congress.
	PROFESSOR BASIL HILEY	He wanted to plead the First Amendment, which is freedom of speech, but the lawyers suggested, no, that will be a difficult thing to get out of. You must plead the Fifth Amendment. And the trouble with the Fifth Amendment is that it's essentially preventing you from incriminating yourself. McCarthy was absolutely frustrated with all these people refusing to testify, so he put to the Supreme Court that it should be illegal-to be made illegal or unconstitutional to plead the Fifth Amendment in this case. And one day when Bohm was, uh, in Princeton, a sheriff came and actually arrested him. And he was arrested because he was using the Fifth Amendment.
00:31:19	PROFESSOR BASIL HILEY	The interesting story here is that he said the sheriff was a very intelligent sheriff, and they had a discussion on the foundations of quantum mechanics as he was driven from Princeton to Washington, which is unbel-but typical David Bohm. Then he was bailed, but very shortly after the bail, the high court ruled that it was not unconstitutional to plead the Fifth, and so he was released. But because he had been enmeshed in this mess, the principal or the head of the university banned him

		from the campus.
00:31:59	PROFESSOR BASIL HILEY	Einstein actually wanted him to become his assistant, but Oppenheimer objected. In fact, Oppenheimer saw Bohm in Princeton once and said, "I thought I asked you to get out of the country because I think for your own safety, you should leave the country."
	DR. F. DAVID PEAT	And I know he did write to Einstein asking him to help him, but no, the only thing was-was to leave the United States and go to Brazil. So he had no future in the States. He just had to leave. And that was it.
00:32:27	DR. F. DAVID PEAT	When he got to Brazil, the American authorities took his passport away so that he could no longer travel.
	PROFESSOR OLIVAL FREIRE, JR.	David Bohm left the US because he was a victim of McCarthyism. Uh, he lost his position at Princeton University, and he was unable to, uh, get another job in American universities. Uh, he came to Brazil because at the time, there were Brazilian physicists, uh, at Princeton too who invited him to teach at the University of Sao Paulo in Brazil.
00:33:12	ANNOUNCER	Exile was a chilling experience. At Princeton, he had been surrounded by friends. His work on plasmas was recognized as significant. His book on quantum theory was considered the best. His continuing concerns about Niels Bohr's interpretation of the quantum world in which Bohm responded with a more causal or realistic version of quantum theory

		he put into a new paper which he called "Hidden Variables".
	PROFESSOR OLIVAL FREIRE, JR.	Bohm realized that the success of quantum mechanics, success in productions of quantum mechanics, and also the stability of quantum mechanics were evidence of a new kind, a new type of a physical series.
	DR. F. DAVID PEAT	Well, he-he, uh, had really questioned the orthodox interpretation of Bohr, Heisenberg, and Copenhagen interpretation, and decided to develop his own approach which he called "Hidden Variables."
00:34:13	ANNOUNCER	In other words, the behavior of quantum particles were not chance processes, for the motion of electrons were guided by underlying pilot waves.
	PROFESSOR YAKIR AHARONOV	His book on quantum mechanics was the best ever book written in time to explain as best as possible the ideas of Niels Bohr. But why Bohm wrote this book, finally he decided that the delivery was his own explanation therefore led him to this new theory of hidden variable. The theory of hidden variable was extremely interesting be-because it showed quantum [INAUDIBLE] everybody [INAUDIBLE] responsible will come from all the quantum behavior by similar [INAUDIBLE] points, which are the hidden variable.
00:35:03	ANNOUNCER	When he finished his paper, he sent it for publication, believing it would act as a shock wave to physicists.
	DR. F. DAVID	And that was what he wanted, you

	PEAT	know. Some people would say, "No, you know, I want to be accepted." No, I-it's not that I wanted to be accepted; I want to open the door to the debate that he felt was-with-with the Copenhagen interpretation, the orthodoxy had closed the door. There was a bit of controversy, but let's close the door. Let's all agree. We'll all come together, we'll come to Copenhagen, we'll all have some meetings, we'll have a lot of arguments, but in the end, we'll agree, okay, we all believe the same thing. No, Bohm said, "I want to open it up." So that's what he felt. And when this paper comes out, it'll cause great controversy. He's in Brazil, the paper appears, nothing. He hears nothing. He only heard from one person, Dubrois [PH], his assistant. That's it. He heard nothing. Uh, and he was shocked. Why? Why is there nothing? Why-why aren't-why aren't people writing to me? Why is there no controversy?
00:35:57	ANNOUNCER	This deeply puzzled Bohm, and it was only later that he discovered the reason.
	PROFESSOR BASIL HILEY	There was a student who had read Bohm's paper in Princeton when Bohm wasn't in the country and took the paper to Oppenheimer and said, "Look, this is what Bohm wrote. Nobody refers to it. Nobody's discussing it. What's wrong with it?" and gave the paper to Oppenheimer. Three or four weeks later, Oppenheimer had not responded, so the student went to Oppenheimer and said, "Have you read the paper?" He said, "Yes." And he said, "What's wrong with

		it?" And Oppenheimer said, "Nothing." So the student said, "What are you going to do about it?" And Oppenheimer said, "Nothing, just ignore it."
00:36:49	PROFESSOR YAKIR AHARONOV	Physicists at the time had a kind of prejudice against the research of foundations of quantum mechanics. They thought that, uh, all foundational issues had already been solved by the founding fathers of the discipline. Uh, but, uh, this was a mistake.
	AEPHRAIM STEINBERG	So Bohm was a huge pioneer in-in this regard, and it's perhaps not surprising that there wasn't a huge audience for the kind of ideas he had then, um, but he simply asked the question instead of taking it for granted that Bohr must be right because it was the word given from on high. Uh, he really insisted on investigating what the alternative pictures were just as Einstein did.
00:37:30	DR. JAN WALLECZEK	But at the specific level, the Bohmian theory made a clear predication about the nonlocality of the world. What is nonlocality? Nonlocality is really, to put it in simple words, the profound discovery of the interconnectedness of the universe at the fundamental level of quantum. Now, that conflicts deeply right away with relativity theory where it says, no, the speed of light is limited, everything is local, uh, nothing can travel faster than the speed of light, so how could everything be instantaneously interconnected in the universe? And that's the big clash that we have today, and that's why also Bohm's theory of hidden variables, which are

		nonlocal, has really been rejected from the start because there was this deep conflict with relativity theory. And nobody could get the two together.
00:38:26	DR. F. DAVID PEAT	It was only later he learned that after he'd left, uh, the United States in exile that Oppenheimer had called a conference at Princeton, invited the leading physicists to discuss Bohm's paper, and find a flaw in the argument. And at the end of the meeting, Oppenheimer said, "If we cannot-if we cannot find a-if we cannot find an error in Bohm, we must all agree to ignore him." So word went out to ignore Bohm. And that's what Oppenheimer had done, ignore Bohm. And that was, for Bohm, a tremendous shock.
	PROFESSOR BASIL HILEY	And that was the end of the discussion of that particular paper.
	DR. F. DAVID PEAT	And Oppenheimer wanted Bohm out of the way. He didn't want to be contaminated by Bohm. Bohm was politically suspect. He was politically suspect. He'd been before the House of American Activities, he'd been thrown out of the States, he wanted Bohm out of the way. He wanted nothing to do with Bohm. So I think that's it. Distance himself from Bohm.
00:39:20	ROBERT OPPENHEIMER	A few people laughed. A few people cried. I remembered the line from the Hindu scripture, the Bhagavad Gita, "Now I am become death, the destroyer of worlds."
00:40:20	ANNOUNCER	Unhappy in Brazil and unable to travel, Bohm's only option was to

		take out Brazilian citizenship. And so he traveled to Israel where he accepted a position at the Technion on Haifa. It was here that he had a successful collaboration with one of his students. What became known as the Aharonov-Bohm effect was several times nominated for a Nobel Prize.
00:40:47	PROFESSOR YAKIR AHARONOV	When I came to study at the Technion in Haifa as an undergraduate and my teacher in quantum mechanics was the famous Nathan Rosen who was one of the three famous author and also the Einstein-Podolsky-Rosen. And I took my course of quantum mechanics with him. At the end of the course, we had to write a kind of a self-thesis to Nathan the great. And each one of us had to come to Nathan Rosen and propose a subject. So I came to him and told him I want to do some work on quantum foundations. And he said, "No, no. This is supposed to be something that only old people like me worry about. Young people like you should do down-to-earth problem with physics." And I told him, "But, Professor Rosen, the only reason I decided to do physics is because I was interested to get answers to basic questions, and the only way I could get answer for those are by continuing the foundations of-of physics, especially of quantum mechanics."
00:41:57	PROFESSOR YAKIR AHARONOV	So he say, "I'm not going to agree with this because you will waste your time thinking about it," and we had an impasse. I-I thought that he wanted to even test me, and at that time, somebody came and told me, "Look, there is a new

		professor who just arrived in the Technion by the name of David Bohm," I knew about his quantum book, serial book that he wrote, and you must go and-and see him. So I came to his office, knocked on the door, came in, and told him my difficulty. He said, "Tell me what you're thinking about." So I started to tell him about my worries about quantum theory of measurement, in particular how you combine it with the find the velocity of light, and said, "That's very interesting. I'm willing to take you as my physics student," and that's how it started.
00:42:52	ANNOUNCER	While in Israel, Bohm also met and married the woman who is to become his lifelong partner, Sarah Woolfson.
	MAUREEN DOOLAN	David had been exiled to Brazil after the House in American Activities business, and he was never happy there, you know. There were-there were many problems he felt. And then he was offered, uh, an opportunity, um, in Israel. Uh, and of course, it was a new state at the time, and, you know, I mean and also of course he was Jewish. Um, maybe he saw this, you know, as a-as a good opportunity. And, um, he'd only been there a couple of weeks when he was invited to a party, and Sarah was present. And, uh, she spotted him from across the room and immediately was interested in this young man. And, um, my feeling it was-it was much more than a physical attraction; she actually saw something in him.
00:43:52	MAUREEN	And she said within no time, she

	DOOLAN	felt that she'd been given this responsibility to look after this man and to look after him for the rest of his life. And in fact, that's what she did. I would describe Sarah as a very motherly person. And in the photograph, she does look rather matronly I would say. And certainly, Dave does look younger than-than Sarah. She wanted to look after people. She liked to feed people, you know. Uh, she was very sociable and including everyone, and she was looking for someone to mother, and he was looking for a mother. And in fact, one of the early girlfriends said, you know, she felt Dave had two great talents, and one was for, uh, being miserable, and the other was for getting people to take care of him. And they did take care of him, you know. I mean I've seen him sort of surrounded by women who wanted to take care of him.
00:45:00	ANNOUNCER	From Israel, Bohm moved to Bristol. And it was here that his fundamental ideas on the nature of reality began to take fresh impetus. In Bristol, Bohm left his hidden variable ideas behind and was now focusing on the fact that despite decades of work, physicists had been unable to reconcile quantum theory with Einstein's relativity.
	DR. F. DAVID PEAT	He's left behind his hidden variables, he's left that behind, and now he's asking why has there been decades of work on relativity and quantum theory, the two key-key theories of physics. Why are there are there two? Why not just one theory, one unified theory, as

		Einstein had hoped there would be? And-and so he's wondering, do we need-do we need a new theory? Is that q-issue, or is it a completely new order to physics, a new approach? And that was what he began to think about was he called the implicate order. We need a radically new order. So that was where his thinking was when he arrived in Britain.
00:46:03	ANNOUNCER	At this time, Bohm also developed a new interest that was to have a deep impact on his life and his approach to science. As we have seen, quantum physics has long been concerned with the process of wave function observation. And Bohm was very much aware that depending on the conditions of an experiment that electrons would behave differently depending on what was being observed.
	DAVID BOHM	When I was younger, I felt that in the beginning that science would surely be, uh, a source of benefitting mankind, and, uh, I had no question about it. I began to feel that something beyond science would be needed to approach this question, you see. Th-that, uh, people-science alone could not guarantee that it would be used for benefitting mankind, the scientific impulse that at the beginning, I thought it would, just truth alone.
00:46:58	DAVID BOHM	Then, uh, uh, I began to look into philosophy and, uh, Eastern and Western and so on and some people with religious ideas, I mean just simply looking at it when I was in Bristol in England, and we were-my wife and I used to go to the public library, and she discovered a book

		by Krishnamurti, and she read in there the words the observer and the observed. I have been interested in that because in quantum mechanics, that is a key question in the sense that because of this undivided wholeness, the two cannot be separated.
00:47:27	LEE NICHOL	And she opened the book and in it immediately saw references to things with regard to the observer and the observed. And she was startled because that's what David was working with in physics. And Sarah was trying to understand how could this be that this Indian philosopher is also talking about the observer and the observed?
	DR. DAVID EDMUND MOODY	In quantum physics, in the study of the behavior of the electron, you have this very mysterious property that the very active observing the electron changes it in such a way that there's a link between the apparatus of observation and what is observed. And Krishnamurti made a similar, uh, statement about events in the psychological field, which is that, um, the act of-of-of observing something inwardly, some emotion or some attitude or whatever, the very seeing of it changes it. So if the inward sense of-of an observer myself who's looking is inextricably connected with whatever I'm looking at.
00:48:33	DR. DAVID EDMUND MOODY	And so Krishnamurti expressed that in sort of an aphoristic fashion by saying the observer is the observed.
	LEE NICHOL	Which in essence took the questions that David was working with in physics and flipped them into the

		human realm, the realm of human experience, human life, human difficulties, and that the issues of the observer and the observed, which in part are related to the spectator consciousness, David felt that Krishnamurti was onto something of great importance that could help to complete the sense of wholeness that he was trying to bring to light with his work in physics.
00:49:17	ANNOUNCER	Krishnamurti's approach aligned with Bohm's own views on the nature of thought, of reality, and on the nature of consciousness in particular. Seen as a coherent hold which is never static or complete but a continuous process of enfolding and unfolding.
	DR. DAVID EDMUND MOODY	We're talking 1922, and this is when Krishnamurti first came to the United States for the first time. He was 27 years old, and he came here with his brother, Nitya, Nityananda, who was 24 and suffering from tuberculosis. And that is the reason they came to the United States and the reason they came to this valley of Ojai because, um, the way the valley is situated, it's supposed to have a-a good climate for people suffering from tuberculosis.
00:50:12	ANNOUNCER	Both Bohm and Krishnamurti questioned their respective backgrounds, ultimately rejecting the orthodoxy they had once felt would provide answers to humanity's big questions.
	DR. DAVID EDMUND MOODY	In his early life, he was kind of adopted by this organization called the Theosophical Society, which

		discovered him when he was a 14-year-old boy, uh, on the beach and in South India. And they predicted that he was going to become, you know, this great what they called world teacher and, uh, and bring a new kind of consciousness to mankind. And they cultivated him and nourished him in this role. They created this organization called the Order of the Star, which was just for him to emerge and become this, um, world teacher.
00:51:06	DR. DAVID EDMUND MOODY	But somewhere about the age of 25, 27, maybe a little bit earlier than that, he began to seriously question all of this and find it very limiting, similarly to the way Bohm had found the scientific orthodoxy to be limiting.
	DR. F. DAVID PEAT	When he was out in Ojai, California, he went through what was called a process. He went through something in which his brain was transformed. So he believed his brain had been transformed, it was unconditioned.
	DR. F. DAVID PEAT	Something spoke through him what-when he spoke directly. He said, "Somebody could speak directly through me." So Bohm wanted to meet this man, and they had this meeting, and I'm told part way through it, Krishnamurti supposed to stood up, you know, with pleasure or enthusiasm or whatever, and said, "You have seen it, sir." So that Bohm had seen it, and then Bohm began to have more meetings with Krishnamurti. He became a trustee of Krishnamurti's school at Brockwood Park. Uh, they had, uh, a number of dialogues together that were tape recorded. Th-these

		dialogues continued for some years. So he became very involved with Krishnamurti.
00:52:14	ANNOUNCER	It was at Brockwood Park that Bohm and Krishnamurti entered into a series of conversations whose themes covered the ending of time, the nature of mind, cosmic order, and much more over a 25-year period.
	DR. DAVID EDMUND MOODY	They had a-a great deal of interaction over 25 years. And from Krishnamurti's perspective, it was very important for him because he felt as though he had, um, a tremendous reservoir of, um, insights to share with the world, but he felt like he couldn't necessarily bring it out by himself. He needed people to ask him. He needed people to-to dig and to question him. And of all the people he ever met, Bohm was the best at that. And I think Bohm, you know, to some extent, formed a similar function for Krishnamurti because Krishnamurti could raise questions with him that might not occur in another context.
00:53:12	DR. DAVID EDMUND MOODY	For example, in the-in the, um, series that they did together that was published, um, as the ending of time, uh, you know, Krishnamurti raises this question.
	KRISHNAMURTI	If humanity has taken a wrong turn?
	DAVID BOHM	It must have been so for a long time thought I think.
	DR. DAVID EDMUND MOODY	And Bohm immediately starts talking in terms of events which occurred within the last, uh, two or three thousand years, or five thousand

		years, and Krishnamurti goes, "No, no, much longer." Um, he's thinking in terms of evolutionary times, something really deep in, uh, in the evolutionary development of consciousness. And-and so they explore this together and they come up with it together. They come up with a lot of interesting observations about that.
00:53:58	DAVID BOHM	Uh, uh, so th-th-this might be one of the barriers to the whole thing that people get behind, that-that behind the ordinary everyday thought, there is a deeper thought of mankind, which is that these qualities, though we're all divided, and this various qualities either belong to us or don't belong to us.
	KRISHNAMURTI	Okay. Okay.
	DAVID BOHM	Then we compare.
	KRISHNAMURTI	Is it fragmented mind that invents one.
	DAVID BOHM	Yes, well, it has all been invented, but now we have picked it up verbally and nonverbally from childhood and by implication.
	KRISHNAMURTI	Implication. Right.
	DAVID BOHM	And therefore, it-it pervades. It is at the ground of our thoughts, you see, of all our perceptions. And now so this has to be questioned, you see. Uh...
	KRISHNAMURTI	We have questioned.
	DAVID BOHM	Yeah.
	KRISHNAMURTI	I mean we have questioned that

		[CLEARS THROAT] grief is not my grief; grief is human.
	DAVID BOHM	Yes, not-but how are people to see that? Because a person feeling grief feels that it's his grief, you see. I mean doesn't that seem right?
	KRISHNAMURTI	Yes, sir. I think it is because part of our education, part of our society, tradition.
00:55:01	DAVID BOHM	But it's also implicit in our whole way of thinking.
	KRISHNAMURTI	Yeah. Your whole way of th-quite right. So...
	DAVID BOHM	Then we have to jump out of that, you see.
	KRISHNAMURTI	Yes.
	DAVID BOHM	But perhaps we can see that love is not personal. Love does not belong to anybody any more than any other quality does.
	KRISHNAMURTI	Earth is not, uh, English Earth or French Earth. Earth is earth.
	DAVID BOHM	You see, and-and I was thinking of an example in physics that say if a scientist or chemist is studying an element such as sodium to see if-that that it's not his sodium and somebody else studies [OVERLAP].
	KRISHNAMURTI	Yes. [LAUGH]
	DAVID BOHM	And they somehow compare notes.
	KRISHNAMURTI	Quite, quite. Sodium is sodium.
	DAVID BOHM	Sodium is sodium universally.

	KRISHNAMURTI	Yes.
	DAVID BOHM	And I have to say love is love universally, right?
00:55:43	DAVID BOHM	Essentially, the point made by Krishnamurti was that the problems of mankind or-originated in thought itself, in consciousness itself, you see. Uh, and I was previous to that. You know, I had grown up believing that poverty was the main problem of mankind and science would help eliminate that. And I could see that no matter how far since went, it probably wouldn't, and even if it did, it wouldn't really solve-it wouldn't really make mankind happy. [LAUGH]
	DR. DAVID EDMUND MOODY	Krishnamurti was very concerned with conflict, inwardly and conflict between people and the resolution of conflict. He had very, very few statements that he would have characterized as a law, but this one statement that he made repeatedly and said was a law, I-I call it Krishnamurti's law. He said, where there's division, there must be conflict.
00:56:27	PAAVO PYLLKKANEN	I remember I once asked Bohm that so what-what do you think was the main contribution of-of Krishnamurti? And if I remember it correctly, Bo-Bohm said something like that Krishnamurti kind of pointed out that thought is an actual movement in our lives. It's-it's some-it's-it's some-it's-it's-it's a c-it's a physical movement, uh, physiological movement, and it has a tremendous, uh, power. It's behind all-almost all our problems. Of course, we have some problems like a meteorite

		that we haven't caught and other natural disasters, but many problems actually originate from the mind.
00:57:03	DR. DAVID EDMUND MOODY	And we have to give attention to that manner in which thought is participating and shaping what we observe in order to understand how our whole, uh, mind is working, especially with respect to, um, uh, conflicts which occur between you and me, between my country and another country, and-and also conflicts which occur inwardly.
	PAAVO PYLLKKANEN	Be aware of our thoughts in this way that the mind could also be inquired, and there-then, of course Krishnamurti was suggesting that if-if you are able to be quiet, uh, you know, deeper layers of reality might open up for you.
	DR. DAVID EDMUND MOODY	So in that state of mind, uh, the mind is not just blank, but you know, not doing anything, it-it's very active. The thinking process doesn't have to do with thought or recognition or knowledge but is in a state of just perception, awareness, attention, and maybe you could even say receptivity to truth.
00:58:01	AEPHRAIM STEINBERG	I think there might have been many reasons Bohm was drawn to Krishnamurti. The ones that are apparent to me is that Bohm perceived the wholeness of life. He perceived life as one indivisible whole, including nature, including consciousness. Um, and in Krishnamurti, he found someone who also had this notion.
00:58:29	DR. F. DAVID	Krishnamurti, who was actually

	PEAT	addressing the separation of the observer and the observed in the same way as the wholeness in quantum's theory was saying you can't make a separation between the system that you're looking at and the apparatus, which was the old traditional way of doing it, that somehow these things formed a whole. But rather than saying you can't develop concepts for it, what David was trying to do was to develop concepts, uh, to develop those concepts, you can't develop it within a scientific context. You've got to go outside to a wider set of concepts. And he found in Krishnamurti a way of discussing this more general question.
00:59:11	LEE NICHOL	Krishnamurti had an enormous impact on David and the entire trajectory of his life, particularly in terms of what is the nature of the human being at the deepest level? Does it have access and contact with some kind of primordial intelligence? And I-I think it was the contact with Krishnamurti that really, really set that in motion in a very strong way for David, for better or for worse.
	DR. F. DAVID PEAT	Bohm would talk to me about Krishnamurti, uh, and he felt that he did believe that Krishnamurti's brain was different than anybody else's, that it had been transformed, that it was unconditioned. And he also said he felt that in the presence of Krishnamurti, it was possible that his own brain could be transformed. And, uh, at times, you could say almost a bit to an extreme. I remember one day, we were here in Italy, and he said to me, "Do you

		think I should give up doing physics and just devote myself to Krishnamurti?"
01:00:20	DR. F. DAVID PEAT	And my reply was, uh, "Can a-can a fish exist outside the goldfish bowl?" So [LAUGH] but that was it. He was that-that extreme that maybe he should devote himself completely to having his own brain transformed.
	PAAVO PYLLKKANEN	One way of saying it is that he had become somewhat disappointed with both science and politics, and therefore maybe he was asking, well, could something more in the spiritual, uh, domain be-be the right-right thing to do.
	LEE NICHOL	Well, you know, David honestly would question anything and everything. So yes, he did come to question, uh, everything about his work with Krishnamurti, and I think he probably sifted what was useful for him and what he could carry forward and work with that was true for him, and he left what wasn't.
01:01:35	ANNOUNCER	Having settled permanently in the UK, it was while at Birkbeck College in London that Bohm formed one of the most enduring science partnerships of his life with physicist Basil Hiley. And he also had an unexpected and welcome encounter with a forgotten theory. And that encounter changed everything.
	PROFESSOR BASIL HILEY	When I first joined David Bohm, we didn't talk about his hidden-his hidden variable '52 paper. What we were talking about was how could we get quantum mechanics and gravity and general relativity into one

		theory? How could we gravito-how could we quantize the gravitation field? Fortunately, we had Roger Penrose [PH] with us at Birkbeck at the time, and David Bohm, Roger Penrose, myself, and some mathematicians used to meet and talk about this problem.
01:02:36	SIR ROGER PENROSE	Well, I got to know David Bohm quite well when I was a lecturer at Birkbeck College in London. And Bohm was there at Birkbeck too. And he, Bohm, and Basil Hiley and I used to have get togethers, but we had many very interesting discussions. And, uh, Bohm was somebody who I got a lot from. I always thought that his-he was very much like a wave function in himself that you'd ask a question, you see, very specific question, and he would be very focused and give you a deep, very focused answer, uh, to that question. And then it would start to spread out, and it would encompass a little more about physics, and it'd spread out and then about theology and about h-human nature and so on. And I'd get a bit lost about what's going on. So I needed another question. I'd ask him another question, and boof, the conversation would focus itself very deeply on this particular point, and he would give us very succinct answers to that. And then again, he would spread out like this. So just aware-a wave function. You measure it is the particle here, and woof, you see, and then it spreads out again like this.
01:03:45	PROFESSOR BASIL HILEY	At that time, David Bohm was developing a new idea which was

		called structure process that basically we want to start with process. Not particles moving in space time but a process from which both particles and space time can emerge. Very radical ideas.
01:04:09	PROFESSOR BASIL HILEY	And it was only much later, I think it was almost after ten years of me working with David, that Chris Dewdney and Chris Philippidis came up to me and said, "Why don't you talk about the '52 paper?" And that's when I said, "Na, na, because I think it's wrong." And that's when Chris said to me, "Basil, have you s-have you read the paper?" And I then had to agree that I hadn't.
01:04:40	DR. CHRIS DEWDNEY	Basil was giving impression, well, he didn't think it was worth pursuing, hadn't really read the papers. It wasn't what they were doing now. They were doing something, you know, more, uh, fundamental. Um, but the more we talked about it, I think the more he realized there was something... maybe there's something in this, you know, maybe something worth doing. Um, and so yeah, Basil went off to read the papers.
	PROFESSOR BASIL HILEY	And when I went away and I saw it, I thought, well, how on earth can he get trajectories out of this non-commutative stauncher?
	DR. CHRIS DEWDNEY	I think it would be a very valuable thing if we-if we could show clearly how Bohm's '52 theory worked in the two slit experiment because obviously the two slit experiment is the iconic experiment in, uh, in the interpretation of quantum theory.

01:05:28	PROFESSOR BASIL HILEY	And that's what Chris was a absolute master at was actually developing computer programs to actually simulate this, and let's have a look at what is going on here.
01:05:46	ANNOUNCER	In Bohm's hidden variables view, wholeness is present and analyzable, and the evolution of particles is describable in a clear and intuitive way that gives rise to well defined motions in the real space of our everyday world. What Bohm refers to as the quantum potential seen here arises naturally within the quantum domain. Giving rise to a force, a process that conditions the energy of a particle so that its internal form responds appropriately. It is in this context that we can say that the quantum potential is informing the particle of its condition and context within the whole.
01:06:39	ANNOUNCER	David Bohm and Basil Hiley show how this new interpretation introduces a radical new approach of an unbroken wholeness in the universe that gives rise to a fundamental new quality in quantum physics called nonlocality. The profound interconnectedness of the entire physical universe.
	DR. CHRIS DEWDNEY	So, um, I set about calculating the particle trajectories for this, and Chris Philippidis, um, produced the-the quantum potential picture, and we-when we put the two together, I mean we were initially, um, I think quite staggered by the-how amazing this story was, which had never been told, um, in any

		sort of clear detailed way.
01:07:29	PROFESSOR BASIL HILEY	And there was a trajectory to the two-slit experiment. Chris Dewdney and Chris Philippidis approach it, beautiful. I thought wow. Then I said, "Well, wh-what about the quantum poten..." "Oh yes, we've worked that out as well."
	DR. CHRIS DEWDNEY	You could actually see in the images that we produced exactly how you could have particle trajectories in the two-slit experiment and the camp for interference, something of course which is forbidden, uh, in normal quantum theory. And I think that was, uh, something that was very, uh, very amazing to us, you know, that you could actually see how the thing worked exactly. You could follow individual particles as it was affected by this true potential, um, through space and consequential guide the particles into the bright interference fringes, so it was quite, uh, yeah, quite an amazing experience actually to see it done and, uh, to see how well it worked.
01:08:33	PROFESSOR BASIL HILEY	Wherever there was a dip in the quantum potential, that's the rate of change of a potential, which is a force. And the trajectories would jump across the ditch, and when they were on the plateaus, they would just come straight. And the end result was gathering these trajectories which explained completely the interference pattern.
	DR. CHRIS DEWDNEY	The films actually have within them, uh, a plot of the quantum potential, um, and how this changes

		with time. And so two of the particles coming in, and they meet this quantum potential, and the quantum potential exerts a force on them. You can see how that, uh, changes the motion of the particles and allows them through the barrier or reflects them from the barrier. So the quantum potential was-was there in these pictures.
01:09:24	PROFESSOR BASIL HILEY	Now according to-to the orthodoxy, that is not possible. There's nothing in the formulas, and they told us to make that possible. At that stage, when Dave was still alive, he saw these trajectories and-and these quantum potential, and his eyes actually lit up because he had not seen them. He'd written about them, but he had not seen them. And then we started discussing the quantum potential. What could it mean? And this quantum potential energy only functions when quantum phenomena appear. That is in the particle approaching two slits. It is the quantum potential that organizes the way the traje-the individual trajectories work. So there is a dynamic whole process going on in which the quantum potential appears.
01:10:21	DR. CHRIS DEWDNEY	When I showed these films, you know, the lights went down, and-and the film was projected, and the-the impact was often very strong because, uh, you know, sometimes you would hear almost gasps from the audience. How could they be seeing this, this thing which was forbidden, um, to be done, you know? And [all?] said, "You can't make pictures of what happens in quantum phenomenon. But there they

		were seeing them, you know. So that was, uh, they had a major impact. In fact, um, there was a physicist, Franko Celery [PH], who-who was particularly supportive of this work once he-he'd, uh, learned about it, um, and he referred to these movies as the hard porn of physics in a sense because, um, you know, they-they would be censored by the, uh, orthodoxy. You shouldn't be able to see this stuff, and yet here we were projecting it in-in front of them.
01:11:17	ANNOUNCER	Because the quantum world transcends any description limited to our apparent three-dimensional realty, Bohm's theory can explain the loss of interference when a detector is in place. We describe the detector as a particle quantum mechanically. It will have one wave function when it detects a particle moving through the left slit and a distinct wave function when it detects a particle moving through the right slit. We see wholeness emerging from the quantum world, transcending three-dimensional space where our sense perceptions arise. The wave functions of the detectors slide up and down from the off position. This changes the trajectories, causing the waves to separate from the two-slit pattern to the noninterfering single slit pattern.
01:12:13	ANNOUNCER	There are no separate wave functions for each particle, just a single function that describes the whole system where nonlocal connections are made.
	PROFESSOR BASIL HILEY	If you actually explained this nonlocality which was found in

		quantum theory, which is sort of a manifestation of this wholeness in a particular totality, namely the totality of two entangled particles. Because it was nonlocal, everybody said, you know, oh, it's a load of rubbish. John Bell [PH] saw this paper, and as he put in the title of one of his p-"I saw the impossible done."
01:13:02	DR. JAN WALLECZEK	Now these experiments that are done today at UCL at Toronto University, they take this to another level. They are designed to actually prove the existence of Bohmian quantum trajectories which would provide evidence for the existence of an underlying quantum potential which would in fact have these nonlocal properties for real in connecting those distance states. That would be an enormous breakthrough, uh, because people then couldn't argue, no, there is no underlying reality, because to show trajectories with an indicator, the first sort of indicator people would-would really t-have to take-have to take a deeper look at for the existence of sort of a potential that could connect instantaneously at a distance.
01:13:51	SIR ROGER PENROSE	The picture we have normally is that something happening over here is independent something, I mean you-th-this is what these experiments, particularly what Bohm's example, you have a, um, a-a s-something which starts off without any spin, and it produced two particles which spin in the most basic way, and because this didn't spin initially, then these have to have compensating spins, which could be in any direction. But if you measure this in one

		direction, the other one is automatically the other way. But yet how does it know? The problem is if this thing actually sent a signal, then because of the idea of special relativity, that signal could not propagate faster than the speed of light or you'd have contradictions. But it's a subtle thing that somehow the entanglement between this and this can't be understood as the signal which could carry information; otherwise, you'd be in trouble. And there are a lot of subtleties about this, which sort of originated with David Bohm or Einstein, and two of his collaborators, Podolsky and Rosen, wrote a paper, but the-the ideas that David Bohm had on this were in my view a lot clearer and gave a much better picture of-of what these entanglements are.
01:15:11	ANNOUNCER	We see two particles created together in an entangled state. The fate of each particle at its measuring device depends on what happens to its partner. Even when at opposite ends of the universe, the particles' motions are non-locally correlated. When one goes up, the other must go down. But no information passes between them. Flipping the switch affects the motions of both particles instantaneously. This demonstrates a wholeness that is not understandable in our everyday world of space and time. Arising instead from the deeper level or the implicate order in which all things are nonlocally correlated.
01:16:04	DR. JAN WALLECZEK	Nonlocal information does exist. And in all aspects of the universe at that level are correlated

		informationally. But what it also says is the price to pay for that is that we cannot access that domain. It always will be a hidden domain, that nonlocal domain. This is why it's called hidden variables. It really says that there exists a hidden regime of reality in which everything is interconnected but no person, even in the future, will be able to access that domain and make-and-and control it. Uh, so this is also what the mystical traditions tell us that we must be humble in front of reality, that there will always be domains of reality that will remain beyond science, beyond the scientific method, uh, will remain beyond access by scientific agents. And if the quantum potential is discovered in this way and nonlocality is proven, then the existence of that domain is proven.
01:17:08	DR. CHRIS DEWDNEY	Nature must be nonlocal if it's going to have a hidden variable explanation.
	AEPHRAIM STEINBERG	It seems strange to us, and I stress the word seems, but if we want to make sense of a theory, that matters also. And sometimes when a theory seems strange, we get past it, and other times when it seems strange, it's pointing us to something that we haven't understood well enough.
	DR. CHRIS DEWDNEY	So you can, you know, an event here could be influenced by distant event but only if it sends, uh, only if the signal could pass it, if some influence could pass between the two. Um, that's locality. Um, whereas what we're seeing in quantum theory is that,

		um, we have events and-and these distant particles which can affect each other with no signal passing between them. There's no signal. So they are in a sense, um, in touch with each other, um, they're affected by each other, uh, but there's no possibility for any signal or any influence to pass between them.
01:18:16	DR. CHRIS DEWDNEY	So the particle on Andromeda and the particle on Earth, um, are in direct contact somehow but not through space and time in-in the usual way. So this nonlocality just means, uh, you know, distant events can influence each other without any signal passing between them.
	PROFESSOR BASIL HILEY	But the point is... remember that everything emerges, particles emerge out of this background, and this background is the totality. So the emergence doesn't mean that we've-we've got-and-and from that emergence, we get locality and nonlocality being side by side. It's very much like the hologram.
01:19:00	PROFESSOR BASIL HILEY	The interesting thing about the hologram is that if you take an object with all its local relationships, form a hologram of it, the hologram you can tear it in half, quarters and so on, and you yet see the whole picture.
	DR. CHRIS DEWDNEY	So this was a different way of seeing quantum mechanics. So if you want to have a theory which is underlying quantum theory, you have to then connect that to the version of quantum theory which one has with, uh, the hidden variables. So you want to see how that rises from

		some more fundamental theory. And I think that's what really excited, uh, Bohm and Hiley. That's what-that's what they wanted to do. They wanted to go beyond this model, um, which had to be recovered, um, from the deeper model, but I think the real excitement for them was-was definitely to, uh, to try and develop this underlying model from which the hidden variables would emerge.
01:20:01	SIR ROGER PENROSE	If you're looking at interpretations or ways of looking at quantum mechanics, my view is that probably that Bohm-Hiley way of looking at quantum mechanics, has the most satisfactory ontology. So you have a picture of what constitutes reality without changing quantum mechanics.
	DR. CHRIS DEWDNEY	The ultimate reality is in what he would refer to as the implicate order in which there aren't any separate objects or, um, things to-to influence e-each other, you know. It's-it's more of a whole-a wholeness there, um, which everything is connected. And it's only when we try to talk about individual objects, we, um, explicate them to the-explicate order, th-the order of which we observe, that, um, that we then see this nonlocality. It arises from the fact that we are bringing out of the implicate order these separate structures, um, but these separate structures aren't independent because ultimately they are part of the implicate order.
01:21:08	PROFESSOR BASIL HILEY	Remember we're talking about wholeness. We have to have

		wholeness in here. Here we agree with Bohr. Bohr pointed out that it was very important the new features that quantum mechanics introduces is a kind of wholeness, which means we cannot analyze things by cutting them up into little bits as we do in classical physics. What-but what we can do is if we want to try and cut it out that the way one bit goes into the next bit actually involves unfolding into the whole and then enfolding back again into a particular region. And so you get this idea of unfolding, enfolding, unfolding, enfolding, so what looks like a continuous trajectory is actually a series of foldings and unfoldings.
01:22:07	DAVID BOHM	I've tried to get some idea of what might be the process which was implied by the mathematics of the quantum theory, and this process is what I call enfoldment, that the mathematics itself suggests a movement in which everything, in which any particular element of space may have a field which unfolds into the whole, and-and-and the whole folds and enfolds into it, right?
01:22:36	ANTONY GORMLEY	For me, the way that quantum cloud works is that you-you are the determiner of what you see. This is a mess of, you know, I think that [LAUGH] of-of elements that-that are both, uh, particles and-and hopefully trajectories, uh, that come together, and depending on where your position is, either in a boat or walking along, um, the side of The Thames, and depending on the time of day, you will see or not see the possibility of a body.

		Uh, we-we are just things in space. We are places of transformation. And furthermore, you know, our relationship with others, but with all phenomena, is very much a question of, um, you know, the-our relative positions.
01:23:31	ANTONY GORMLEY	And I think that was something else that really deeply affected me about Bohm's work, the participant nature of the observer in the-the emerging of what we call reality. Visual art has spent most of its time in terms of its evolution dealing with pictures, pictures of the way things look. But I'm not interested in that. I'm interested in saying let's try and discover how things are, and actually, how they look can be extremely superficial and simply the-the accidents of how light happens to hit the skin of something, but actually I want to get-I, you know, we-we know that this is all illusionary, illusion. Quantum physics invites us to be participators in that emerging of a world. And it has very, very fundamental, I think, both philosophical, spiritual, and political implications which are essentially that each of us is a coproducer of a world, that each of us is a coproducer of a possible future.
01:24:49	ANTONY GORMLEY	You know, my interest in David Bohm, uh, who I kind of came across through an association with both David Peat and Basil Hiley, was, uh, this-this notion that actually there is no determinism, that everything is becoming, everything is in a state of emergence. Because actually, the only thing

		that we can be certain about is the fundamental transformation of energy into matter and matter into energy. I think half of which all of this in a way extraordinary realizations, both about the nature of mind but also about the nature of matter have come.
01:25:36	ANTONY GORMLEY	The work of people like Einstein, Bohm, they are like huge windows opening in the imagination to-to a way of dealing with life and the things we encounter within it, uh, freshly and in a sense with the right level of uncertainty.
01:26:13	DR. LEROY LITTLE BEAR	Not everybody, you know, on the street speaks math, okay. David Bohm, you know, was starting to say well, for people to understand what we're talking about, English has to be able to explain these things so that the ordinary person can understand. So he started to talk about in the English language has to become a lot more process oriented as opposed to being noun oriented. And that process-oriented approach to English he was referring to as the real mode. And that's what he was working on.
01:27:05	DR. LEROY LITTLE BEAR	And when-when I understood that, I said to him, "Hey, Black Foot," which I grew up being, there's a whole lot more process oriented than so on. And I jokingly told him, "Hey, quit the real mode. Hey, just learn Black Foot." [LAUGH] You know. In the Black Foot mind, nothing is static. Everything is always on the move. And you can never predict what is going to happen. It's the whole notion that Heisenberg was talking about, you know, the uncertainty

		principle, which David Bohm refers to as enfolded notions, implicate hidden variables, all those things are similarities similar to, you know, Black Foot thought.
01:28:17	DR. LEROY LITTLE BEAR	Sometimes I think about David Bohm as an artist. Artists, for instance, are forever crossing boundaries, similar to poets. Poets don't always follow grammatical rules. Most scientists today are still hanging on to what they call the standard model. So I have to congratulate David Bohm for his brave-scientific bravery.
01:29:16	PROFESSOR BASIL HILEY	What I've-and what David and I have done is to open up the discussion, which I find when I'm talking to young people that they are very interested in trying to proceed further with these ideas. In other words, some of them have actually got it, as I put it. They know in their basic feelings that this is an interesting way to go.
01:29:42	ANNOUNCER	The lab at University College London is at the center of experiments to prove the existence of the quantum potential.
01:29:52	DR. JAN WALLECZEK	If these experiments are successful, then this is really first substantive evidence that we have to assume the existence of something like the quantum potential, which David Bohm postulated in his early theory. If the quantum potential exists in this way, then that really is the first evidence for the profound interconnectedness of the physical universe at a very deep fundamental level. Then we have to deal with the problem of how to reconcile

		this result of true nonlocality of the universe with relativity theory that we talked about before. Um, because what it tells us is not that a quantum potential is a nonlocal energy system or nonlocal force system in the universe; it simply means that information can be nonlocally distributed across the universe. That literally means that things can be informationally connected at one side of the universe to the other side of the universe.
01:30:53	PROFESSOR BASIL HILEY	With quantum potential, you explain the qualities that gives you the interference without the need for introducing a wave function. And the wave function had been getting in the way, in my view, and we have this collapsed problem, which has been going now for 56, now a hundred years. And it still has no solution. And maybe it has no solution because it is not relevant. We have got the thing wrong.
01:31:25	DR. JAN WALLECZEK	David revolutionized our scientific worldview. So in that sense, it would validate those views of unification, those views that speak to the wholelism of the universe. And it truly would be a-a confirmation of a kind of wholeism that religions and spiritual systems and mystical systems have intuited for many, you know, centuries and-and millennially.
01:31:52	PROFESSOR BASIL HILEY	What I feel is that the universe is organic. With the organic, it's not the parts that determine the whole; it is the whole which determine the parts. So the wholeness basically role in it, and

		the way we talk about it is through process and not through particles and interaction.
	MALE	Is it possible scientifically to define this wholeness?
	DAVID BOHM	Well, not really completely. Wholeness is an attitude or an approach, but it can be given a scientific, uh, uh, realization, you see.
	H.H. THE DALAI LAMA	I think two levels of interdependency. Uh, firstly, there are certain things, different nations, different country, environment, and human being, other animals, everything interdependent.
01:32:51	H.H. THE DALAI LAMA	Uh, so now, uh, according to that reality, we have to take care about the whole world and environment.
	DAVID BOHM	We-we are internally related to everything.
	MALE	Yes.
	DAVID BOHM	Not externally related. Consciousness is an internal relationship to the whole. We take in the whole, and we act or the whole.
	MALE	Yeah.
	DAVID BOHM	And that internal whatever we have taken in determines basically what we are.
01:33:23	H.H. THE DALAI LAMA	When we passing through some sort of forest, no bird, we feel something missing. When we're passing through, some birds singing, some birds flying, uh, then we feel more full. So that's

		now the reality. So interdependency on that level.
	DAVID BOHM	I read long ago that in-in some ancient saying that there were three basic attitudes. There's spirit, the scientific, the artistic, and the religious. And they-they have certain things in common and certain differences. Now [CLEARS THROAT] the, uh, I think it's essential, the essen-most-one of the most essential points of the scientific spirit is, uh, to acknowledge the fact or the interpretation of the fact whether you like it or not, you see, that is not to engage in wishful thinking or not to reject something because you don't like it.
01:34:20	DAVID BOHM	The religious spirit requires the same thing that if-otherwise it will get lost in self-deception as is so easy to do.
	H.H. THE DALAI LAMA	Since my childhood, I have an interest about science. Now modern science investigation. Everything investigate. Versus the ancient Indian sort of concept also usually come out of investigation. The same way modern science also now investigate and experiment. The difference is ancient Indians are those great thinker. They only think. Only use, uh, mind or wisdom and sometimes meditation. No instrument. Now modern science use instrument.
01:35:12	DAVID BOHM	Science is whatever people make of it. You see, science has changed over the ages, and it's different now from 300 years ago, and it could be different again. Now there's no intrinsic reason why

		science must necessarily be measurement. This is a-another historical development which has come about over the past few centuries. It's entirely contingent and not absolutely necessary.
	H.H. THE DALAI LAMA	So all is the same point versus reality.
	DR. JAN WALLECZEK	If you expand on that, as David Bohm did in his life, he expanded on ideas, uh, then you end up with the biggest picture of a completely unified universal perspective that also integrates the observer with the observed, and it overcomes the illusion of separation between observer and the observed. And you are recognizing that it is all one act of observing as things unfold. And I think this ins-this view inspired David Bohm.
01:36:11	H.H. THE DALAI LAMA	David Bohm were one of the scientists who really, uh, showing interest in what quantum physics. Nothing objectively exists. All depend on observer. There's reality so far we know this part still limitless reality we have to further investigate. So David Bohm I think really something like open up our mind. So grateful.
01:36:54	DAVID BOHM	The present-day identity is based, I think, on a wrong mode of thought, you see, in which a person identifies with his thoughts and with his body and with things, you see. In which it means that he's creating an illusion, right? That this self which people feel they have is not-is-is only a show and it's not really there, but it is such a convincing show that

		everybody acts as if it were there, and that gives it an apparent reality.
01:37:29	ANNOUNCER	So what does all this mean for you, for me, the universe, and everything? Bohm suggests that out of perceived emptiness, out of the so-called vacuum state, particles interact with, respond to, and are informed by an information potential which allows each particle to carry the necessary data for the cosmos to emerge, to be through the flux and transformation of an activity of information.
01:38:02	PAAVO PYLLKKANEN	So it's the information informing action of the point of potential that makes it possible for the physical universe to be.
	ANNOUNCER	Everything we know and everything we will come to know is already in formation, waiting to unfold into manifest reality. It's the implicate waiting to become explicate.
	DR. SHANTENA AUGUSTO SABBADINI	Bohm's model of the implicate and explicate, uh, is I think he's talking about how the subject/object split duality emerges from the ground, which, uh, [lots?] would call the dowel, which is non-nonsubject/nonobject but a-a unity, a wholeness.
01:38:57	ANNOUNCER	Bohm proposes that everything is interconnected throughout the entire known universe. Everything is in a state of undivided wholeness. Each part of the universe contains the whole universe.

	AEPHRAIM STEINBERG	The ground beyond consciousness would be unmanifested. Now if something is completely unmanifested, how do we ever know about it? But the unmanifested, David said, acts into, uh, the manifested. And the action is an appearance then in consciousness, and it implies the ground from which result came.
01:39:45	ANNOUNCER	This suggests that the nature of reality is infinite and nonlocal, meaning the reality we know and perceive through our sense perceptions unfolds from the deeper nonlocal or implicate order.
	DR. CHRIS DEWDNEY	I think Bohm was onto something there and that there will be beyond quantum theory a new theory, and it may well be a theory of implicate order from which we'll see how quantum theory and-and the classical world emerges.
	ANNOUNCER	David Bohm rejected the orthodoxy that he hoped would embrace new ideas about the nature of reality. If we must learn anything from Bohm, it's that we must question everything.
01:40:28	LEE NICHOL	In all the areas that he worked in, he was constantly pushing, pushing, pushing in physics, in dialogue, in consciousness.
	ANNOUNCER	Mathematics needs to go beyond calculations, science beyond the limits of old formulae, philosophy beyond mind, religion beyond dogma. Can any one of them explain consciousness? It is consciousness that gives light its brightness, color its color, creates images in your mind that allows you to

		perceive the world. Without an explanation of consciousness, mathematics, science, and philosophy will continue to have a mysterious relationship to reality.
01:41:18	MALE	My feeling about this is that we understand so little about consciousness, and despite all the advances in neuroscience, and-and they've been amazing, the basic philosophical fact that you experience a self, and a self-centered existence is something we're no closer to explaining or predicting than we've been at any time in the history of humanity.
01:41:47	H.H. THE DALAI LAMA	So now, the younger generation of scie-scientists, uh, medical holistics or study, uh, quantum physics I hope it's a bit more serious and then that according to my own sort of little experience, ancient Indian philosophical views also I feel may be useful to make [operation?] like that.
	DR. JAN WALLECZEK	People realize that we're hitting a brick wall unless we are engaging the problem of observation, of what the relationship is between the act of the observer and the observed, but we cannot address that question unless we ask the question what is consciousness, or even more, what is agency, what is the ability for human beings to act in the world? And ob-observation is one aspect of it. But it sounds very passive, right. We're just observing what's already going on. But science is doing more, and human beings are doing way more than that. We are actually interacting with the world. We're changing the world to our needs.

01:42:52	ANNOUNCER	If we aspire to go beyond our present state of consciousness, if we truly want to be happier, to love and know ourselves better, to regain meaning and wholeness, the old disciplines only serve to deepen the illusion of manifest reality. We must look beyond the veil of form to a realization of oneness, present in you, in me, the universe, and everything. When you grasp this, it will put you on the threshold of what is real and your place in reality. Reality is wholeness, undivided wholeness, and this fact has yet to don on billions of people.
01:44:04	MAUREEN DOOLAN	This particular day, he picked up the phone, spoke to Sarah, said, "I'm-I'm on my way home." And then he said, um, "You know, I feel I'm on the edge of something." He said, "It's quite tantalizing." And those I guess were his last words because by the time the cab arrived at his home, he was dead.
01:44:36	PROFESSOR BASIL HILEY	But I do remember, and I said to him, I said, "David," I said, "I'm-I'm sorry I'm going to have to leave now because I-I'm feeling tired, and I want to get home. Are you okay?" And he said, "I'm feeling fine." And then the next thing I heard was Sarah saying-giving this message that they-he was on the edge of something.
	DR. DAVID EDMUND MOODY	Bohm was a universal genius. He had a quality of genius in any direction that he directed his attention. And he had directed his attention to everything, right. He-he-the whole was-was the thing, and so anything salient within the

		whole required attention.
01:45:18	ANTONY GORMLEY	Now the question is how-how do our spiritual, political, and economic, uh, uh, structures begin to adapt to this new reality? And I think that's where maybe everything for David Bohm, uh, experimented with and in comes to be very, very valuable.
01:45:46	DR. JAN WALLECZEK	He became a scientist, I believe, in order to benefit humanity. And I think that was all there throughout his life, and I think the discovery of interconnectedness through nonlocality he saw as a way to actually demonstrate that we are all one, to put it very simply. Uh, I think his mission was always to leading up to transformation, uh, for human society, overcoming to fragmentation that we experience, uh, towards and having the experience of a new interconnectedness among us all to solve problems together. Uh, overcoming the divisions. And so I think science inspired that initially, but clearly, based on the scientific insights, he tried to address all the different levels from psychology to sociology to cultural subs, even bringing-bringing these ideas into the arts and also into education with his work on dialogue.
01:46:46	DR. JAN WALLECZEK	Uh, so-so in that sense, he-he represented a truly holistic integrated vision, uh, of a human being. And I think as that he can serve as a model for future generations.
	DAVID BOHM	Wholeness I say as a kind of attitude or a-an approach to the

		whole of life. If we can have a coherent approach to reality, then reality will respond coherently to us.
01:47:15	H.H. THE DALAI LAMA	I think time come to investigate there is observer. I think worthwhile. [LAUGH]
01:47:26		[CREDITS]
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