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ATOMIC DREAM

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Begin composer's music

Hubble telescope images

DYSON, [vo] So I had this dream of traveling in a spaceship with my son. He was piloting the ship. I was just hanging on behind, as a passenger. We went far out into space and finally got so far away that we lost contact with the home and just went traveling forever in space.

DYSON, [on cam] It was a very vivid dream. From time to time, that kind of thing happens. It doesn't sound so much when you talk about it.

Buildings at dusk

TITLE CARD, "ATOMIC DREAM"

DYSON, [vo] The skies are usually clear so we would see the planets overhead. It was usually Jupiter or Saturn we were looking at. The places we most wanted to visit which have lots of moons.

DYSON, [on cam] It was all very real. That was the first year of the project when we really expected to go.

Begin music

Project Orion animated title

DYSON, [on cam] Project Orion was a scheme for driving a spaceship with nuclear bombs, and it sounds absurd but it's actually quite simple.

GOODMAN, [on cam] You know we laugh at the outrageousness of this project. It must have been pretty outrageous, even then, but still, the idea of blowing oneself with atomic weapons to Mars. That's quite something.

Vintage cartoon about nuclear power

NARRATOR, The atomic age was born. There is no denying that since that moment the shadow of the atom bomb has been across all our lives. Here in fact is the answer to a dream as old as man himself. A giant of limitless power at man's command.

GEORGE, [on cam] The important thing to remember is this was before NASA. NASA did not exist.

Animated cartoon of Sputnik

GEORGE, [vo] The Russians put up Sputnik and America wanted to catch up somehow.

DYSON, [on cam] And of course there was a huge political push to do something exciting. So we were riding that wave. So that's what made these crazy ideas seem less crazy.

TITLE CARD, "THE MATHEMATICIAN."

"Primrose Mount", written by Sir George Dyson, played by Phillip Sear

Photos of man at piano and Dyson as child

DYSON, [vo] My relationship with numbers is sort of like my father's relation to notes. My father was a professional musician. I mean for him there was just no question that was what he did. It was similar with me. From about the age of three it was obvious that I was a mathematician, and...

DYSON, [on cam] there was nothing I could do to change that.

Dyson writing on chalkboard

DYSON, [vo] If you have that kind of a skill, it's one of the great pleasures in life is to play an instrument. I remember when he was very, very, old, the year before he died, he would play the piano just for half an hour every day, just to show that he was still alive.

GEORGE, [on cam] My father is a British-born mathematician. His trade is mathematics. You give him any problem and he will look at it in a mathematical way and give you some kind of answer.

Begin composer's music

DYSON, [on cam] Well I was always interested just in calculating. I love calculating.

Dyson's scraps of paper with his childhood calculations

DYSON, [vo] Certainly as soon as I could write numbers I started calculating. Oh, I remember one was the number of atoms in the sun. That was a really nice, big number.

DYSON, [on cam] I don't think it was right. At least it was, sort of, the right order of magnitude.

Dyson thumbs through a math book

DYSON, [vo] An Elementary Treatise...

DYSON, [on cam] ...on Differential Equations and Their Applications. It's written in a beautiful old-fashioned style.

Black and white photos of Dyson as a boy

DYSON, [vo] The Christmas holiday was four weeks. And I just got through the whole book, doing all the problems, about 700 of them, I think. Anyway, so that was a time of great joy. I was 13 or 14, that sort of age. Certainly I was...

DYSON, [on cam] ...very much obsessed.

Dyson thumbs through a math book.

DYSON, [on cam] Teenage passions, of course, are very strong.

TITLE CARD, "THE PROJECT"

Composer's music

Photos of Dyson as a boy with other children and a series of illustrations

DYSON, [VO] I was at a boarding school starting at the age of 8. There were books of Jules Verne there. One of the first books I read was *Hector Servadac*. It's about a bunch of people who discover a new planet, and they have lots of adventures. And I thought it was true. I hadn't any idea this was just a story.

DYSON, [on cam] I thought this all really happened. It was a great disappointment then afterwards to find out that it was all made up.

Star Trek clip

CAPTAIN PICARD, Mr. Data. Could this be a Dyson Sphere?

LT. COMMANDER DATA, The object does fit the general parameters of Dyson's theory.

COMMADER RIKER, A Dyson Sphere?

CAPTAIN PICARD, In the 20th century, a physicist called Freeman Dyson postulated the theory that an enormous hollow sphere could be constructed around a star.

Image of Institute for Advanced Study

Photos of Dyson in his 20s.

HAPPER, [vo] Freeman Dyson is a fixture here at Princeton. He came here in the 1950s and was a real boy wonder at the time. He had solved some spectacular problems in physics...

HAPPER, [on cam] ...before he ever got his PhD. So Freeman actually never got a PhD.

HAPPER, [vo] He was considered one of the founders of quantum electrodynamics, and one of the few that you could actually understand if you read his papers.

BROWER, [vo] The fact that he would interrupt a normal, standard...

BROWER, [on cam] ...academic career to embark on something like Orion, that's not a safe way to go.

BROWER, [vo] And yet he plunged into it with a really incredible passion.

Begin composer's music

Montage of Orion documents with paragraphs and images redacted

GEORGE, [vo] Project Orion was top secret. They couldn't put anything on paper. It was all just whispering.

Date card over black, "1958"

Photo of Oppenheimer

DYSON, [vo] Oppenheimer, who was the director of the institute, disliked Orion. He didn't like the idea at all.

Letter from Dyson to Oppenheimer

DYSON, [vo] He thought it was a waste of my time. I asked him for a leave of absence...

DYSON, [on cam] to go and work on Orion, and he grudgingly allowed me one year and that was it.

Memo from Dyson, "Spaceship project has begun"

Photo of Dyson in convertible.

Composer's music begins

DYSON, [vo] So I signed up for Orion and moved to California for a year and a half.

TITLE CARD, "THE SPACESHIP"

Images of Orion spaceship drawings and documents

Coca Cola advertisement

DYSON, [vo] The whole thing was massive. Total weight was 5,000 tons. So it would be built like a submarine, essentially. Not like an airplane. Inside you'd have big, big rack with all the bombs, like a

Coca Cola machine. Bombs instead of Coca Cola bottles.

DYSON, [on cam] We actually had a Coca Cola man as a consultant.

Pusher plate diagram

DYSON, [vo] The bottom was this huge, steel flat plate, about a foot thick. So that weighed about a thousand tons.

DYSON, [on cam] The difficult part is delivering the bombs.

Drawing of ship and pusher plate

Film of model rocket

DYSON, [vo] The bomb has to be delivered a hundred feet below the pusher plate in about a quarter of a second

Animation of Orion spaceship

DYSON, [vo] Each explosion drives debris against the bottom of the ship, and this flat plate at the bottom takes the shock, then you have a set of shock absorbers converting the shock into a steady push.

Diagrams of Orion

DYSON, [vo] The bombs only fire for about 5 minutes, then after that you're just coasting through space.

DYSON, [on cam] You need about a 1000 to take off from earth, and something like 400 or so to land on Mars. Considerably less.

Archive aerials of Point Loma and test site

Begin composer's music

DYSON, [vo] It's always much more fun to see something fly than just to scribble on paper. And so on Saturday mornings we would go out to Point Loma, which was a Navy test stand where they used to test Navy rockets, and we flew our little flying models of our spaceship there.

DYSON, [on cam] So the thing would go, "Bang, bang, bang, bang, bang, bang!" like that up into the sky.

Model test footage of rocket lifting off then descending to earth.

GEORGE, [vo] It was sort of like building model airplanes carried to a very high degree. And what's astonishing is that they were allowed to ...

GEORGE, [on cam] play freely with that much high explosives.

Test footage of guys prepping the models.

GEORGE, [vo] They were allowed to have 400 pounds of C4.

DYSON, [vo] That was fun. And of course we were quite reckless. We were always carrying explosives around and not being particularly careful.

DYSON, [on cam] It was amazing that nobody ever got hurt.

Yellow model rocket lifts off

DYSON, [vo] The full-scale ship, of course, would have had a lot more bombs. They would have been nuclear, so it would have been a much,...

DYSON, [on cam] much more complicated operation. Still, this gave us a feeling that at least we knew how to make a few bombs go off correctly.

Bomb parachutes to ground from airplane

TITLE CARD, 'THE BOMBS'

Animation of an atomic research laboratory, exterior and interior. Panning of machines turns transitions into an atomic bomb

GEORGE, [vo] A big fraction of the Orion people did come from Los Alamos, so they had come from that world where they worked on this Manhattan Project during the war, and Project Orion was, sort of, the next step.

FREEMAN, [vo] So I came to Los Alamos to talk about reactors, and instead they immediately told me all about the bombs.

GEORGE, [vo] They showed him everything about the bombs. He didn't really want to work on them...

GEORGE, [on cam] but he couldn't resist it. It's that sort of problem. You give him a problem, he couldn't resist thinking of better, how you could make better bombs.

DYSON, [on cam] In about three days I found out how these bombs worked.

Animation of nuclei splitting, fades into actual atomic explosion

DYSON, [vo] So this whole explosion is really a very simple thing. You take a piece of plutonium. You only have to squeeze it to a high density. When the plutonium reaches a certain density, the nuclei start splitting with a huge amount of energy release, and it will explode, just like that. We were worried about radiation...

DYSON, [on cam] from the beginning. But at the beginning, when we started Orion, the United States and the Soviet Union...

Explosion, workers look

DYSON, [vo] were exploding bombs in the atmosphere all the time. There were huge amounts of radioactive fallout from the bomb tests, so it didn't look as if our contribution...

DYSON, [on cam] would have been all that bad. We were, perhaps, one percent of what was being done by the military.

TITLE CARD, "THE WAR"

Archive WWII footage

DYSON, [vo] I was 19 when I moved in. That was already 1943. I was a lowly statistician. And of course we were

DYSON, [on cam] forbidden to fly because we were much too valuable. We knew too many secrets.

DYSON, [vo] We all wanted to fly. We somehow knew we couldn't do a good job if we weren't flying. So I had the job of, essentially, just collecting information about the bombing campaign, looking at bomber losses and how the bombers were actually getting shot down. But there was really nothing I could do about it.

DYSON, [on cam] I think the nightmares came a lot later but that's hard to remember. But these boys who were flying the planes were just my age and I was protected because I happened to be a scientist...

Begin composer's music

DYSON, [on cam] and they were all getting killed. So it wasn't a comfortable feeling.

World War II funeral footage

DYSON, [vo] The dreams I used to have were mostly of planes crashing and then people burning to death inside the planes and my not being able to rescue them. I think that was sort of... I would be...

DYSON, [on cam] stuck, unable to move and these people were being burned in the planes.

Scenes of WWII London

DYSON, [vo] So it was a very depressing and miserable time. To distract me from this misery I did some mathematics in the hours which were left over. That was a great consolation.

But normally I would take a rest day in the middle of the week...when I would go home to London. I could ride my bicycle all over the city. There was no traffic at all.

Begin composer's music

Hubble telescope images

DYSON, [vo] And I could see the stars at night. Everything was blacked out so that you could see the Milky Way.

DYSON, [on cam] So it was a wonderful time in some ways.

TITLE CARD, "THE MISSIONS"

Illustrations

BROWER, [vo] To be talking in the evening as they did about how they would dig caves in the icecaps of Mars to survive. It was like they were in love. They were really in love with this project.

BROWER, [on cam] This little amateur telescope they brought on somebody's backyard...

BROWER, [vo] and really looked at these places, and really talked as if they were going there.

GOODMAN, [on cam] The drawings that were made of, for example, the profile of acceleration versus time.

Project Orion diagrams and drawings

GOODMAN, [vo] It was clearly hand drawn with a thick pen on old-fashioned graph paper. I don't know. Somehow it was funny. The contrast between the audacity of the project and the tools they had to work with. The drawings of what they would look like on Mars. It was like a New Yorker cartoon

with a bunch of guys standing around in white coats with clipboards and binoculars.

GOODMAN, [on cam] No breathing apparatus from what I could see, on the surface of Mars.

DYSON, [on cam] So we thought of everything in sort of 19th century technology.

Darwin's Beagle drawing and Mars Hubble telescope images.

DYSON, [vo] We were thinking of people going to Mars like Darwin going to the Galapagos. Stepping on the soil of Mars with a notebook in hand and making notes about everything we saw, and trudging all the way across Mars and doing all the observing, sort of, in the old fashioned style.

DYSON, [on cam] And then, finally, after five years, you'd come home bringing back all this information.

GEORGE, [on cam] There would have been a full, like the crew of a ship. If you look at their plans, half the people were sailors and the other half were scientists.

Illustrations

GEORGE, [vo] They would have had people actually navigating using sextants and calculating the trajectory with slide rules.

DYSON, [vo] The big ship would have been massive, more or less like a hotel. There was plenty of room. It was a large space about a 100 feet high as well as a 100 feet diameter.

DYSON, [on cam] We intended to travel in style

Illustrations

GEORGE, [vo] It was sort of this grand tour where you would leave some people on Mars and the rest of the guys would go on to Saturn and come back and pick up the people on Mars on the way back.

GEORGE, [on cam] You could imagine the film of this. How would you feel being left on Mars when the other ships leave. It's incredibly romantic to think about.

Space Traveler's Manifesto document

DYSON, [vo] There are more things in heaven and earth than are dreamed of in our present-day science, and we shall only find out what they are if we go out and look for them. It is in the long run essential to the growth of any new and high civilization that small groups of men can escape from their

neighbors and from their governments to go and live as they please in the wilderness.

DYSON, [on cam] A truly isolated, small, and creative society will never again be possible on this planet.

Space Traveler's Manifesto document

Begin composer's music

DYSON, [vo] We have for the first time imagined a way to use the huge stockpiles of our bombs for better purpose than for murdering people.

TITLE CARD, "THE TREATY"

HAPPER, [on cam] It's an ambivalent relationship because, you know, the physics of nuclear weapons really is fascinating.

Footage of cannon

HAPPER, [vo] And so he really likes that part of it a lot. But, he's certainly right, you know? It's the most immoral thing you can think of.

DYSON, [vo] We were looking for a place to do our own testing. We needed to do a nuclear tests...

DYSON, [on cam] ourselves if this was ever to fly.

Nevada Test Site images

DYSON, [vo] So we went to Jackass Flat and nothing was happening there. That was totally quiet... It's just this beautiful place with absolutely not a sound...

DYSON, [on cam] And then I was thinking, "are we really going to come in here

Begin composer's music.

Nuclear bomb test footage.

DYSON, [vo] ...and turn it into a garbage dump?" Cause obviously we would have left it as sort of a radioactive dump.

BROWER, [vo] We didn't really understand this fallout for a while. Very rapidly in the late 50s people came to understand, "Wait a minute..."

BROWER, [on cam] there is a cost to these experiments."

United Nations building

Begin composer's music

KENNEDY, [vo] The logical place to begin is a treaty assuring the end...

JFK archive

KENNEDY, [on cam] of nuclear tests of all kinds in every environment in order to save the human race from the poison of radioactive fallout.

DYSON, [on cam] So I had to decide whether I would testify for the treaty, which that would have been...

Orion model footage

DYSON, [vo] a death sentence for Orion; if you couldn't test bombs then Orion...

DYSON, [on cam] was certainly out.

Bomb being carted out

DYSON, [vo] Bomb tests were going on for military purposes, on a hundred times bigger scale than we would ever have done.

Nuclear bomb test footage

DYSON, [vo] So the tests were in fact a huge operation, something like a hundred megatons a year or so at the peak...

GEORGE, [vo] Some things just are...

GEORGE, [on cam] bad. Are subject to being abused. I think he's willing to make that choice.

DYSON, [on cam] We were testing bombs at a rate which was exponentially...

Document of bomb totals

DYSON, [vo] increasing. So that was an enormous contamination of the planet.

DYSON, [vo] You can see from this...

DYSON, [on cam] the time it took to double is about 3 years. And that went on consistently doubling every 3 years. So it was obvious that this was something you had to put a lid on one way or another.

Test Ban Treaty document

Begin composer's music

DYSON, [vo] It seemed to be quite clear at that point. The test ban was more important than Orion.

DYSON, [on cam] So I decided then to testify for the treaty. I thought the treaty was necessary anyway, and, I don't regret that.

Kennedy Presidential Address

KENNEDY, [on cam] Yesterday, a shaft of light cut into the darkness. Negotiations were concluded in Moscow on a treaty to ban all nuclear tests in the atmosphere, in outer space, and under water.

GEORGE, [on cam] He says, which is I think true, in a way it ended well; it ended while was still a dream, leaving the dream intact. He wanted to go. He physically intended to go along. Where things would have gone from there nobody knows.

Hubble Space Images

Begin composer's music

DYSON, [vo] I've always looked on space as a tremendous waste as long as it remains dead, and a tremendous opportunity for life. It's terribly boring to see all of those dead worlds and just to imagine how much more beautiful it would be if all those billions and billions of planets, which we now know exist, were full of life ... It's only one big jump and it will get all over the universe.

DYSON, [on cam] And we'll be the ones to help make that big jump.

Credits

Atomic Dream

A documentary by

Derek Lartaud and Melanie Ruiz

SOURCE LIST

Interviews

Jaromir Astl, retired, worked on Project Orion

Jeremy Bernstein, retired physicist

Kenneth Brower, writer

Brian Dunne, retired, worked on Project Orion

Esther Dyson, daughter of Freeman Dyson

Freeman Dyson, theoretical physicist and mathematician, Institute for Advanced Study, Princeton, NJ

George Dyson, writer and son of Freeman Dyson

Jeremy Goodman, physicist, Princeton University

William Happer, theoretical physicist, Princeton University

Verena Huber-Dyson, retired mathematician and ex-wife of Freeman Dyson

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