

"SuperPeople "  
– SHOW 1102

Episode Open  
No Limit  
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I Was a Spaceman

#### EPISODE OPEN

ALAN ALDA Some people can hold their breath like that for almost 8 minutes. They think it's fun, too. On this edition of Scientific American Frontiers - the people who push themselves to the limit.

ALAN ALDA (Narration) We'll plunge into the depths, with the world champion deep diver... We'll scale the heights, even if the body complains... We'll make our brains work like never before...

TATIANA COOLEY All my brain cells are going, No, no, please!

ALAN ALDA (Narration) And we'll try life off the planet - as far out as you can get.

JERRY LINENGER 18,000 miles and hour - pure speed!

ALAN ALDA I'm Alan Alda. Join me now to meet the SuperPeople.

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NO LIMIT

ALAN ALDA (Narration) Meet Loic Leferme, the first of our Superpeople and a superstar in a rapidly growing new international sport. In a deep dive contest called "No Limit" he's just pulled off a new world record -- 452 feet. Loic is a member of the French national apnea team - apnea means holding your breath. Today they'll be using the same underwater sled Loic broke the record with. It's the team's regular Saturday morning training session, 4 months after the record dive. As they practice, the team members will also be supporting Loic, who today is preparing for a 300-foot training dive.

PHILLIPE AFFRAIT If you want to be great at that discipline, you have to be more quiet, to relax and to have a psychological preparation, as he does.

ALAN ALDA (Narration) Relaxation is essential. Exertion just consumes the precious single lungful of air. Loic's companions practice an event which requires swimming directly down. They move slowly and deliberately. Loic starts breath-holding exercises. Learning how to stay under like this is the basic skill that deep divers have to develop. The best in the team can do seven minutes, while most people can manage a minute or less.

ALAN ALDA How long will they stay like that?

PHILLIPE AFFRAIT I've heard here now only one minute and a half.

ALAN ALDA Only a minute and a half.

PHILLIPE AFFRAIT Yeah.

LOIC LEFERME 5, 4, 3, 2, 1. OK Alan, try to relax your face and your neck here.

ALAN ALDA (Narration) I tried several dives using Loic's relaxation techniques, and my breath-holding did begin to improve.

LOIC LEFERME You close your eyes.

ALAN ALDA (Narration) These techniques can be very powerful. We can actually defeat our body's own signals to breathe - and then black out and drown. That's why teams like these always train in a group, and always watch each other like hawks.

ALAN ALDA That was worse. Oh no, it was longer, wasn't it?

LOIC LEFERME One minute and five.

ALAN ALDA I stayed under about 10 seconds longer.

ALAN ALDA (Narration) Surface breath-holding is a competitive event, and I could see the fun in it, but it has to be done with others, who know the very real risks.

ALAN ALDA It's possible to black out and not realize that you're blacking out.

CLAUDE CHAPUIS Of course, you never realize...

ALAN ALDA You never notice it. You never realize. So you need somebody else there with you to read the signs.

CLAUDE CHAPUIS Of course.

ALAN ALDA You need an experienced person.

LOIC LEFERME It's like climbing. If you climb alone without any rope, you take your risk. If you have a rope and you know how to use it, if you are both... two, it's easy.

ALAN ALDA (Narration) This little finger clip detects Loic's heart rate and oxygen level in the blood. His low 70s heart rate, with 99% blood oxygen saturation, are about normal. Loic is going to perform a long breath-hold, while we monitor his heart and blood. He's going to be down for 4 minutes. The secret to these amazing performances is in something called the dive response. It's a primitive reflex, triggered when our faces are plunged into water, and found in all mammals. One consequence is a dramatic drop in heart rate.

PHILLIPE AFFRAIT You see, he has lost from 10 to 15 beats per minute, after one minute of breath-holding. He's OK.

ALAN ALDA (Narration) Loic's heart rate continues to drop. He's taking a natural reflex and amplifying it through his well-practiced and profound relaxation.

PHILLIPE AFFRAIT Two minutes and 15 seconds. The O2 saturation is perfect.

ALAN ALDA (Narration) The dive response also contracts blood vessels in Loic's limbs, concentrating blood in the vital heart, lungs and brain.

PHILLIPE AFFRAIT 3 minutes, 30 seconds.

ALAN ALDA (Narration) By three and a half minutes his blood oxygen is way down. Again, Loic's mental discipline prevails.

PHILLIPE AFFRAIT The concentration of oxygen in his body is really decreasing, even in his tissue in the heart, in the brain. But you see that he can bear it. Me, I can't bear it, but he can. OK. Put it on your nose.

ALAN ALDA What you're doing now is just to get a baseline?

PHILLIPE AFFRAIT Yes, just to get a base.

ALAN ALDA (Narration) Loic is not only mentally disciplined, but he trains to keep his body physically very flexible. That's so he can use a technique for increasing lung capacity, which we're just about to measure.

PHILLIPE AFFRAIT Third time. Then after it will be up to you. Take your air in max... take it, take it, and then blow very fast, blow, blow, blow, keep on, keep on, go on, go on, go on, OK, OK, OK. OK it's good. Fine.

ALAN ALDA (Narration) Loic scores 5.9 liters - normal for his body size. For the second test, Loic uses a special pumping technique.

PHILLIPE AFFRAIT Alan, look what his technique does is to increase that capacity.

ALAN ALDA (Narration) The pumping blows up Loic's lungs, literally like a balloon.

PHILLIPE AFFRAIT OK. Blow, blow, blow, blow...

ALAN ALDA (Narration) The result is dramatic.

PHILLIPE AFFRAIT Blow, keep on, keep on. OK.

ALAN ALDA So he went up a whole liter. He went up from 5.9 to 6.9.

PHILLIPE AFFRAIT 5.99 to 6.9 Cinq, quatre, trois, deux, un. Top. Whenever you want.

ALAN ALDA (Narration) Back at the team's training session, Loic is still warming up for his 300 foot -- or hundred meter -- dive. Actually, we should say, he's slowing down. He's relaxing to heighten the dive response, while minimizing exertion.

PHILLIPE AFFRAIT For that first attempt he is going very slowly. Usually it doesn't take a lot of time. You can go to 20 meters very fast.

ALAN ALDA (Narration) This is just a 20 meter - 60 foot - warm-up, but the hundred meter dive Loic's going to do today would have broken the record in the 1970s, and now techniques like Loic's are allowing divers to aim for 150 meters. That's nearly 500 feet. Loic drifts back to the group at the surface, satisfied his dive response is fully functional.

PHILLIPE AFFRAIT OK.

LOIC LEFERME That was good. The training is always like this. It's not like zen and yoga. But it's another way to relax yourself because then your head is with the group, and you have time to relax, you have time to play.

ALAN ALDA (Narration) Now the group checks out the weighted sled that will carry Loic down.

LOIC LEFERME It's the team which is the most important, because the team make someone go down very deep. And without the team you don't do anything.

ALAN ALDA (Narration) The sled is raised with an airbag, inflated from a scuba tank that's attached to it. Loic will bring himself up from his deep dive this way, too. Everything is in order. While safety divers stand by, Loic prepares himself. He gets his face wet, to stimulate the dive response. His heart rate now starts to drop. The safety divers head down to wait at a hundred feet. Although Loic is going below normal scuba limits, they may be needed when he comes up. Loic breathes deeply, then pumps to expand his lungs. The safety divers flash past.

PHILLIPE AFFRAIT 40 seconds. He's 50 meters. It takes more than one minute, one minute 15 seconds to go up to a hundred meters. Almost at the bottom. We will see perhaps the rope - it will pull down... in ten seconds.

TEAM MEMBER One minute.

ALAN ALDA (Narration) At this depth Loic feels great - the pressure has collapsed his lungs to one tenth their size at the surface, forcing most of the available oxygen into his blood.

PHILLIPE AFFRAIT He has taken one minute and 4 seconds, and now he's going up.

ALAN ALDA (Narration) Now comes the dangerous part. Loic's lungs rapidly re-expand, pulling oxygen back out of his blood. He could black out. 30 feet down he releases his air bag.

PHILLIPE AFFRAIT We see the balloon, and there is a safety free-diver with him, and they are coming up very slowly. He's here. We can see him now. OK.

ALAN ALDA (Narration) The last 15 feet, when the lungs expand the most, are the riskiest. Everyone's relieved to see Loic in good shape. Well, I'm not diving to a hundred meters, but I am going to try extending my breath-holding performance.

LOIC LEFERME You try to relax. Your arms. Your neck. 3, 2, 1.

ALAN ALDA (Narration) I'm about as relaxed as I can manage with an underwater camera pushed into my face. But it's totally relaxing to know Loic is watching me every second.

LOIC LEFERME He's OK. Relax your neck. OK you feel good. You feel good. Close your eyes. Good.

ALAN ALDA Wasn't much longer. Probably the same. What was it?

PHILLIPE AFFRAIT What do you feel? What do you feel?

ALAN ALDA A minute and thirty two.

PHILLIPE AFFRAIT A minute and thirty two? A minute and forty five.

ALAN ALDA Really?

PHILLIPE AFFRAIT Yeah.

ALAN ALDA Oh. So, OK that's better.

ALAN ALDA (Narration) After just a few hours training, I had almost doubled my breath-holding, and that was no surprise to Loic.

LOIC LEFERME In training one month, perhaps you will do four or five minutes, and sometimes people, they say, Oh - it's impossible. Yes, it's possible. You just have to train, and you have to put your mind in the way of apnea. That's all. And that's simple.

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## MEMORY MARATHON

ALAN ALDA (Narration) Shuffle the deck thoroughly... Set aside 10 cards... And then...

ALAN ALDA Ace of diamonds.

FRANK FELBERBAUM Alright.

ALAN ALDA Five of clubs.

FRANK FELBERBAUM Alright.

ALAN ALDA (Narration) Now I'm reading off the remaining 42 cards -- just once, only. And now Frank Felberbaum, using his memory of the 42 cards I read off, is going to list the missing 10.

FRANK FELBERBAUM Alan, you have the 2 of clubs. Is that correct?

ALAN ALDA Yes

FRANK FELBERBAUM You have the seven of clubs.

ALAN ALDA Yes.

FRANK FELBERBAUM You have the nine of clubs.

ALAN ALDA Yes.

FRANK FELBERBAUM Ten of diamonds.

ALAN ALDA Yes.

ALAN ALDA (Narration) Frank continues faultlessly.

FRANK FELBERBAUM You have one more card left, right?

ALAN ALDA That's right.

FRANK FELBERBAUM You have the, er... king of spades.

ALAN ALDA Yes. That's really great. And the card that I thought was in there, isn't there. I didn't even get one out of ten.

ALAN ALDA (Narration) This is a story about how to develop a super memory. It does not involve eating ginkgo leaves or vitamin E, but instead learning how to use the brain's resources systematically.

ALAN ALDA When I read off the first card, seven of spades, what did you do in your head?

FRANK FELBERBAUM OK. Well, the seven of spades to me represents a rake.

ALAN ALDA (Narration) To get from the seven of spades to "rake", Frank first uses fixed conversion tables. Spades equals four, which equals R. Seven equals K. Then he makes a word with R, K - "rake." It could have been "rock" or "rack," it makes no difference. The point is to create an object in your mind, and then imagine the object in a visual story.

FRANK FELBERBAUM Once you put something into a visual form, and then you create a visual scenario -- a story that has the visual contents in it -- you cannot forget that.

ALAN ALDA (Narration) Frank's theory is that, since humans are very visual, it's easier for us to handle - and to memorize - visual scenes, rather than abstract symbols like letters and numbers. He can't prove this, although one recent brain study did show that when we work on spatial problems, we use twice the brain area employed for verbal tasks. The fact is we know so little about the process of memory, that improving it becomes a purely practical matter - if it works, it works.

CONTEST JUDGE You may begin now.

ALAN ALDA (Narration) We're going to find out if what Frank does works, here at the US Memory Olympics, held in New York City in February, 2000. Open to all, it's a day of competitive memory challenges that most of us would be happy to avoid. Frank is coaching a team from Bergen County Academy, a New Jersey high school. Work started 5 months earlier.

FRANK FELBERBAUM This is Spiros Nikolopoulos. This is Lylan Wang.

ALAN ALDA (Narration) By the way, these are smart kids, but they're not a specially selected group of high flyers -- including the one with the gray hair.

FRANK FELBERBAUM Don't say it - just write it.



ALAN ALDA (Narration) To start the day there's a test.

FRANK FELBERBAUM If you know the first name write it, too, but last name is the one that counts. OK, anybody? Nobody got this one. Ah...

ALAN ALDA (Narration) Frank promises by the end of the day we'll do this much better.

FRANK FELBERBAUM It's a Dutch name. It's Van Etten. Alright, how many got 3?

ALAN ALDA (Narration) And there's certainly room for improvement. The class average was just 30% correct names. For this event in the contest there are 15 minutes to memorize up to 99 names and faces, with 20 minutes for recall.

CONTEST JUDGE Time is up.

EDISON HONG I think I did decently. For every name, like full name, we get 2 points and there were 99 names and I think I got about 30 of them, so around 60.

JASMINA NUESA I put around 32, 33 names down, but who knows if they're right?

ALAN ALDA (Narration) Frank's team is up against people who love these challenges, and know they're good at them - including the reigning US champion, Tatiana Cooley.

TATIANA COOLEY If I got all of them correctly, 88.

CONTEST JUDGE Third place person with 75.5 names and faces was Joseph Song.

ALAN ALDA (Narration) In the first event -- third place went to one of Frank's team.

CONTEST JUDGE Our second place person, with 81 points, and breaking the USA mark also was Terry Williams. And the new US world record of 85 will belong to Tatiana Cooley.

ALAN ALDA (Narration) Tatiana's in the lead, with four events to go. She can only roughly describe how she does it.

TATIANA COOLEY I was sort of taking a feature from their face and making that something to remember, and then looking at the name and...

FRANK FELBERBAUM Let me give you a way to remember my name.

ALAN ALDA (Narration) We don't know how to explain a talent like Tatiana's, but for the rest of us, Frank's got a system we can use.

FRANK FELBERBAUM "Fel" -- very easy, something fell, right? OK. Alright, add another "l". Let's go to the last part. What does "baum" sound like that's concrete and visual to you?

STUDENT Bomb

FRANK FELBERBAUM A bomb - OK. So we got a falling bomb now. Alright now, let's go to the middle part. What does "ber" sound like to you?

STUDENTS Cold...

FRANK FELBERBAUM Cold. And what if you stretch it a little bit, what have you got, cold, what?

STUDENT Air? FRANK

FELBERBAUM Close. Beer, beer, cold beer. So we now have falling bottles of beer coming down from the sky in the shape of bombs. Where are they going to go?

ALAN ALDA Went to your face.

FRANK FELBERBAUM Went to my face. What feature would you choose on my face?

STUDENT Your nose?

FRANK FELBERBAUM My nose. I knew he'd say that. Alright, so now -- that's an easy one, it's standing out -- so all those bottles of beer coming down, crashing down on my nose, exploding, all that beer going all over my face - right? You can imagine that happening. The more unusual an image you create in your mind about information, the more you're going to remember it. It's the ordinary, everyday things that slip through the cracks. Look at the feature you chose.

ALAN ALDA (Narration) After a day of coaching, we're using the system on a fresh group of names and faces, and occupations, too.

FRANK FELBERBAUM Last name...

STUDENTS Brodsky.

FRANK FELBERBAUM Brodsky. First name...

STUDENTS Joseph.

FRANK FELBERBAUM What does he do?

STUDENTS Ballet dancer.

FRANK FELBERBAUM Where?

STUDENTS Lincoln Center.

FRANK FELBERBAUM Right on. Give yourself three points if you got all three of those. And, what's her last name?

ALAN ALDA Madigan.

FRANK FELBERBAUM Madigan. First name?

STUDENTS Jeannie.

FRANK FELBERBAUM Jeannie...

ALAN ALDA (Narration) Well, I missed that one, but it's obvious we're all doing a lot better than before.

ALAN ALDA Oh yeah, right. Lieutenant Madigan.

ALAN ALDA (Narration) In fact, the class average more than doubled, to 80% correct.

ALAN ALDA Missed it.

FRANK FELBERBAUM OK. Last name.

STUDENTS Newton.

FRANK FELBERBAUM First name.

STUDENTS Derek.

FRANK FELBERBAUM Occupation.

STUDENTS Computer analyst.

FRANK FELBERBAUM Computer analyst. Right.

ALAN ALDA I said computer engineer. I'll give myself three for that.

FRANK FELBERBAUM Alright, last name.

STUDENTS Palladino.

FRANK FELBERBAUM Palladino. First name.

STUDENTS Frank.

FRANK FELBERBAUM And occupation.

STUDENTS Investment broker.

STUDENT You got them all?

ALAN ALDA You got everything?

STUDENT Well I wrote banker instead of broker, but I...

FRANK FELBERBAUM That's OK.

ALAN ALDA You got 100%? STUDENT Yes. Go me!

ALAN ALDA (Narration) Over several months, Frank taught his students how to tackle all five contest events. That didn't make them easy - just do-able. The word event, for example -- 15 minutes to memorize up to 500 random words in order. Frank's method -- weave the words into a memorable story.

CONTEST JUDGE If you're ready, start now.

ALAN ALDA (Narration) Edison Hong got as far as 75 words.

EDISON HONG I think I did pretty well in this event. I created a story in my mind and like all 75 just quickly came out

CONTEST JUDGE Third place winner, with a score of 96 - now our US record for this event was 65. This is incredible performance here. Here we go with a score of 96... Helen Cho.

ALAN ALDA (Narration) Third place to one of Frank's team.

CONTEST JUDGE Please stand up Helen. Our second place person with a score of 106... Edison Hong.

ALAN ALDA (Narration) Second place to one of Frank's team.

CONTEST JUDGE Our new record for the USA belongs now to Christopher Turner.

ALAN ALDA (Narration) And Frank's method gets first place too.

CHRISTOPHER TURNER When I was memorizing them, I just kind of looked at the word list, and it all kind of fell together into one big story, that I owned an island. And then as I'm going back through, I'm just... the story's coming out, and I'm seeing pictures in my mind, and the words are just coming straight out.

ALAN ALDA (Narration) Next, there are just lines of random numbers to be recalled in order. Frank's method - convert numbers to letters, make words with the letters, then make a story with the words. When it's time to recall, just reverse the process. And Frank's method worked again.

CONTEST JUDGE In third place is Ryan Giuffre. In second place is Tatiana. And the winner is Joseph Song.

ALAN ALDA (Narration) Another win for Frank's team. Joseph Song recalled 56 consecutive numbers. It's enough to drop Tatiana back to second over all. The second to last event is a peculiar 60-line poem.

TATIANA COOLEY In the land of dreams change is constant, insistent, incessant...

ALAN ALDA (Narration) It's tough to use Frank's system to create a story, because the poem's already a kind of story. Tatiana's really good at this.

TATIANA COOLEY ...all movement like atoms...

ALAN ALDA (Narration) With 45 lines perfectly recalled, it's an easy win.

TATIANA COOLEY ...have been reversed, memory once last, now first...

ALAN ALDA (Narration) She's back on top.

TATIANA COOLEY ...black beetles basked in the burnishing beams of the sun. I've quite a headache right now. I think it's from thinking so hard. All my brain cells are going, No, no please, no more!

CONTEST JUDGE Please begin, now.

ALAN ALDA (Narration) It's the final event - 5 minutes to memorize a shuffled deck of cards, in order. Frank has taught the students to lay out the cards in threes, convert them to words, then make sentences from the words. He can do a whole deck, as we saw at the beginning. It takes terrific concentration. Tatiana doesn't really have a method, at least not consciously.

CONTEST JUDGE Would you begin your recall, now.

EDISON HONG Two of hearts.

ALAN ALDA (Narration)

EDISON HONG, second in the standings, has a long way to go to beat Tatiana.

EDISON HONG King of spades.

CONTEST JUDGE Correct.

ALAN ALDA (Narration) And right away Tatiana's in trouble. She goes wrong after just nine cards. Edison, though, gets as far as eighteen.

EDISON HONG Jack of hearts.

CONTEST JUDGE Our second place winner, with a score of 337 points, and off to London, is Edison Hong.

ALAN ALDA (Narration) Edison's score in cards was enough to move him up to second overall. The top three attend the world championship in London, by the way. Third place was another of Frank's team, Joseph Song. And astonishingly the team took the next seven places. What they couldn't do was catch the brilliant Tatiana.

CONTEST JUDGE For the third year in a row it's...

ALAN ALDA (Narration) For Frank though, he'd proved his point.

FRANK FELBERBAUM I'm absolutely ecstatic. It's like my own children did this. And it shows you what the potential of the human mind is.

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## HIGH ANXIETY

ALAN ALDA (Narration) The Alps. Beautiful. Enticing. And all too often, deadly. Hardly able to move, this climber is a victim of mountain sickness. Here at 15,000 feet, thin air is starving her body of oxygen. One-in-ten climbers get so sick their lives are in danger. She could become one of them It's an all too common sight for the mountain guides. Swiss Guide It's mostly from the high altitude, why they get very tired. Sometimes they vomit in the snow. They walk like drunken people. But mostly they don't like any help, but they don't like to go down also. Strange. It's difficult to say why they don't go back.

ALAN ALDA (Narration) Going back would clear the symptoms. But like most climbers, she goes on. Getting to the top despite the risks is what mountaineering's all about, of course. Nowadays more and more people are taking the risks. On distant peaks around the world, we're seeing the tragic consequences. The problem is, we're not all superpeople. We can't all be brilliant mountaineers. This story is about trying to predict the basic attribute that mountaineers need - not to get altitude sickness on their way to the top.

DR. PETER BARTSCH There is a big population that exposes itself to high altitude. If you look at the Rocky Mountains, all the resorts you have there. If you look at the Andes. If you look around here and see how popular mountaineering is, this is I think an important question to these people - that we find measures how to predict and how to treat and how to prevent these illnesses.

ALAN ALDA (Narration) Here in Heidelberg, Germany, Peter Bartsch is trying to develop a test to predict which climbers will get altitude sickness. He has recruited volunteers willing to push their bodies to the limit in the lab, and then go mountain climbing. This is Arndt. His testing begins by finding out how fit he is. As he works harder, his body responds by increasing his heart rate, pumping more blood to his muscles and so supplying them with more oxygen to burn.

## LAB TECHNICIANS (German)

ALAN ALDA (Narration) To get that extra oxygen into his blood, he breathes faster and more deeply. Now the real test begins. Arndt's oxygen is cut back, simulating high altitude. The idea is to see how he responds when there is less oxygen available. Again his heart rate increases - and again his breathing gets faster and deeper. At the equivalent of 15,000 feet, Arndt is breathing five times more air than usual, even at rest. This is Michael, another volunteer for the test. On the fitness test, he's as good as Arndt. But when Michael's oxygen is reduced, there's a striking difference. At a simulated 15,000 feet, Michael's breathing is little different from what it was at normal altitude. Even during moderate exercise, his body -- unlike Arndt's -- seems to be ignoring the fact that his oxygen supply is dropping. The Heidelberg researchers wondered if people like Michael, whose bodies don't seem to recognize they're getting into trouble when oxygen is scarce, might be the ones most susceptible to mountain sickness. There was one way to find out. Perched at 15,000 feet on the Italian-Swiss border is the perfect laboratory, a 100-year-old mountain hut, the highest building in Europe. Peter Bartsch, the leader of the Heidelberg team, is heading there now. He's taking it slowly, giving his body time to acclimate. But the subjects in his experiment don't have that luxury. They climb fast, rising two miles in elevation in just over a day. So the experiment is unbiased, neither Bartsch nor his subjects know how they performed in their lab tests. So Arndt, for instance, doesn't know his test suggested he'd cope with the mountain air by breathing more.

ARNDT I feel good, very good. Good air.

ALAN ALDA (Narration) Michael, who didn't adapt his breathing in the lab test, is finding the going rough. As the test predicted, his body isn't getting the message that the air up here is thinner. But then there's a third subject - Udo -- who like Arndt adapted fine in the lab, but may be having the first hint of a problem.

UDO I've just a little bit of a headache, very little bit. Except for this I'm feeling really good, and I'm lucky to do this now.

ALAN ALDA (Narration) We are going to see what happens to Arndt, Michael and Udo once they reach Peter Bartsch's mountain top laboratory. Night falls -- the most dangerous time for those vulnerable to mountain sickness. During the shallow breathing of sleep, blood oxygen levels can drop steeply. Six hours after arriving, Arndt -- whose test suggested he'd do well at high altitude -- is absorbed in a murder mystery. But Udo, whose test results also suggested he'd cope, is in trouble.



UDO When I came up I was feeling quite good. But then it was developing a big headache. And it was a stomach ache and wasn't good. I had to vomit.

ALAN ALDA (Narration) All he wants to do now is rest.

UDO My body is exhausted and I have to sleep. So I hope that I will have a good night.

ALAN ALDA (Narration) Knowing the dangers of the night, Bartsch makes regular checks. At 5:30 am, the only one complaining is Udo.

DR. PETER BARTSCH Udo has a lot of problems. He was vomiting once at night and he had headache. I gave him some drugs. His symptoms went away. He didn't feel nauseated any more but he couldn't sleep.

UDO I have just an incredible headache the whole night. I got some pills, some drugs, but they didn't help so I didn't sleep the whole night. I think another night like this and I'm going crazy. It's just you can't sleep and there's all this banging the whole night.

ALAN ALDA (Narration) Udo's lab test clearly did not predict his difficulties, although of course neither he nor Bartsch knows this right now. ARNDT meanwhile is still doing fine, as predicted. His balance is good, his blood oxygen normal.

ARNDT Now I feel me good. Only muda -- in German. Tired.

DR. PETER BARTSCH He would love to climb the Dufourspitze or any other mountain here. I actually think he's enjoying himself here, that's my impression.

ALAN ALDA (Narration) Which leaves Michael, who is definitely not enjoying himself. Of course Bartsch doesn't know his pre-climb test suggested he wouldn't adjust his breathing to high altitude. He is now very sick.

DR. PETER BARTSCH The problem with him was he didn't call us last night. When he went to bed he already realized that something was wrong and no one called us. And when I saw him this morning he was really in a severe condition. I think if we had caught him earlier we could have stopped the process at an early level.

ALAN ALDA (Narration) Michael's decision to tough out the night could have been a fatal error.

MICHAEL I didn't notice quite that I was getting worse and worse. So just this morning at half past five they wake me up and I couldn't do anything.

ALAN ALDA (Narration) X-rays show Michael has advanced pulmonary edema. The lace-like pattern in his lungs, especially on the right, is accumulating fluid.

DR. PETER BARTSCH This means that we have a very severe illness. If we do not treat Michael he's most likely going to die. Fluid will accumulate in all his lung and he will eventually drown. And we have to immediately install treatment by giving oxygen now and fly him down as soon as possible.

ALAN ALDA (Narration) The oxygen will stabilize Michael's condition for a while, but the only way to clear the fluid from his lungs is to get him off the mountain -- fast. A rescue helicopter is called in from Zermatt, Switzerland. For Michael, the experiment is over. As it turned out, the breathing test Peter Bartsch hopes might help predict mountain sickness was accurate in Michael's case, and by not admitting he was having problems he got into serious trouble. Fortunately, after a few days at a low altitude, he'll make a complete recovery. Back at the hut, there's a farewell dinner. Tomorrow all the subjects will be heading down. Feeling fine to the end is Arndt, whose pre-climb test also proved accurate. But Udo, whose test results suggested he'd cope, got sick - at least temporarily. So the breathing test alone isn't a perfect predictor.

UDO I'm feeling good now. It's okay. I have no more headache and I'm fine now.

ALAN ALDA (Narration) And as things turned out, Udo's acclimation -- and Michael's rescue -- had come in the nick of time. A fierce blizzard means no helicopter could have made it in today. For Udo and Arndt, it's going to be a difficult climb down. While the experiment was promising, the mystery of why altitude illness devastates some but leaves others unaffected isn't solved yet. These young people now know, if they want to be super-mountaineers, the best advice is the old advice: climb slowly, heed the warning signs, and you'll be back to climb another day.

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I WAS A SPACEMAN

ALAN ALDA (Narration) We're 250 miles above the Earth. It's May 16, 1997. The American space shuttle Atlantis edges towards Mir, the Russian space station, and gently docks. One Mir crew member is especially happy today. It's Jerry Linenger, an American who's been in space for the last 5 months. He's going home. Three years later, Jerry and his wife Kathryn live here in Northern Michigan. Life in space was filled with problems, but for Jerry it was also exhilarating, even life-changing.

ALAN ALDA Hi...

JERRY LINENGER Good Morning. How you doing, sir? Nice to meet you. Come on in.

ALAN ALDA Thank you. Hi, hello, how are you?

KATHRYN LINENGER Hi. Nice to meet you.

ALAN ALDA What's his name?

KATHRYN LINENGER His name is Henry.

ALAN ALDA Henry. Hi, Henry. That must have been hard for you both, for you to be in space, and you to have a little baby, and...

KATHRYN LINENGER It was. And I spent the entire time over in Russia, while he was up, too, so...

JERRY LINENGER By having Kathryn there we thought we'd be able to talk once a week at least, but we had failures of those systems also. So it didn't work out, but Kathryn spent the five months I was in space over in Star City, Russia.

ALAN ALDA (Narration) Jerry started training at Star City, the once top-secret cosmonaut training center outside Moscow, in 1995. For two years, he was taught the Russian systems -- the space suits, the cramped Soyuz re-entry vehicle, every detail of plumbing, wiring and computers on board Mir.

JERRY LINENGER (Russian)

ALAN ALDA (Narration) Instruction was entirely in Russian, so he had to pick that up pretty quickly.

JERRY LINENGER (Russian)

ALAN ALDA (Narration) You could say Jerry was a political pioneer before he was a space pioneer. He was one of the original five astronauts in the joint Shuttle-Mir program in which US dollars helped prop up the Russian space program, after the Soviet Union's collapse. But regardless of the political overtones, the fact is the Russians had then a near monopoly on long-duration space flight. They've been blasting cosmonauts up to the Mir station since 1986. Jerry arrived on Mir in January 1997, brought up by the Shuttle. He learned to enjoy living in weightlessness. These are mankind's first steps toward space travel and colonization, he believes, and he's helping to blaze the trail. But he's also a down to earth scientist and ex-Navy flight surgeon. When he got back he found his months in space had led to a 13% loss of bone mass in the lower spine.

ALAN ALDA What does 13% bone loss translate into? Is that like serious osteoporosis?

JERRY LINENGER It's pretty serious osteoporosis. And what it really is, is leaching of the calcium. You know, this little frame structure here is built to hold the load. Our bones are built to hold the load, and it's an Earth jolt-load that we can hold. You get in space, you float. The structure says, I'm over-built, starts dumping calcium, says I'm too strong. Very smart, the bone is. Starts losing, losing, losing. Unfortunately in space it doesn't need any strength, essentially, because you're floating, and it just loses too much.

ALAN ALDA (Narration) To counteract this effect, on board Mir exercise is mandatory for all crew members, using a bungee cord harness to simulate gravity. The Russians discovered this deterioration, and they developed the counter measures, but the problem is you're still weightless most of the day. Bone and muscle loss is a major potential obstacle to space travel in the future.

ALAN ALDA (Narration) How severe is that loss going to be, I mean you were working out two hours a day, and you still had the 13% loss.

JERRY LINENGER That can be a show-stopper. The bone is just too smart, and it says I'm over-built and it just keeps dumping.

ALAN ALDA (Narration) Apart from some friction with Moscow ground control, Jerry adapted easily to life in space. He didn't mind washing in a few ounces of water squeezed from a tube. He stayed healthy. He never got headaches or motion sickness -- both common in space. His body began to think weightlessness was normal. And then he came back to Earth.

JERRY LINENGER The first few nights I'd lie there and I'd say, You're on Earth, you're on Earth, you're not going to fly, you're not going to fly, but I just could not

relax enough. I ended up taking my sheet, rolling it up, wrapping it around me, as a constraining device, and then I was able to close my eyes and sleep.

ALAN ALDA In those five months in space you had become so accustomed to any little force that would send you flying, that you couldn't take it just lying in bed.

JERRY LINENGER You know, I was a spaceman.

ALAN ALDA (Narration) He loved being a spaceman, but he paid a price -- the bone loss, and something much scarier.

JERRY LINENGER Sleeping some nights all of a sudden I'd see flash, flash, flash, flash. Looked like a bright flash bulb of a camera. And what's happening is I'm getting hit with radiation. Incredibly I turn my head 90 degrees, and I'd see a con-trail. A little bit less dense light, but spread out linearly. Turn again, pinpoint, very bright. Realize it's coming from that direction, very directional source, probably from a solar flare. You know I'm thinking family, things like that, you're doing this, I really don't like getting irradiated up here...

ALAN ALDA Scary. Yeah.

JERRY LINENGER Get behind some big lead batteries, try to block it, er -- couldn't block it.

ALAN ALDA (Narration) Now as he looks out at Lake Michigan, Jerry hopes the radiation won't have long term effects. His bones, at least, are almost back to normal. The aging Mir also nearly cost Jerry and his two Russian companions their lives, with the worst ever fire in orbit.

ALAN ALDA Didn't it burn for like, fourteen minutes?

JERRY LINENGER About a fourteen minute fire. I'll tell you, it was master alarm blaring, I turn the corner, peer down the length of the module, kind of the end of a school bus, if you will. Out of a solid fuel oxygen canister, big, kind of looks like a garbage can, big metal container, filled with a slurry of oxygen-rich chemical, coming out of that thing, instead of percolating a little bit of oxygen we got a big flame coming out. Two, three feet in length, this big around...

ALAN ALDA And smoke?

JERRY LINENGER Smoke just like I've never seen smoke come billowing out of a fire. Within thirty seconds, couldn't see the fingers in front of your face, and the first words out of my mouth, I said, Not good! Understatement of my life, but

that's what I said. Look low, try to get some air. Warm air doesn't rise in space. There's no density difference. Smoke doesn't rise in space. Smoke is everywhere. I see a window. I think open the window. You can't do that in space, you got a vacuum out there. Call 911 goes through my head, I tell you all the normal things...

ALAN ALDA You actually thought, call 911?

JERRY LINENGER I thought call 911. And I actually was laughing when I looked at that window and said, Jerry - you can't open the window. (Continues talking on board Mir.) The things that I think pretty much saved our lives are these oxygen breathing devices, and during the fire of course that had to go on quickly.

ALAN ALDA (Narration) The crew rapidly found their oxygen respirators, but for Jerry that was almost the end.

JERRY LINENGER Breathe in, I get nothing. Breathe in again, mask collapses around my face - I got a failed respirator.

ALAN ALDA Oh!

JERRY LINENGER Not a good day. Throw that off, feel my way along the bulkhead, can't see a thing, smoke right in your face. Er, you know, the next minute of my life, that's in my brain forever, that's split second by split second. Adrenaline flowing, had thoughts about my family here, I told my wife, I love you, Kathryn - take care of our son, John. Feel my way along. I actually looked around and I said, Wow, what a strange place to die. Finally get to the second respirator, mask over my head, I activate, and say, God help me. Breathe in, and I get air. You know, just hyperventilate the next 30 seconds, and then I yell, We're going to get that fire out!

ALAN ALDA (Narration) They'd saved their own lives, and the fire eventually burned out. Jerry also found the right stuff within himself, when he was swung out to replace some equipment, surrounded by the emptiness of space.

JERRY LINENGER I felt detached, and all at once I felt speed. Gut level, I felt 18,000 miles an hour speed.

ALAN ALDA So what happened? What was your reaction to that?

JERRY LINENGER You know - grab on! Aaaah...

ALAN ALDA That's a familiar feeling to me. That sounds like an anxiety attack. Right there.

JERRY LINENGER It's not anxiety. It's...

ALAN ALDA You wouldn't call that anxiety?

JERRY LINENGER Anxiety keeps me up at night. That's just fear.

ALAN ALDA (Narration) Then, on the way back in he had to cross the same empty void.

JERRY LINENGER I get swung back. Same point in space, no-man's land, I get the same sensation again. This time I take my tethers, attach them, push off, fling my arms out and go, Yahoo, what a thrill!

ALAN ALDA Ha! You're crazy!

JERRY LINENGER Well, it's incredible. I'm telling myself, 18,000 miles an hour, pure speed, man! How many people have ever felt this?

ALAN ALDA That's extraordinary. In that one hour, you got so that you were saying, Yahoo.

JERRY LINENGER Yahoo. The ability of the human being to adapt and change -  
- immeasurable.

ALAN ALDA (Narration) Jerry was supremely adaptable - first Star City, Russia, then space, and now back to Earth.

JERRY LINENGER You're plunging through the atmosphere, and if you don't like turbulence in an airplane, you would not like re-entry in the Shuttle. Pull about one and a half gs, I'm moving my arms, I'm telling Houston I'm doing OK. Last thing we do, 180 degree turn, dive down at the Earth, Charlie pulls back, Eileen Collins lets the gear down. Touch down, Eileen lets out the drag shoot. Nose gear down. Get a call from the flight deck, How you doing, Jerry? I say I'm doing alright, able to move, able to move my head. Feel my chest... doing this. Could literally feel my heart - and people say you're crazy, I'm not crazy, I'm a doctor and I'm a physiologist and I know what I was feeling. I could feel my heart muscle, the two ventricles, two muscle chambers of the heart...

ALAN ALDA Do I have this right - your heart suddenly had gravity to contend with, that it was not any longer used to?

JERRY LINENGER Exactly. It had to pump blood from here, to the brain and support that weight of the blood. In space my pulse was around 30, 35 beats a

minute, for the most part, even when I'm working, because it doesn't take much to pump the blood to your brain when you're floating. So all at once you've got that challenge of gravity yanking you down, your heart pumping trying to keep yourself conscious. Side hatch opens, you know fresh air just comes billowing in. You know, Earth air - don't have to make it, don't have to measure it, just tastes good.

ALAN ALDA (Narration) As far back as the 70s, we've known how hard it is to re-adapt back to Earth after a long flight. Muscles and bones are weak, balance and coordination are disrupted. At this point Jerry's extraordinary adaptability and determination triumphed once again.

JERRY LINENGER It's tough back on Earth with that gravity yanking.

ALAN ALDA But you wanted to walk.

JERRY LINENGER I wanted to walk, you know. The flight surgeon came on and said, Jerry, two big guys out here will carry you off. Just let us know when you're ready. Take an hour, two hours, when you're ready let us know. I told him, I said, Tom, I've been in space for five months, overcome a lot of tough times, and, er, it may be foolish pride but I said, I'm an officer of the United States Navy and we don't get carried off on stretchers. And my wife hasn't seen me in five months, don't want her seeing me carried off on a stretcher. And I told him I'm going to walk off this thing, or I'm going to crawl off this thing, but I'm going to get off on my own power. I'll tell you though, biggest surprise of my entire Russian experience is that we got along. You know, here I am US naval officer, used to fly off aircraft carriers, Indian Ocean, escorting Russian Bear bombers away from the carrier task force, radar locked on, missiles ready to fire. Er, Vasily Tsebliev used to live over in East Germany, Mig fighter pilot opposing our NATO forces in West Germany. You stick us together in a school bus off the planet for five months, pressure cooker environment. You know, who would think we could get along? Different language, different culture, different, backgrounds...

ALAN ALDA What was it? Was it just that you all thought Mission Control in Moscow was your common enemy, or what?

JERRY LINENGER The common enemy, sort of nice, I wouldn't put it that extreme, er, but you know what it is? It's common goal. You got a goal, colonize space, bigger than us as individuals, bigger than our countries, bigger than our differences. You set all that baggage aside, and you accomplish the goal. That 5 months in space was so profoundly different that it changed me as a human being. That grand view of the Earth, man! You know, you're looking out - the hook of Cape Cod, Florida, the boot of Italy, Sicily, curvature of the Earth, absolute big picture. When I see people having a little conflict, first thing I do, I



step back, look at a bigger picture, eventually understanding follows. I had a little press report, I got a one-liner saying they're slaughtering each other down in Bosnia. And I always wish, you know, I could snap my fingers and get us all up there, and I think we'd change our attitudes - toward the environment, toward our closed ecosystem here on Earth, er, toward getting along with people. So a lot of those things, you know, that five months off the planet, becoming a spaceman, changed me a lot.

ALAN ALDA (Narration) And wouldn't we all be Superpeople if we could adopt Jerry's view of Earth's problems? That's all for this edition. See you next time.

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