BBC Horizon: An Experiment to Save the World (Transcript)
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NARRATOR (DILLY BARLOW): We have assembled a team of experts to conduct a unique experiment to test out these claims. If the result is positive then this man will be on the way to a Nobel Prize, and a dream of a shortcut to a world with unlimited cheap energy could finally be within reach. But if it fails one of the great dreams of science will surely die.

NARRATOR: The small town of Oak Ridge in Tennessee has witnessed some remarkable scientific discoveries. The first atom bombs were developed here. And since then the Oak Ridge National Laboratory has been home to some of the US Government's most secret nuclear research projects. Now one of its scientists Rusi Taleyarkhan claims to have found something that could be an even bigger breakthrough for mankind. It's something that could potentially liberate millions of people trapped in poverty. Save us from global warming. And transform the entire global economy.

Dr RUSI TALEYARKHAN (Oak Ridge National Laboratory): It would raise the standard of living and have people be able to stand up and I guess be counted as human beings rather than be treated like dirt, the world would be a much better place, for everybody. That would be the crowning glory of my life if I can, if I can make it happen.

NARRATOR: But the claimed breakthrough has been condemned by many fellow scientists. And Rusi Taleyarkhan has faced a storm of criticism.

Dr RUSI TALEYARKHAN: We had to stand firm on what we believed to be right. We knew that whatever data was obtained was obtained under the best of circumstances with the best of intentions, and with whatever resources we had. And we believed the data.

NARRATOR: What Rusi Taleyarkhan claims to have found is one of sciences holiest grails, nuclear fusion. Nuclear fusion is nature's atomic power. At the core of stars like our sun, conditions are so hot and so extreme that atoms of hydrogen are forced together until they fuse. This natural nuclear reaction gives off massive amounts of heat, light and energy. And many scientists are convinced that fusion could provide cheap energy for mankind forever. Because here on earth exactly the right fuel needed for fusion is locked inside water, the stuff that covers most of our planet. So every river, every lake, every ocean is a potential source of energy. Enough for everyone on the entire planet for millions of years. And to cap it all, nuclear fusion is clean. So it would spell an end to global warming. And unlike conventional nuclear power there would be no nuclear waste. Not surprisingly realising this dream has been a goal of scientists for decades.

Prof STEVEN COWLEY (Imperial College London): Fusion is one of the great quests of science, it's one of the great things that we would like to be able to do like finding a cure for cancer. And we've known for fifty, sixty years that there's this unbelievable amounts of energy that we could get if we could just figure out how to do it.

NARRATOR: The key to releasing that energy was heat. Temperatures in the core of the sun are an unimaginable ten million degrees. And recreating those conditions here on earth has been one of the most difficult scientific endeavours of all time.

Prof STEVEN COWLEY: Nature does fusion, nature does fusion in the centre of the sun. But if you wanted to do it on earth you've got to recreate some kind of condition like the centre of the sun, that's difficult.

NARRATOR: For over thirty years and at a cost of billions, mammoth fusion machines were built to try and achieve this goal. But the experiments always used up more energy than they ever produced. Until in 1991 a team at this laboratory in Oxfordshire finally succeeded in producing enough energy to light up a few houses. But it lasted for just one second. A few years later the same team were back at it. This time they produced enough energy to light up a small town, for just four seconds. These bursts of energy were so short lived that fusion scientists had to admit that the practical reality of a world with unlimited clean energy was still as far away as ever. But some scientists dreamt of an easier way to achieve nuclear fusion, a short cut that would get mankind there quicker and cheaper. It was a dream that led to one of the most infamous scientific episodes of all time. On the 23rd March 1989, Professor Martin Fleischmann made the most extraordinary claim. That he and a colleague, Stanley Ponds, had discovered a simple way of doing fusion that didn't seem to cost the earth, it was called cold fusion.

Prof MARTIN FLEISCHMANN: Well the belief is that in order to create fusion we have to slam two atoms together. Bang, we have to slam them together. And that has been the background to attempts to create hot fusion. And what we were saying is no, no, no, no, no, it may be that you can achieve fusion under much milder conditions.

NARRATOR: What they had done seemed truly revolutionary. They had taken a test tube of the fuel for fusion, a type of hydrogen called deuterium, passed a simple electric current through it and made the atoms fuse together. Nuclear fusion seemed to be happening almost effortlessly, in a test tube, and it caused a sensation.

NEWS REPORT: Two scientists are claiming a breakthrough in the production of energy by nuclear fusion. The same process that powers the sun.

NEWS REPORT: It's been a dream of scientists for decades.

NEWS REPORT: Dr Ponds is an instant celebrity here.

NARRATOR: Ponds and Fleischmann became household names, as the idea of a cheap solution to all of mankind's energy problems caught the world's imagination. The rest of the scientific community quickly scrambled to catch up with Ponds and Fleischmann and repeat what they had done.

Prof STEVEN COWLEY: Any scientific process ought to be able to be reproduced exactly. Like about you know a hundred or maybe two hundred of the labs around the world, within a day Princeton had set up some cold fusion experiments and everybody was trying to replicate the results.

NEWS REPORT: Several hundred research teams around the world have been trying to prove the cold fusion theory.

NEWS REPORT: ..rushing to replicate its test, the results of an apparently successful nuclear fusion experiment...

Prof STEVEN COWLEY: Could be a hundred million dollars worth of research was done in a couple of weeks I reckon. In terms of all the people's salaries that were paid for their time, all the people who were thinking about it, all the people who were trying to reproduce it, all the people who were spending their time carefully reading the paper and trying to understand.

NARRATOR: The world waited expectantly to see if the results could be reproduced. And to begin with it seemed to go well.

NEWS REPORT: Scientists of the University of Texas say they've repeated the experiment which claims to create nuclear fusion at room temperature.

SCIENTIST: One, zero, nine, ok.

NEWS REPORT: This morning's pictures from the Texas University showed energy and maybe history in the making.

NARRATOR: The key was tiny particles called neutrons. When ever fusion happens neutrons are given off, so in theory the presence of neutrons would prove that fusion had taken place. But there was a complication. On a small scale neutron detection is notoriously difficult, because just tiny amounts of neutrons are produced. And these can easily be confused with something else, naturally occurring background neutrons produced by the sun and found all around us here on earth. And as neutron readings were double checked the picture began to change.

NEWS REPORT: Britain's leading atomic scientists have poured cold water on the idea of cold fusion. British scientists who have carried out extensive tests say there's no evidence that it works.

SCIENTIST: This would have been a very significant discovery and we're very sad that we've put all this effort in and failed to find anything.

NARRATOR: Most groups across the globe eventually agreed that all they could find were background neutrons. But it had taken several months and cost millions of pounds to reach that conclusion. With no fusion neutrons whatever was happening simply couldn't be fusion. And so what had started as the biggest scientific breakthrough in the world turned in to a scientific embarrassment of epic proportions.

NEWS REPORT: The two researchers who claimed to have made the breakthrough have made no comment themselves.

Prof MARTIN FLEISCHMANN: There was a conflict situation really, the newspapers, which escalated in the University, hmm, it was very bad, hmm.

NARRATOR: Now, even Professor Fleischmann acknowledges he made a mistake.

Prof MARTIN FLEISCHMANN: It isn't fusion, it's not fusion in the, in the narrow sense it's not fusion. Charlatans, frauds, yes, well they'll say whatever they want to say.

NARRATOR: Professor Fleischmann continued his work for a few years, but ever since March 23rd 1989, he has found it hard to get papers published in scientific journals.

Prof MARTIN FLEISCHMANN: So you're just squeezed out, excluded, scientifically excluded. Well, never mind.

NARRATOR: It seemed that the dream of a short cut to nuclear fusion was dead. But then something happened to resurrect the dream. It began when physicist Seth Putterman heard about something that seemed more like magic than science. It was a way of turning sound in to light. Seth Putterman was so intrigued by this idea that he set about trying to do it himself. It's a process called sonoluminescence.

Prof SETH PUTTERMAN (University of California, Los Angeles): The first time I saw sonoluminescence was in a darkened room. I was transfixed to look at this spherical flask of fluid. And you'd look in to the centre and in the centre see a glowing blue purple light, which could be seen with the unaided eye. It looked like a star in the headlights.

NARRATOR: Seth Putterman called it the star in a jar, a tiny spot of bright light contained in a flask of liquid. This star in a jar is made when a sound wave is passed through a small bubble inside a flask of liquid, and this sound wave makes the bubble do something remarkable. First it expands, then it collapses. And this collapse happens so violently that vapour molecules trapped inside the bubble slam together and heat up so much that the bubble gives off an incredible burst of heat and light, several thousand times a second, giving the appearance of a star. What made the phenomenon so exciting was the temperature of this star in a jar. On its surface alone the light burns at tens of thousands of degrees. And Seth Putterman now contemplated a tantalising possibility. Could the core of the collapsing bubble be even hotter, hot enough for fusion?

Prof SETH PUTTERMAN: One of the mysteries of sonoluminescence is to determine exactly how hot the interior of the bubble gets. In the sun, the interior can be millions of degrees, hot enough to cause fusion. And the thought crossed my mind that perhaps inside the collapsing bubble, the interior of the bubble might also get hot enough to cause fusion.

NARRATOR: If so this would be something truly amazing. By simply bombarding tiny bubbles with sound waves, temperatures of over ten million degrees would be created. And nuclear fusion, the same reaction that powers the sun would be happening almost effortlessly here on earth. One organisation realised just what was at stake, the US Government. They immediately started pouring money in to research to investigate whether sonoluminescence could finally be the short cut to nuclear fusion that scientists had been dreaming of. And across the USA several groups set to work trying to achieve this remarkable goal. One of those groups based at Oak Ridge National Laboratory was led by Rusi Taleyarkhan.

Dr RUSI TALEYARKHAN: Mid January, 2001, mid afternoon. Trying to look for signals. Now started pressing the button on our high speed scope and just kept our fingers crossed and said let's see what comes out. The very first time around it started clicking. That was extremely exciting.

NARRATOR: The clicking was the sound of a detector recording neutrons, a tell tale sign of nuclear fusion. At the first attempt it seemed that Rusi Taleyarkhan had done what nobody else had been able to do. Make his star in a jar hot enough for nuclear fusion. The key to his triumph was a brilliant idea. In sonoluminescence vapour molecules trapped inside the bubble smashed together, heat up and give off a flash of light. But Rusi Taleyarkhan realised that too many molecules might actually cushion the bubbles collapse. And so the reaction wouldn't be violent enough for fusion. So he started with smaller bubbles that contained fewer vapour molecules, which he thought would now be forced together with much more energy when the bubble collapsed. Creating a much hotter core inside his star in a jar, a core that would finally be hot enough for fusion. And in January 2001, it worked, and he detected neutrons.

Dr RUSI TALEYARKHAN: Elated is not the right world, ecstatic may not be the right word either, it was difficult to sleep soundly at night that day onwards.

NARRATOR: Rusi Taleyarkhan knew that his breakthrough would be big news. But he also knew that cold fusion had been big news before it was comprehensibly discredited. So over the next few months he checked his results, and confirmed them with other tests. He measured the neutrons again and again. But the results were always the same. And only then was he convinced about the scale of his discovery.

Dr RUSI TALEYARKHAN: Nuclear fusion is a major finding, some people think that it may be worthy of a Nobel Prize. It would be nice if it were. But I don't, I don't keep dreaming about it just now, if it happens so be it.

NARRATOR: And so the dream of a shortcut to nuclear fusion, and the prospect of unlimited clean energy was alive again. But that was just the beginning of the story, for such a huge breakthrough to be scientifically accepted the results first had to be published. Rusi Taleyarkhan aimed high, and sent his paper to one of the most prestigious scientific journals in the world, Science magazine. Its editor Don Kennedy remembered just what had happened with cold fusion.

DON KENNEDY (Editor-in-Chief, Science): With the over hang of cold fusion one would naturally be a little hesitant about a fusion claim that looks improbable. But you shouldn't ignore something because it's scary. I think the experiments were very well done, I found them convincing, and so although we recognised that this was going to be controversial we really thought it was a very interesting finding.

NARRATOR: Science magazine sought out the opinions of other experts in the field. And although their comments were not all favourable, Don Kennedy decided that on balance this remarkable paper was good enough to print.

DON KENNEDY: We felt really comfortable about going on with the paper, comfortable in the sense that it was solid work from a very good laboratory by good people and it would have to then endure the test.

NARRATOR: So on the 8th March 2002, Rusi Taleyarkhan received the endorsement of America's most prestigious scientific journal, and his fusion results were published in Science magazine. And immediately ran in to a storm of criticism, that serious flaws had somehow been overlooked. Ultimately many scientists felt the paper should never have been published at all.

DON KENNEDY: Fusion research is a heavily contested field, both because there are reputations to be made and because the amount of federal dollars spin on it is quite large and people want their share of that research support. So don't ever expect this to be a peaceful domain in science, it's not going to be.

NARRATOR: The criticism focussed on one crucial issue, the same issue that cold fusion had founded on, neutron detection. The best way to check if fusion was happening was to detect neutrons, the tiny particles that are given off when atoms fuse together. But there was one major complicating factor, Rusi Taleyarkhan was also using neutrons in his experiment. The small bubbles that led to his breakthrough were created with a device called a pulse neutron generator, which fired out over a million neutrons a second. And sorting out these background neutrons from any created by a small fusion experiment, although possible, was no easy task. Some scientists suspected that Rusi Taleyarkhan's fusion neutrons could in fact be coming from his own neutron generator. Bouncing around the room, and then entering the neutron detector, where they were mistaken for evidence of fusion. Rusi Taleyarkhan had an answer. He had conducted several control experiments to rule out the influence of background neutrons. But even in Oak Ridge there was a conflict over his work. The management of the laboratory was sufficiently concerned about Rusi Taleyarkhan's fusion claim to ask someone else to double check it.

Dr MIKE SALTMARSH: And now we'll count for another two minutes and see how many we've got.

NARRATOR: They called in Mike Saltmarsh, an expert neutron hunter, with over thirty years experience of neutron detection and fusion.

Dr MIKE SALTMARSH: Forty two thousand and forty three neutrons.

Dr MIKE SALTMARSH (ex-Oak Ridge National Laboratory): The reason why I was asked to look at it is actually I hate to sound immodest but I'm rather a good experimental physicist, and I do bring a background in neutron detection.

NARRATOR: Mike Saltmarsh's task was to work out whether the neutrons detected could indeed be from fusion or were simply background neutrons from the neutron generator.

Dr MIKE SALTMARSH: There is always a background, some of it due to natural background radiation. In the case of this experiment there was an additional enormous background from the neutron generator itself, which was producing a million neutrons a second that were going all over the place. And consequently any neutron detector has to be able to sort out whether the neutrons it's seeing are from that or from something else.

NARRATOR: The way to do it was to run the experiment again in Rusi Taleyarkhan's laboratory, where Mike Saltmarsh could measure the neutron background, take it in to account and then concentrate on finding fusion neutrons over and above that. So he took a neutron detector, set it up, and after extensive testing he found no evidence of fusion.

Dr MIKE SALTMARSH: If there'd been fusion going on at the sort of rate that Taleyarkhan's paper was claiming we should have seen an enormous increase in the neutron detection, and we didn't.

NARRATOR: Instead Mike Saltmarsh thought that any fusion finding could be explained by the background neutrons from the pulse neutron generator. So he wrote up his report. And a couple of months after Rusi Taleyarkhan's paper this was also published, it was a damning conclusion. Rusi Taleyarkhan and his team disputed Mike Saltmarsh's conclusion, but for the next two years there was a steady stream of criticism.

Dr RUSI TALEYARKHAN: There has been many a day that I'd come home dejected, desperate, but not until somebody really goes through trials and tribulations of that type, being called all kinds of things, nasty things. You know it shakes your self-confidence and your value as a human being sometimes.

NARRATOR: Eventually he decided to try again. So he designed a new experiment with better neutron detection. And after months of checking and confirming the results were ready. This time the neutron signal was even stronger, and he was convinced it simply had to be from fusion.

Dr RUSI TALEYARKHAN: Now there is very, very, very little or absolutely no chance that these neutrons could be confused as having come from the pulse neutron generator.

NARRATOR: So he sent these results to Physical Review E, a highly respected journal. And after an extraordinary thorough review they were accepted for publication.

Dr RUSI TALEYARKHAN: With everything we've gone through, I mean all the trials and tribulations and the gut wrenching feelings that you could be wrong and you might be making a fool of yourself on the world stage, you feel like I guess you've been, what's the right word? Er vindicated.

NARRATOR: But despite this second publication many sceptics still weren't convinced. They believed that there was one vital measurement that still hadn't been made. It was a measurement that could finally prove once and for all whether Rusi Taleyarkhan's neutrons really were from fusion. It was all to do with timing. If fusion was taking place neutrons should be recorded at the very moment the flash of light was given off. The flash of light would be recorded like this. And the neutron would be recorded at exactly the same time like this. But there was a complication. Sonoluminescence light flashing are incredibly fast. Each flash lasts just a nanosecond, one billionth of a second. And if fusion was happening then any fusion neutrons should be produced at exactly the same billionth of a second. And should be recorded like this together. But Rusi

Taleyarkhan's instruments could not measure with nanosecond accuracy, they measured over a much longer time scale. Which meant that stray background neutrons recorded some time after the flash of light here, or here, or here, could still be mistaken for signs of fusion. So to convince the sceptics that fusion really was happening the burst of neutrons had to be recorded in the same billionth of a second, if not they wouldn't be convinced that it really was fusion.

Prof SETH PUTTERMAN: Unfortunately this particular measurement which is within the capability of modern technology has not been presented in either the first paper which appeared in Science magazine or in a follow-up paper.

NARRATOR: Rusi Taleyarkhan believes that he has repeatedly detected neutrons at the same time as flashes of light, and that he has already proven his claim beyond a doubt.

Dr RUSI TALEYARKHAN: My life has been audited, my instruments have been audited and my books have been audited. The data speak for themselves, the data had to speak for themselves and it's difficult, it's difficult to, you know how can I answer that I know absolutely one hundred percent sure that it is, that it is what I think it is? I just have to look at the data and the data had been looked at very carefully. In the history of publications, I probably will not be able to find one that has gone through this level of scrutiny, if you do let me know.

NARRATOR: If he's right a great discovery has already been made. But if he's wrong his reputation could be severely damaged. The dream of a shortcut to nuclear fusion hangs in the balance. So tonight, on Horizon, we've decided to try to resolve this extraordinary dispute once and for all. We're going to try to make fusion ourselves, the same way Rusi Taleyarkhan says he does it. It will be the first comprehensive and independent attempt to repeat Rusi Taleyarkhan's fusion results. A sacred scientific principle is at steak. The principle of reproducibility.

Prof SETH PUTTERMAN: Nothing is too wonderful to be true that it can't be reproduced in another experiment. And this is what distinguishes science from religion.

NARRATOR: If Rusi Taleyarkhan's results can not be reproduced independently the claim could suffer the fate of cold fusion.

Dr RUSI TALEYARKHAN: Well professionally it would be, it would be, it would be difficult to live with, but on a personal level I don't care.

NARRATOR: If we do get fusion, one of the holy grails of science may finally come within reach, and the Nobel Prize would surely follow. For Rusi Taleyarkhan if not for Horizon. So we've assembled the best experts to try and sort it out. Seth Putterman, the man who first realised the potential of sonoluminescence will run the experiment. While back in the UK a team of leading experts will scrutinise the experiment and analyse the results. Professor Tim Mason from Coventry University, an expert in sonoluminescence. Dr Nigel Hawkes, a world renowned expert on neutron detectors from the National Physical Laboratory. Dr Mike Loghlin from the UK Atomic Energy Authority, an expert fusion neutron hunter brought in to check the neutron data. And Professor Cathy Sykes, to help cut through the technical jargon. We even invited Rusi Taleyarkhan to come to the laboratory and check Seth Putterman's equipment. But he declined our invitation on the basis that in the small and competitive world of fusion science he did not feel comfortable with Seth Putterman's group.

Dr RUSI TALEYARKHAN: I would help out anybody who I feel, who I felt comfortable with. I would, I would, but I have to be comfortable with that particular group.

INTERVIEWER: Why, why is that, because is it not just science?

Dr RUSI TALEYARKHAN: I will not answer that question right now.

NARRATOR: So without Rusi Taleyarkhan's input to the experiment our team had to follow his recipe for fusion from the published papers. In early October 2004 Seth Putterman and his team went to work. First they set up the experiment. They started with a liquid in which the bubble would be created, a liquid called acetone to which deuterium, the type of hydrogen needed for fusion, was added. It was treated to remove any excess gas that might prevent the bubbles getting hot. Then came the neutron generator, the vital piece of equipment needed to make the bubbles. Rusi Taleyarkhan used two different types of neutron generator and got fusion both times. So our team made sure their generator matched one of those. Then the flask in which the bubbles would be created was installed. Rusi Taleyarkhan said that the design of the flask was important, it had to survive being bombarded with sound waves. So our team ensured that their flask was up to the same job. Finally, Seth Putterman made one major improvement, and a neutron detection system much more accurate than that used by Rusi Taleyarkhan was installed. Using this, Seth Putterman would be able to record any fusion neutrons at the exact moment, the very same nanosecond as the flash of light. If there were any there at all.

Prof CATHY SYKES: So just to be clear that we can really compare the two experiments.

NARRATOR: Because of the specialised nature of the equipment not everything could be identical. So we asked our UK experts to scrutinise whether minor differences in equipment were likely to prevent fusion.

MIKE LOUGHLIN: There is one classic difference which is the source of the neutrons.

Dr NIGEL HAWKES: The energies are different, the source produces lower energy neutrons.

Prof CATHY SYKES: Now would that matter?

Dr NIGEL HAWKES: Not according to Taleyarkhan, because in his first paper he said he got this effect.

NARRATOR: The neutron generator got a clean bill of health.

Prof CATHY SYKES: Is the sound wave that he has applied just the same?

Dr NIGEL HAWKES: Slightly different frequency?

MIKE LOUGHLIN: Minor, I don't think that would do it.

Prof CATHY SYKES: You don't think that would matter?

Dr NIGEL HAWKES: No.

NARRATOR: And so our experts were convinced that the recipe for fusion laid out in Rusi Taleyarkhan's published papers had been followed as closely as possible. Confident that he could reproduce Rusi Taleyarkhan's vital scientific conditions Seth Putterman went to work.

Prof SETH PUTTERMAN: So have we got the deuterated acetone in the cell? So we're cooling down now in order to get to zero degrees?

SCIENTIST: Yeah we're getting there, we're at seven point five degrees.

Prof SETH PUTTERMAN: And Brian put the source in?

SCIENTIST: Yeah.

Prof SETH PUTTERMAN: Yeah. Ready to roll, let's get the data and let's see what we can find.

NARRATOR: On October 7th 2004, the test chamber was sealed, the sound waves started, and the experiment was underway. In two six hour runs, spread over three days, sound waves bombarded bubbles inside the flask. And the neutron detector did its work, searching for neutrons in the same nanosecond as flashes of light. To give the experiment the best chance of success data from four thousand bubbles was painstakingly recorded.

Prof SETH PUTTERMAN: It looks like a really good resonance. It's good. That's really good.

Narrator? And when the experiment finished, to ensure fair play, all the data was sent off to the UK to be thoroughly checked and analysed.

Prof CATHY SYKES: So let's try summarise the different results that we got from.

NARRATOR: A few weeks later our team came together to discuss the results.

Prof CATHY SYKES: ...expect them both to see were the bubbles. Are the bubbles reasonably similar or can we say there are a few differences?

TIM MASON: They're the same.

Prof CATHY SYKES: They're the same.

TIM MASON: As far as we can tell.

Prof CATHY SYKES: As far as we can tell, ok. And then we've got the sonoluminescence. So these are the flashes of light, we know that Rusi saw them, how about Seth, did he get that too?

MIKE LOUGHLIN: Yes he saw it as well.

Prof CATHY SYKES: So there's a load of energy being produced, we know that.

NARRATOR: It was clear that our experiment successfully produced bubbles that gave off flashes of light.

Prof CATHY SYKES: When you get the flash of light that's exactly the same time that you expect the neutron to be produced.

Dr NIGEL HAWKES: Yes, if the neutron is coming from fusion you'd expect to see it at the same time as the flash of light.

NARRATOR: But then it came down to the biggest question of all. Just how many neutrons did Seth Putterman record in his neutron detectors in the exact same billionth of a second as flashes of light?

Prof CATHY SYKES: And how about Seth?

MIKE LOUGHLIN: None above the background.

Prof CATHY SYKES: None.

MIKE LOUGHLIN: None at all.

NARRATOR: Our experiment failed to find any evidence of fusion. We put this conclusion to Rusi Taleyarkhan. He said that it had taken him several years to perfect the exact conditions necessary for fusion. And that because our experiment was not an identical copy of his any one of several differences might have affected the outcome. Never the less we followed his fusion recipe as closely as possible, on the principle that if the key scientific conditions are reproduced the results would be too. But we found nothing. It is possible that other scientists may succeed in reproducing Rusi Taleyarkhan's results, but for now, all we can say is that the dream of a shortcut to unlimited clean energy forever must remain just that, a dream.