

## THE CENTER FOR NATIONAL POLICY

### **“THE CHALLENGES OF ADAPTING TO A CHANGING CLIMATE”**

#### **FEATURED SPEAKER:**

**DR. BRUCE PARKER,  
FORMER CHIEF SCIENTIST FOR THE NATIONAL OCEAN  
SERVICE, AUTHOR OF *THE POWER OF THE SEA:  
TSUNAMIS, STORM SURGES, ROGUE WAVES,  
AND OUR QUEST TO PREDICT DISASTERS***

**2:00 PM – 3:00 PM  
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MR. STEPHEN FLYNN: Good afternoon. I'm Steve Flynn, president at the Center for National Policy. It's great to have all of you here today. We usually do a lot of things around the noon hour but today we pushed it in the afternoon, hopefully providing a good excuse for you not to be having to work too hard at the end of the day but something of real value I think in terms of presentation. I couldn't be more delighted to have Dr. Bruce Parker with us.

You know, as a guy who comes out at this in two fronts, one is retired Coast Guard officer but secondly who spent a lot of time working national security issues, I can't understate I think how important the work that Dr. Parker is doing here.

A lot of my effort I found in the '90s, particularly with national security issues, was to essentially face challenges that would impact dramatically on loss of life and our threatened interest of the United States. And that became a real focus obviously post-9/11.

I can't come up with any national security scenario short of a nuclear weapon going off in a major city that could destroy as much property or kill as many people as we saw in the case of the tsunami in 2004. And certainly here at home in terms of destruction of property, what we saw with Katrina.

Somehow in our focus about what we assign priority in this town, we focus at manmade threats that are really, really high bar and then we invest a huge amount of energy in trying to use intelligence and other tools to deal with that, and yet we have something as powerful as the sea and other forces of nature that can be destructive plus some and we're struggling still trying to figure out what the tools are to anticipate that and then how we manage it.

This is, of course, something that Dr. Parker has made his career of figuring out going back from the beginning. Actually, we spent some time in the same neighborhood as a graduate of the Coast Guard Academy of New London – your very first assessment, right, in oceanography was in New London.

MR. BRUCE PARKER: Summer job as a civilian yes.

MR. FLYNN: His summer job as a civilian. And then spent an extraordinary career in NOAA and finishing it as a chief scientist for the National Ocean Service, been involved in this sphere for quite some time. And he has now left service, wrote this wonderful book which you're going to hear about, continues to be sought after consultant on many of these issues. We're just delighted to have you here today, Bruce, and share with us the story of the power of the sea.

MR. PARKER: Well, thanks very much, Steve. I appreciate it. I have to admit this is kind of a different arrangement. I'm used to either standing at a podium or like wondering back and forth. So we'll see how this goes.

And I guess to kind of follow up on what Steve said and give you a little background on why I wrote this book – Steve's kind of led into it a little bit. I was with NOAA for many, many years with many different types of jobs. The last one was chief scientist for National Ocean Service. Before that I ran a research lab. I was the director of the World Center for Oceanography, a couple of other jobs like that.

And all during that time we think we're working on really important stuff, things that affect people's lives and whether it's forecasting, storm surges hitting a coast or whether it's dealing with issues related to climate change and global warming that can affect the whole world, you think, you know, why aren't people listening?

Of course, government agencies have what they call outreach, which is their word for advertising, trying to show much important their stuff is, try to convince Congress to keep funding them. And then, of course, all the non-profits have various ways of doing that as well. And, you know, it seems to work sometimes, sometimes it doesn't. And before I left, I had started writing some more popular oriented articles, not just science journal articles and that type of thing.

So I thought once I left that I would try to write a book for a general audience to kind of get across some of this. And I used to kid around there's enough – the whales and dolphins are fine. I care about them. But there's enough books about them. There's no books about ocean physics for the general audience. So maybe I could do that.

And what I should do is try to find a theme that is compelling enough that people would be interested and rain prediction really is compelling enough. The idea is, well, the book actually starts out with when the sea turns its enormous power against you, the best defense is to get out of its way. But to get out of its way, you've got to predict when and where it's going to hit you. And this, of course, goes back to ancient times. This isn't just now.

And so the idea was I would try to write a popular book, not a dumbed down book but a popular book that would kind of show the history of us learning how – mankind learning how to predict when the seas are trying to kill you, essentially.

And the idea was also to kind of intersperse really thrilling compelling stories of natural disasters, some of them even quite sad, with stories of scientific discovery, how scientists and mariners were trying to figure out how the ocean works and learn enough to predict when the ocean was going to do these things.

So I came up with the idea of this book. It's essentially an attempt to raise public awareness from a different sort of angle. And the book basically, if it was more of an academic book, could be called the history of rain prediction. But it isn't.

It's a popular book and when you're dealing with a popular book editor and a publisher there's often compromises. And they like the *Power of the Sea* title but we must have debated for like a year over the subtitled. And they finally decided they wanted to put tsunami, storms or rogue waves in there because they were the sexiest of the things in my book.

And in fact, even when I try to first go out and find an agent which you have to do for popular books and then who would then find the publisher, you'd send out a query letter and you say, this is what I want to wrote. I've got letters write back saying, oh, yes. It sounds really good. Send your proposals. So you write like a 50, 60-page proposal and you lay it all out and who the readers are supposed to be.

And I got another response back, in fact on a phone call, said, oh, that sounds really good but then the inevitable came: well, could you change it a little bit? (Laughter.) And the first thing they wanted to change was, could you make it more like the perfect storm? And I said, well, you know, this is kind of a broad book and there's lots of stories but I'm not following any one character through the whole book and I don't know about the love affairs on (shore ?) and there's no sex in this book. And they said, there's no sex in the book? (Laughter.) And I said, well, not but there's a lot of death. Does that count? Well, that's good they said but could you get some sex into it? I said, no.

So I had to move on to a couple of other – I finally – and there was this one agent I was really hoping for but you couldn't get to him. He didn't take unsolicited proposals. But I figured at this point I'd learned enough and I'd polished my proposal enough and I found an inside to get to him from a friend of a friend kind of a thing. And as soon as he saw it, he said, send me the proposal. And then the second time, he looks at the proposal and instead of saying, could you change, he said, let's do it. And he's a guy who's got Jared Diamond and Brian Greene and all really top notch people so I felt pretty good about that.

So anyway, to get to the book itself, yes, it's a history of marine prediction. And the book really starts with the tides because that's the one phenomenon the ancients had some handle on. They never understood what caused it. They thought it was – the earth was an animal spitting out water and sucking it back in. But they did see the correlation with the moon and because of that correlation with the moon and the phases they had a kind of a crude way of predicting it.

And the book starts, the first two chapters, with that and works through storm surges which after the tides it's not until the 20<sup>th</sup> century we really learned how to predict any of these things. So the storm surges are next in the book because we really are quite good at that now and talk about how that happened but also some of the incredible disasters because storm surges have killed millions. It's killed more than anything else that's talked about in this book.

Then we segue in the wind waves which is even more difficult to predict and talk about some nice World War II stories, how critical it was to the allies landing in D-day and that type of thing.

And then we get to tsunamis which to be honest we still can't predict. We can predict once it happens. One a year, a submarine earthquake happens, we can predict where it's going to go from that point, once you know there's a tsunami but you can't predict the earthquake so you can't really predict the tsunami, so there's still tons of work there. And eventually into the longer term stuff of El Nino, a little history of how we learned to predict that, although we still have a lot of problems with that.

And ultimately, last chapter talking about climate change, global warming and that type of thing, and as we'll talk at the very end, we do pretty well on the global models but as soon as you get to the point of trying to do regional models to predict what's actually going to happen at that location so that country can mitigate and respond to it, we're not really very good.

So, as I said, the first part, the earliest predictions for the sea were tide predictions. And the story – again, this book is based on stories. It's based on some really interesting stories that haven't been told before and then the science comes in as the stories of the scientists who are involved. And I tried not to go too heavy on the science or I'd lose my audience and yet, as I said, I didn't dumb it down so it's really – I may have to put this on, if you don't mind.

And the earliest use for the tides actually was fishermen who would go out and dig shellfish at low tide and some places with huge tide ranges, this is off – near Anchorage, Alaska, with a 40-foot tide range that if you're there at low water digging up scallops or muscles or clams and the tide comes rushing back in and you don't get out there, you've had it.

And even up here around Anchorage, even in this modern age there's always stories still happening of like, hunters who go out there on the mudflats, which are like quicksand in places, and it gets caught in the quicksand and suddenly the tide starts coming back and it's moving upward at like seven feet an hour, you don't have much time before it's over your head. And literally the hunters that are breathing through the barrels of their shotguns like straws trying to stay alive as the water is rising. And of course, the Coast Guard has helicopters now and special equipment they're as fast as possible if you had a cell phone or something to say get me out of here kind of thing.

And of course, the other big thing in ancient times was for mariners bringing ships into a port that if you didn't bring your ship in in high water you might run aground, you might hit a rock. A lot of people die just from people hitting the bottom when they're trying to bring the ship in.

And, of course, this is a 40-foot tide range in Bristol, United Kingdom, where this – this is the issue here, this is low tide just sitting on the bottom but it's high tide that they usually really care about.

And this is – Mount Saint Michelle or Michael in the southern end of the Gulf of Saint-Malo, France, which is connected to the English Channel – 40-foot tide range and literally when it's low tide, there's just you know so many square miles of mudflats but then the tide comes rushing back in and the natives always say it's like horses galloping in and swirling around.

And the reason I mentioned this is because the first story in the book is actually about Napoleon. And Napoleon, of course, knew about the Gulf of Saint-Malo and he knew about the tides. In fact, Pierre, the marquis de Laplace, actually worked for him at one point and he was – he with Isaac Newton were the two guys that really made tidal science a true science in the 1600 and then 1700s.

But Napoleon had just conquered Egypt. And he was a man of science actually and he was man of history and he had some time to kill before he was going to have to fight the British and the Turks, but he'd just won the battle of the pyramids and so for a while he sort of owned Egypt.

So one day he decided he was going to take a small band of men and cross the northern end of the Gulf of Suez at the very northern end of the Red Sea and go over to the wells of Moses and to Mount Sinai and visit with some Arab chiefs and that kind of thing. And he knew that it was a place of low tide, this one mile stretch of sea bottom became dry and they could just go right across there. And caravans had done this for years. I mean, this was nothing new.

So he went across and he had his visit and stuff and he was supposed to come back about exactly 12 and a half hours. Twelve and a half hours later, because that's when the next low tide would be, but he was a little late. So he got there and it seemed to still be dry and they started crossing and the tide came in, started swirling around them.

Now, this is not a 40-foot tide range. When he was there it was about an eight-tide range. But it's still enough when you're horseback and there's one general with a wooden leg who had trouble staying on the horse because the water was up the chest of the horse and up to his waist.

But Napoleon told all this men top form circles around him and be straight lines like the spokes of a wheel and everyone just sort of go outward and if you lost your footing, then fall in back one of the other lines. And eventually, one line was the one that kind of stuck to the shoal which they couldn't see anymore and they escaped from the Red Sea.

And this was actually an etching I found in an 1852 magazine, and that's what actually started me on this kick here, Napoleon's escape from the Red tide – the Red Sea tides, not the Red tide.

But he was on shore his biographer quoted him as saying, had I died like the pharaoh, all of Christendom would have used this as a text against me. And of course, he's referring to the "Exodus" and Moses bringing the children of Israel across the Red Sea. And he had been told – Napoleon had been told this is the place where it actually happened. And, of course, that couldn't be quite true because like 3,000 year earlier when the exodus was supposed to have happened the sea level was much higher then and that sounds contradictory to global warming but this was a tectonic thing. This was land movement. And there had actually been a canal that connected the Nile to the Red Sea at one point but as the sea level went down, they couldn't use it anymore.

So this actually led me to thinking and there's a section in the book that really deals with could the exodus across the sea have depended on a tide prediction by Moses? And it made perfect sense actually because if you're planning to bring your people into freedom out of Egypt, and even if you're expending some help from on high, you've got to have a plan. And a plan depends on timing.

And the only phenomena that he could have ever known with any kind of timing would have the tide. It was the only thing. You hear crazy books about tsunamis and storm surges. There's no way he could have predicted any of that. But having been a guide in that area, in that region, and known about the tides and known about the caravans crossing, it would make perfect sense. And then, let's say in addition to that he decides to take them across at night on a full moon so you have a moonlit path.

Now, full moon means spring tide. It means the highest tides possible and the lowest tides possible. Lowest tides give you more time to bring your people across. The highest tides to better engulf the chariots who were chasing after you. I mean, the timing issue – you entice the pharaoh to cross because you leave a few straggles and he comes across, the tide comes in and whammo (sp).

Now, it's nice to have Charles Heston with walls of water and the 10 commandments but there are actually translations of the Bible and other books that don't describe it that way. They describe it more like around the Gulf of Saint-Malo which it kind of swirls in. It's not – so anyway. Here I think a great story and so that's what I start the chapter out with.

And I keep researching it because I'm always trying to add more facts. And I bumped into this reference by one ancient writer to – this Hellenistic writer from around 80 B.C. and he quotes this guy, Artipanis (ph) I think is the way you say his name, and he says, Artipanis says there's two stories. One is just like in the *Bible* but the other one that the people of Memphis tell simply says Moses took them across a low tide. I say, I'm only 2,000 years late with this story but nobody else has actually talked about it.

And I went into more detail than that than I will on some of the other stories. But, for example, the story of Alexander the Great who would conquer on his eight year binge, so to speak, across Asia had conquered just about everybody, and he just finished with battle with a King Porus and his elephants, and his men were about to mutiny and he decided that he would just explore a little bit more because Aristotle and some other people are his teachers. He just loved nature and world and whatnot. So he went down the Indus River and literally he was almost wiped out by a tidal war. And that's story is in the book as well.

And also the story of the very first tide prediction table was actually for the tidal bore in the results Qiantang River in China. And tidal bore is – I can't get into much detail because I don't have enough time about all these different things, but this is all in the book – but whenever you have a very wide bay at the end there and narrows down and that builds up the tidal range, at the same time you've got friction distorting the wave until it becomes virtually perpetually breaking wave.

Now this actually – I was at the Qiantang River at that same location. This is one of its smaller periods, because it changes throughout the month according to the tide. But even something like this, if the river's like two miles wide and you see this one ribbon in the distance moving at you as it gets closer you see it's one continuous breaking wave across the entire width of the river moving up, that's a little disconcerting.

Only in – (Qiantang ?) is the great case. It was much bigger and there are times even now tourists come out to see it every time it comes. They have family reunions by the pagodas and the temples and whatnot. But sometimes it can end up to 15 or even higher feet and it overflows the banks and some tourists get pulled in so it can still cause problems.

And nowadays you don't hear anything about tides really hurting anybody but there are still plenty of aspects of it besides the tidal war where tides could kill people and then they have to learn how to predict and tidal whirlpools where one of the most famous ones and especially in some of the ancient literature.

In Homer's the *Odyssey*, the two famous monsters, Scylla and Charybdis that Ulysses had to face they were actually at the straight of Messina between Sicily in the lower boot of Italy and Charybdis was actually the representation of a huge tidal bore.

In real life, the mariners could predict exactly when that would happen because it was at the change of the tide and they correlate with the moon and they pretty much stayed out of the way.

And even in Homer's story, the sorceress who advised Ulysses how to avoid it said run your boat way along the edge and you can get by it. And she's talking about a monster but that was good navigational advice too. Of course, Scylla was like an 800 monster that ate most of his men so it still didn't end up helping him in the long run.

But so prediction goes – you know, tide prediction goes back centuries. This is a 1543 tidal almanac this is actually the English Channel and very simple methods based on just how much time after a full moon do you see the high water happen and that type of thing and there's much more detail about that in the book.

And even things like the Boston Tea Party. As I said, there's a lot of death in this book so there's also some slightly lighter stories. This happens to be one of them. And the colonists in the American colonies really knew about the tides, whether they were fishermen or mariners it was very important to them and tide predictions like in almanacs, like *Poor Richards' Almanac* that Ben Franklin did. And Benjamin Banneker had one. He was a free African-American who was a scientist who did all his own astronomical calculations and he had tide – I mean, almanacs that had tide tables in them.

So the colonists were really into this and they were always tricking the British into getting behind like a shoal just as the water level was going down on a deeper draft ship than they were and then they'd scoot out and they'd be stuck there – the British would. And then they'd even burn the boat or they'd get to some place first.

And it actually affected at least of Paul Revere's ride, in fact, even the second Paul Revere ride, the famous one. He used a tidal current to help him get across the Charles River and stay ahead of the British who went across at the wrong way and the tidal current held them up.

So they really knew, but in the Boston Tea Party, tempers were really flaring that night. It was quite an emotional night and so they weren't realizing that the night of the Boston Tea Party was a Proxigean Spring Tide. Now, what that means is spring tide means the sun and the moon are working together. Proxigean means the moon is the closest it is to the earth. This is one of the two lowest tides of the entire year.

So when they dressed up as Indians and they went on to the three ships and they started dumping 45 tons of tea over the side, there was only two feet of water to take it. So pretty soon, the tea has filled off the water gap, it's getting piled higher and higher by the ships, it starts falling back into the ship because the piles are so high. And there was no tidal current either. It was slack water. So some of the Indians were jumping over the side and smashing in and pushing it into the mud and trying to do everything they could.

And when the tide finally came in and started raising up, and then the tidal currents started pushing it away, it was like stacks of hay, only it was tea, that was just floating away so the colonists had to get into boats and kind of smash them into the water because it couldn't be usable tea. That kind of defeated the purpose. They had to destroy it all. So anyway, this is something you never hear about the Boston Tea Party. It didn't quite go as well as planned.

And later in the book, it leads up to one of my favorite stories because it's the tide predictions for D-Day. And I actually got to interview the son and the daughter-in-law of the man – Arthur Doodson at the Liverpool Tidal Institute who actually made the

predictions and some people who are still live who were there at the Liverpool Institute when it happened. And – (inaudible) – and this guy name Ian William Farkinson (ph) who is in the Royal Navy who had to try and get him some secret data from the Normandy Beaches to help him make the tide predictions.

The pictures at the top there are there – what's called analogue computers. The tides are very predictable because of the energies of very specific frequencies it's tied to the astronomy of the problem, the orbits of the sun and the moon. And so you literally could make these little pulleys and each wheel would represent a different bunch of energy relating to the moon or the sun or other things. And it's – the history is in the book there. You can learn about it.

But the reason this is was all necessary is 25-foot tide ranges on Normandy beaches. So if you went at a high tide, you had literally no beach at the cross. That would be preferable to low tide when the beaches get really wide and the Germans are shooting at you. So you want a short a route as possible.

And to make it even worse, Rommel had put all these underwater obstacles literally designed to tear out the bottom of the landing boats. And the allies saw this and they said, well, we're going to at low water then. We're going to send in demolition engineers and we're going to make paths through this.

And so the story of that's in there. And the funny thing is most you've heard about the famous weather forecast that 5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> were the three days they wanted to go because of the tides and the moon and other things. And they couldn't go on the 5<sup>th</sup> because the weather was really bad. And the weather forecasters predicted a break in the weather which the Germans didn't predict and they went on the 6<sup>th</sup> and they caught the Germans by surprise. And – (inaudible) – Omaha where they had left more forces behind.

But Rommel went home to see his wife and Hitler not just because of the weather. He thought the tides were wrong because he still thought they were coming at high tide for some reason. And we've never found out why he thought that. So tide is very well done. And by the turn of the 19<sup>th</sup> century, tide predicting machines were doing it quite well.

Storm surge is a whole another thing. It is certainly thing that kills more people than anything. This is an 1883 etching of a 1934 storm surge that hit the coast of Germany in Nordfriesland, and these are the low countries – the Netherlands, Denmark, Germany – and these are the places that you've probably seen the windmills and the stories of reclaiming the land and they build these polders where they would build these walls around and pump the water around and take some land back and just keep moving it and the dikes and all that kind of stuff.

And they could do that for hundreds of years and then one storm comes through and boom. It's just all wiped out. That's what happened in 1634. And there's a story in

the book, first hand account of a father name Lee Water (sp) who was famous for building polders and his son and the whole thing in terms of how it was destroyed by the storm surge and at that point, of course, they had no idea how to predict it.

And as bad as the North Sea is with its gales, nothing in the world compares to the Bay of Bengal and the tropic cyclones that hit there. Literally millions have been killed over the centuries, 80,000, 100,000, 300,000, just story after story of this. And some of them are in the book.

In fact, the first story in the storm surge chapter is about the 1864 storm where 80,000 were dead. And I chose that one because a lot of firsthand accounts because the British had just set up a – (inaudible) – there and they had gone out and talked to everybody about it. It's a pretty fascinating story.

And, of course, in the U.S., the number one natural disaster in the U.S. in terms of deaths is still the 1900 Galveston storm surge. And, of course, *Isaac's Storm* – there's a famous book about that.

And my slant in here I had to do a prediction, of course, and a little politics involved in this one because they happened to be some Cuban priests who actually were scientists as well and had learned to some degree how to predict, all these forecasts when hurricanes were going to come through because they had a lot of real time telegraph connect type sites.

But the newly, relatively newly formed Weather Bureau in Washington had a guy who read it who was very jealous of them and kept people from hearing their information. And then Isaac Cline, who was the guy who's the tidal character in *Isaac's Storm*, he was the local weather forecaster and he believed Galveston could never be hit by a storm surge. And his dynamical reasons were ridiculous. He didn't know what he was talking about. He had some reputations of river forecasters. He figured he could forecast everything.

The long and the short of it, his wife died and there's a very interesting scene in terms of him and his house which had been hit by the storm surge. That's in my book and in *Isaac's Storm*. Six thousand bodies were found and probably at least another 2,000 were swept out to sea. This used to be all homes and it was just totally destroyed.

But as I mentioned, compared to the Bay of Bengal – and there's also a story in the book about the storm surge that led to the birth of a nation. And in 1970, the storm surge killed at least 300,000. They think it could be as high as half of million. It's always difficult to tell. It was in East Pakistan. This is not long after Pakistan separated off from India when the British gave them independence.

So by 1970, West Pakistan sort of dominating – east Pakistan is made up of Bengalis who adopted Muslim and they were like the poor kids on the block. They weren't treated well by West Pakistan. And when this disaster happened, West Pakistan

virtually ignored them whereas India, U.S. and other people helped quite a bit. And it was the straw that broke the camel's back. Excuse me. I have a little bit of a cold. And it led to a revolution and eventually they won with the help of India and Bangladesh was born because of that.

Now I already told you the parting of the Red Sea. So I couldn't resist in the storm surge chapter to talk about Noah's flood and the ark because a lot had been written about that, including that recent book on the Black Sea and whether through climate change and the buildup up of waters whether it'd broken through and caused a flood that inspired the story.

But in looking at all the evidence, to me, the most likely story that might have inspired this would have been a storm surge in the Persian Gulf caused by a very rare tropical cyclone and they are very rare in the Arabian Sea which right here and then moving up into the Persian Gulf. Cyclone Gonu happened a few years ago and it's about every 800 years or so you have a real big one like this.

Now, you have a very narrow entrance to the Persian Gulf and that would keep any hurricane or cyclone from getting in there but as I said, 3,000 years ago sea level was higher than it is now, a much wider entrance.

And the fact is people can – (inaudible) – about, well, it covered the earth, but it doesn't take much – if the waters covers land to the horizon it looks like it's covered the earth. And a lot of the language in weather it's the *Bible*, the *Koran*, the Sumerian, the Babylonian, there's so many stories that are all similar that one was the beginning, the rest sort of copied each other. I mean, the one in India is very similar except that God came down in the form of a fish and actually pulled the Noah Ark equivalent, helped them out kind of thing. But it would make sense that would be a storm surge going up the river and not just heavy river flow coming down.

A place like the Nile which has heavy river flow flooding every single year doesn't have a deluge story. In fact, they think it's great because it brings sediments and stuff. So there's something in the book about that too. Let me – how much time do I have? I've been talking too long. I was on track.

MR. FLYNN: We want to get some questions – (inaudible).

MR. PARKER: Getting to wave prediction, it also starts in ancient times and it goes through Ben Franklin and a bunch of other things. And Ben Franklin, every time you read about him there's some new story that you haven't heard before. In my case, it had to do with – he was on a ship, a British ship going to capture a French fort up in Nova Scotia.

And he noticed that behind this particular, and there were about 50 ships, waves are really smooth behind this ship but behind the other ships they weren't smooth and the

wind was blowing. And he asked the captain, the captain said, well, Cook (sp) must be dumping out his greasy water out the scupper.

And that lit a bell – lit a light bulb because Franklin had read ancient stories by Plutarch and Aristotle about how certain kinds of oil could make waves disappear. And so he started investigating it and sure enough he did experiments in certain fish oil, olive oil, things like that, you put it out in the water when there's some waves and they just flattened out. It's like magic.

In fact, because it's like magic, he was such a character he used to hide oil in the cane he used to walk with and he'd take walks with his friends and he would occasionally go down to like a lake and he'd see waves and stuff and he'd go up to the edge and he raised his cane up and he said, I'm going to make waves magically disappeared and he waved his cane like a wand and they wouldn't see the oil dropping onto the water. And sure enough the oil hit and it just went like a mirror. And like oh, my god. He's a magician.

Now, he understand – he didn't understand the whole reason why this happened but he understood part of it. He knew that the wind caused these little tiny ripples and that you had to have these little ripples before the wind could grab on and make them into bigger waves. The big waves are gravity waves. Gravity is restoring force. If the water is lifted up, gravity pulls it down. If the water goes down like a trough, then the pressure of the water around it pushes it up and that's the gravity of the weight of the water. But the little tiny waves it's surface tension. Surface tension is what pulls them back and it oscillates against the surface tension. And when you put the oil on, make surface tension even stronger and so when the little waves can't be created, then the big waves can happen.

And even further than that, he, 200 years ahead of his time, came up with the first good theory of how wind creates really big waves. And he used an analogy. He said, "take a really big bell." I don't know if he meant the Liberty Bell or some other bell, but he said, "you try to push it with your fingers. It's just too heavy. But you can get it to move a little bit. So it swings a little, comes back, and then you push it again. It swings a little. It comes back. If you push it just at the natural period of the swinging of the bell and you're putting more and more energy, and pretty soon the thing is really swinging big." He says, "that's how it happens with winds and waves. It's just the natural frequency of the wind keeps adding energy and they get bigger and bigger." And he's absolutely right. Two hundred years ago, they did the math for it and stuff.

And another World War II story, which I won't go into detail because I think I'm probably talking all my time. I haven't even gotten to some of the good stuff. Has to do with wave forecast. Waves are really difficult to predict because waves can come from all over the world. Storms – across the ocean can send swell across and swell comes from lots of places and try to predict it. Seems almost impossible. But a guy named Walter Munk and Harald Sverdrup at Scripps were asked to come up with a forecasting technique by the allies in World War II because it was so critical to the Normandy

beaches and before that North Africa – would the waves be too high for the landing boats, for the men to land on shore, would the surf be too high. And they came up with a technique that helped them and not only was it used at D-Day, but it was used after D-Day because so much supplies and troops are moved across the Normandy beach. The efficiency of it depended on the wave forecast. And that's what allowed them to keep using the Normandy beaches instead of having to like capture another port somewhere else.

You hear a lot about rogue waves and there's definitely row waves stuff in this book. Scientists first never believed him because he couldn't get models to produce them. The only two places they could get big waves would be really close to shore where shallow water and wave refraction would make them really big. And there're stories in the book about light houses being wiped out. The Eddystone Light, on the left there, was wiped out four different times.

And the Stevenson family, Robert Louis Stevenson with *Treasure Island*, his family was light house builders and they just kept building them and they kept getting destroyed, but they'd build more of them.

And then the other place you get really big waves is in strong currents because they understood mathematically how the energy of a strong current like the Gulf Stream or the Agulhas Current of South Africa could prop energy into the waves and make them bigger. So there's stuff in the book about that. And in fact, probably the Bermuda Triangle myth was starting by one ship being hit by a rogue wave in 1963, right at the edge of what's called the Bermuda Triangle. And there's stuff in the book about that.

And actually the waves chapter starts out with a story about the Queen Mary, who in 1942 was crossing North Atlantic with 15,000 American troops heading for Scotland and literally was hit by a rogue wave, not far from Scotland, and turned over almost to the point it were capsized. They say that a few more inches and 15,000 would have died. So – and there's lot of first 10 accounts about that. But in terms of predicting rogue waves that are in currents and are close to the shore, admittedly it's still something being worked on. And you'll hear these things about – using Schrödinger equation or some quantum mechanic equation, that's all baloney, to be honest with you. The non-linearity has to come at the ocean equations and they still haven't totally figured out, but there's a couple things that people are getting closer to that thing, so I think it's conceivable. It's going to be some combination of a global wave model, which works really well today, for regular waves and even pretty big waves, particularly where the sea swell maybe is going to intersect with like an actual local storm. I think that's going to end up being the solution.

But here's the one you still can predict, tsunamis. And the chapter starts out with the 1759 Lisbon earthquake and tsunami. And it's a very interesting story because that's around the time that the British society was first started and the Portuguese guy who took over, after this happened, was – believed in the Enlightenment and believed in science, so they have lot of things written about it. It's the first time they realized tsunamis could

really travel around the world because across the Atlantic and hit islands in the Caribbean, some case fairly large, and they realized in fact tsunamis were very long waves that travelled faster in deep water than shallow water. So that's all in there.

There's also a story about an 1854 one and it's human interest – (inaudible) – because the head of this village, a hero, was an old guy who lived kind of half way up the hill and his father and his grandfather told him stories when the sea recedes and pulls out, run for the hills because that means the water is coming back even bigger. And – but he's too old to warn his villagers, so he had to burn the rice harvest and then he knew they would come up, a lot of money in this rice harvest, they'd come up to try to put out the fire and he save the village because of that.

But the reason it's doubly interesting it's the first it was ever remotely detected and it was detected by the U.S. Coast Survey on their brand new tide gauges in San Francisco and San Diego, where they saw a little blip. And Alexander Dallas Bache, who was the great grandson of Franklin, who ran the Coast Survey, realized it was a tsunami and actually went on to recognize other tsunamis. And the one in 1883 on the San Francisco gauge was caused by Krakatau. And by this time, though – typically, they'd see a blip on their tide gauge. A tsunami happened. They had to wait two weeks to find out where it came from because it wasn't like today. There was no rapid communication. But in 1883, they had finally connected the last of the submarine cables. And so now literally a story could get back in four hours when it used to take two or three weeks. And so when they saw that blip, they knew it was Krakatau, but all of a sudden the first tsunami hit, it broke the cable. Now, they were in the dark again, but – so only the Coast Survey scientists knew it had to be one hell of a tsunami because it'd gone 9,000 and it was still a foot high when it hit San Francisco and sure enough it had killed 35,000. And once the cable was reconnected, it was like the first global news story, really, and literally it was like you'd see on CNN or any other TV station now, interviews, what happened four hours later. It'd be telegraphed back to Boston, to London. It was really something.

That's why they – nowadays they call them Victorian internet, but they actually had more of an impact on the world than the internet even had today because of incredible communication. And Krakatau and the tsunami were part of it.

Then there's this famous Alaskan one that happened in 1958 and it's been said in some other book, you've heard about, that it was a 1,700 foot tsunami, but it wasn't. The – what happened was here is a rock slide and this rock slide caused a 1,700 foot run up on the other side of the inlet from here to over here, but the tsunami itself was only – and I put only in quotes – 500 feet, which is absolutely humongous to even try to figure out. And it started at this end to the inlet and started heading for the Pacific Ocean. It wore down by friction to about 100 feet, only 100 feet. And at that point, it picked up three fishing boats. One of them was never heard from again, but one had a father and son in it, the other had a husband and wife. And once the tsunami – they literally were looking over the side of their boat and said were being carried over trees. It's just unbelievable. And then they get into the Pacific Ocean and then there's so much wide area that just

kind of dissipated the tsunami. But it's a pretty incredible story, but it was a 500 foot local tsunami in Lituya Bay.

This is the first 12 hours of the Indian Ocean tsunami. This is the 900-mile ruptured fault and started at the southern end here that started this. Literally over 300,000 people dead in the first two hours. In fact, there were more than 200,000 dead in the first 30 minutes. At the epicenter here, at the very center, it took only 17 minutes for the tsunami to hit Sumatra and that was the 100-foot waves. So literally it was no time for anybody be warned even if they had today's warning system.

So this is were tsunami – and this is a picture of a mosque – there're a few mosques that survived because it had open floor and the water would just rush through and it was pretty strong building, but most of the devastation – these are pictures like you've seen elsewhere.

And there is a few interesting sidelines. This is the east coast of Sri Lanka, and that one time there Kalmunai had 8,500 dead. And only eight miles south of it, only two people died in Oluvil. And it turned out it was wave refraction. Wave refraction, depending on the depth of the water, can focus energy towards something or away from something and it tends to focus energy along an ocean ridge and it focuses energy away from an ocean canyon, a submarine canyon. And so the people died here versus ones who didn't die here because they had the misfortune of being at the shoreward end of a submarine ridge and they were at the shoreward end of a submarine canyon, which is something would have been impossible to try to explain to the relatives who were mourning over the people there.

And there's another story in the book more heartwarming in that barrier reefs can also stop or slow a tsunami as can barrier islands. And there's a story about an orphanage that was on a barrier island and somehow someone looked out and saw the sea was coming – it's a phrase. Literally 30 orphans and their staff jumped into an outboard motor, pulled the engine, luckily it started. They start heading for the mainland. The tsunami smashed their orphanage, crossed the island, and was chasing after them literally. But it lost enough energy crossing the island and in the shallow water of the lagoon that they made to shore before it tied out. It's just – elephant tsunami warning system. I throw this in this one of the lighter sides because there're stories all over the place of elephants and other animals seeming to sense the tsunami. And they're true, actually.

In fact, in Krakatau, there was a circus elephant that went bonkers and nobody knew why. Well, tsunamis have very long wavelengths, hundreds of miles long, thousands of miles long. But as they get into shallow water, they shorten up. And pretty soon, they'll start causing isolations in the atmosphere that are essentially sound waves, but very low frequency sound waves, what we call infrasound. Elephants can hear that. So elephants will hear that. They see where it's coming from. They run the other way. They run. And there's story after story of like elephants giving tourist rides and all of a sudden they head for the hills and the tourists are just holding on, but the lives were saved by the elephants who heard it. And not only that, they have an advance warning because

through their feet, they can feel seismic waves in the ground. So the elephants get it twice. They feel the initial earthquake seismic waves coming and then maybe 17 minutes later in this case, a half hour later or an hour later, hour and a half later in Sri Lanka, then they start sensing the sound. And so – so literally could you put elephants around this? Well, scientists don't want to do that, but they are studying infrasound and putting sensors that might sense the sound that way.

So when things happen like that, like 17 minutes warning, the idea is that you will raise tsunami awareness, so people, at least when they see this happening, say, "I'm not going to go look at the flapping fish on the bottom or the coral heads that are revealed." Now, this happens in the Thailand, where tsunami wasn't that big, still big enough to kill 7,000, but nothing compared to like Sumatra. And some of these people, in fact, didn't make it.

And – but the other groups that did – there're other stories you may have heard about ancient tribes and what we call non-modern peoples who knew about it through stories and then passed them from generation to generation. The Somali Island here and these people, they were the closest thing to the epicenter. There're 75,000 people on that island. Only two people died because the story is saying if you feel the ground shaking for a long time or even more if you see the sea receding, run for the hills. And they all ran for the hills. Likewise, the local gypsies in Thailand. There's a bunch of Stone Age tribes in the Nicobar Islands that India owns up here. And some of them literally are Stone Age in the sense that they did DNA studies and they haven't mixed with outside populations since the Stone Age. It's just – the one tribe that did mix, they lost their ancient ways and they were killed, a lot of them.

So it's a fascinating thing. And one thing I push in the book is that there're places where the tsunami warning center can't get it to you quick enough. What if it hits at night, you don't see the sea recede. You should have some kinds of sensors, detectors out there in places that are worried about tsunamis and they wouldn't be too expensive that would sense from the pressure or other things if the water has receded and gone down and would make a siren go. And that would be like a safety that if a tsunami hits you – the Chilean one that happened. There was a story of a girl who saw the sea acting funny in a way she'd been told through like her class or something. She went and rang a bell and the villagers ran. But you need something that doesn't rely on a few people recognizing it. And I think what I've been calling a dry seabed detector is something.

Then we segue into the longer predictions. Those are the impact ones that make you think like you could die within minutes with a tsunami or within hours or day with a storm surge and maybe a little bit longer for some other ones. This is really long-term in terms of we know that El Nino can do a lot of damage. It can cause droughts. It can cause floods, that type of thing. This happens to be a satellite view and the really warm water on the Eastern side of the Pacific, where Peru – this is normally like a desert, even though it's next to sea – will be floods and all kinds of things happen. There're stories about that in ancient times, when they first gave it the name El Nino. But other places droughts – and one of the most famous at the end of 1800, there were two really bad El

Ninos. And this one, in 1877-1878 caused droughts in India, in China, and so many other places. And because of the famine and the disease it caused, literally 10 million people died in India. Somewhere between 10 and 20 million died in China, another million in Brazil. It's just incredible. Now, nowadays, it wouldn't be that bad because we respond to those kinds of tragedies and as I say, it's not an immediate thing. It's over time. But there're still other aspects of El Nino that you want to get right so you can prepare. And we can pretty much do it by about six months in advance, maybe a year in some circumstances, but they still have a few problems with that.

And when you get the climate change, of course, now we're talking chaotic situations over many, many decades into the future, with no way to really test it other than doing models on old climate changes and relying on helio-archeological type data and stuff. It's an incredibly difficult thing. The global models, at least, have pretty much been agreeing in terms of the warming that's expected, but when you start getting to the point, where you want an individual nation to be able to know what might happen so they can get ready for it, the regional models have a lot of uncertainty, a lot of inconsistency, and it's not well – known well enough. And these kinds of models have to be improved. Of course, everyone knows about the politics of extreme right and extreme left arguing over this. And unfortunately everything it's blamed by global warming these days, kind of like in the old days when you blamed everything on El Nino. And it became a joke on TV, where it kind of ruined your credibility when you're blaming everything on global warming, when in fact there is a real worry about what could happen and it gets diminished by all this other stuff as well.

And there's discussion in the last chapter, but that including the so-called geo-engineering solutions, some of which are downright scary. You shouldn't be using the Earth just like a laboratory. The real answer, as we know is renewable energy, and it really should be an economic boom for us because I like to always refer to it as – you go back to World War II, right after the Depression, it was a terrible, terrible time, worst than this. And Franklin tried everything he could. And he managed to the – kind of like Obama and the Congress to get a few things going, so it wasn't totally terrible, but the thing that got them out of it was World War II. It was the incredible production that went into World War II and we had to do it because we had to save the free world and defeat the Nazis and the Japanese. But it pumped up the economy. It just started the U.S. down that road to be the most economically strong country in the world. Why can't you do the equivalent thing with renewable energy? And then you have the side benefits of fighting global warming, natural security gets improved because you're not vulnerable to the Middle East. There's discussions about that at the end of the book as well.

So I think I've gone through it a lot. There're reviews there, but – (inaudible) – that there's a website and there's also a Facebook page if you want to look at more things. I periodically put more stories on the Facebook. And it also – it's got a huge endnotes and that's not just because there's a lot of scientific and historical references, which there are – and so especially historical was fascinating – but also, when you're dealing with a popular book and an editor who keeps saying, “well, I don't know, let's kind of slow up the narrative, do we really need that?” I said, “but there're some people

who are really interested in this part.” So we put it in the endnotes. So there’s more stories in the endnotes as well.

MR. FLYNN: Right, well thank you very much. (Applause.)

MR. PARKER: And that’s just the tip of the iceberg as far as some of the stories in there because the finest part about this book was discovering these historical stories that really had – show the impact of science on people’s lives really.

MR. FLYNN: So we can push into the future, which I know is the whole predictive art here. If we’re – and minimum we’re trying to deal with climate adaptation, I guess from the term of art here, we can deal with climate change and one element of which is rising sea level risk and that’s an outgrowth of where people live increasingly and how they live that may lead to that exposure, that is larger populations living in coastal areas. That’s a very broad forecast here, but what the science tells us about broadly rising the sea level and then some of the associated phenomena that this rising sea level translates into higher risk of storm surge, tidal related disasters and – (inaudible).

MR. PARKER: And that’s – obviously, sea level rise is one that a lot of people like – sea level rise, and it’s such a complicated thing in the sense that – okay, back when we had the last ice age and the ice melted to where we are today, it did relatively quickly, but that’s in geological times. And it was – sea levels like 300 feet lower than it is now. So all that ice that melted from the ice sheets that cover like – part of North America and other places – led to a 300-foot rise in sea level, but it still took many, many years for this to happen, and even probably it was still slow enough than most things would have adapted to it. I’m not sure about coral reefs, but even they might have adapted to it.

Now, since that’s happened, sea level rise has been dependent on mostly what we call thorough expansion of the upper ocean, where it gets warmer and expands. And so that rises. And then little bits of still melting from glaciers, mountain glaciers, Greenland, Antarctica, and that’s varying. It’s been through cycles. Cycles can be 10-20 years, can be 100 years. So it’s always been a really difficult thing and kind of – and even now, when we’re trying to predict for the future, it gets really complicated because some of this long-term sea level is affected by long term changes in the wind. So for example, although water entering the ocean may – you feel would sort of evenly raise everything, and that’s totally true because of gravity and other things, but the winds blowing – and that could change because of global warming and climate change – the winds may change – (inaudible) – on average over the years was pushing water up on the shore. And so if it slows up, then the sea level actually would go down there. But other places, it might increase, and so the increased wind could raise it up.

So there’s all kinds of things that enter into one place for another. Of course, the models are critical. The better the models get and get these regional effects figured out, the better off we’ll be in planning each place. So maybe that some coral atoll in the Pacific that worries it’s going to get flooded may be okay, but another one will be

flooded. You really need these models to figure out the regional differences. Now, that being said, they also talk in terms of what if it really warms a lot and the ice sheets on Greenland start melting faster? Antarctica eventually – it's been kind of building up. Actually snow has been adding to it, at least on one major part of it. And they say, "well, it takes so many years for the – all this ice to melt." Well, ice doesn't actually really have to melt. All it has to do is slide faster and end up being really humongous icebergs in the ocean and the weight of it is just like the water. So that'll raise it, too.

So the scariest thing is if global warming got fast enough to increase the lubrication under some of these ice sheets and more and more these humongous icebergs – now, of course, Antarctica's got icebergs as large as Rhode Island floating around. So we're sort of in some kind of an equilibrium now, but it's going to – because it's obvious that sea level rising makes coastal mankind or human kind vulnerable and most of the population lives close to the coast, it's certainly something you have to worry about and we have to keep improving our prediction tools to know – to do a better job of predicting what's going to happen. The answer is we don't really know. And you see the projections of IPCC all over the place in terms of conservative versus extreme on what the sea level will do.

MR. FLYNN: Great. Well, let me open it up to the audience here. We go for another 15 minutes. I know we have – (inaudible) – and a lot of information to convey. If you need to leave, of course, you're welcome to do so. But let me get to a question right here. Thank you. And please introduce yourself, if you will.

Q: I'm Alice Thomas and I work at Refugees International on a program on climate related displacement. And it's a quick follow on to your question, but it's about just the warming of the sea and so there has been some important data about the rising temperature in the ocean. So in addition to this thermo-expansion that you talk about, which can lead to sea level rise, how that impacts the types of weather events we see that are related to see. So you talk about storm surges, but there's also cyclones and hurricanes, and are there any reliable predictions about we're going to see more of this kind of ocean related storm. And also just the monsoons, how you do these super saturated clouds from monsoons –

MR. PARKER: Yes. It's going to take two hours to answer your question, but I will try to do it in two minutes. First of all, it's again, and this will be said probably on almost every answer, it's a very regional based answer. There are going to be some places, where warming might do one thing and another places it will do something else. And there's been debates now going on for decades, for example, on the question of cyclones and hurricanes, whether it's increasing the number of them or are they just getting stronger. The data didn't seem to support that there would be more hurricanes, but did seem to support that there'd be stronger ones. But even then, that would be only in some areas, not in other areas. Unfortunately, we can't say a lot of this. We don't still really know and they'll keep – you have to kind of pretty much model it because there's no real data – there's no history that has any kind of real reliable scientific data to prove it. So you have to get your models as expert as possible and then try the different

scenarios and see what happens. Of course (oceanist ?) certification, there's all kinds of other things as well. And I was going to say something much more major than this at the beginning, but now I'm sort of losing my train of thought. But – I did want to – if I can segue in terms of displacements, too, I think that maybe the one thing it showed which may be of more immediate concern, and that's not to say down 50 years, 100 years all these things won't be concerns, but the water supplies, they're in snow packs in the mountains. And in spite of that climate gate thing, which was semi-bogus, but you know – there're times – or even if it changes when the water comes down from those mountains to a point if it comes down too soon and it's not stored anywhere, it misses the growing season. There can be all kinds of implications that global warming could cause on that as well.

In terms of the sea effects, obviously if it does end up having effect on cyclones and hurricanes, typhoons, it's all the same thing, and storms surges are usually the biggest killer or at least damage causer of those, then you'd see more storm surge activity. In terms of – those are studies about whether they're seeing more waves and bigger wind waves at these various places. And I think there's one off the bar of Columbia River, which may be a pretty good study because a lot of these places, the problem is the older data is not reliable enough to know if you can really prove the change between then and now. And if you prove a change over the last 10 years, that could just be a cycle. It doesn't be it's the long-term – and that's the problem with all of this. And so that's why the studies have to be so careful because if you blow it, it gives like, for example the naysayers on global warming more evidence to say it's all bonk. And it just meant that one particular thing didn't work out.

Likewise, you might call the other extreme, the doomsdayers are going to be ending up like Venus at some point, also doesn't really help the debate because the answer is usually somewhere in the middle. Of course, if the naysayers are just wrong, it just means our economy got a little bad, but we get bad anyway. We find other ways to scoop the economy. So trying to put money into stopping global warming or doing renewable energy, so what, it's one more thing. But if it turned out that the doomsdayers are right, we're in big trouble. There's no fixing that. So better safe than sorry. We should be – do everything we can and when you got something like renewable energy, which could be a real economic boom, why not go crazy with it?

MR. FLYNN: I think certainly one of the things I came away – Bruce on your book – the book and the presentation is that we don't even need climate change to talk about the enormous risk that coastal populations continue to face.

MR. PARKER: Right.

MR. FLYNN: The strength of telling us all these dark stories is that we tend to have amnesia. And in some generations – as you say, native folks have that second, third generation going, the water is going out, head for the hills – we're in a modern generation perhaps that has forgotten how vulnerable we are exposed to the sea and we're – we're not in an esoteric debate in other words here. There's been usual messy stuff and some

risk obviously that climate change will pose that could exacerbate that threat. But there's enough going on for if you're in a coastal population that you should be focused on having these predictive tools and be worried that sea could kill you.

MR. PARKER: Even the Tsunami Warning Center, which now everyone thinks is really important, and when it first started back in the '40s, because there were a series of – '40s and '50s, there was a series of tsunamis that happened and they did seem important, but then the memory, as you said, kind of goes away, and they couldn't get Congress to fund them enough. They were really running on shoe string. Even right up to 2004 and then of course now, they're getting the money to do things that they want to do, and they made incredible strides under those conditions, funding funds wherever they could and stuff. But it just shows you unless there's – you don't want disasters to happen, but when they happen, it wakes people up and they start doing things to help prevent the next one.

MR. FLYNN: A question, yes sir.

Q: My name is Walter Rodgers. I write a column for the *Christian Science Monitor*. You see the increase in carbon parts per million in the atmosphere in so much of the literature about what you study. Do you see, if we're around, what, three, 80 now parts per million, 200 at the turn of the previous century, and projections up to 500 parts within the next 100 years, in this process, do you see increasing climate destabilization? What do your computer models show about a progressive increase in the carbon parts per million?

MR. PARKER: I have to say right upfront that I shouldn't be the one you quote in there. I'm not the expert on that particular figure and where the models stand right now. And some of my opinions are based actually on reading other people's work. So I honestly don't want to give you an answer on that because it might not be correct.

Q: What's your gut feel?

MR. PARKER: I don't want to give a gut feeling either. I think it's of concern.

MR. FLYNN: The scientist.

MR. PARKER: I don't think you can ignore it. I think we have to keep on it because if it goes the direction that the worse predictions are, it's going to be so bad you can say what the hell did you do. And if it turns out not be that bad, I don't think it's going to be the big economic hit that they claim it's going to be. So I really – I don't want to be the one that specifically said what's going to happen because – I like to quote certainties. If I said, okay, this is going to happen, say, 90 percent certain, 50 percent certain. And other scientist said it was more than 50-40, you put the money in just not to take any chances. Does it have to be 90 percent to invest, to try to keep something so bad from happening? And that's what the argument is unless you're 100 sure, then we don't want to waste the money. But that's how politics go.

MR. FLYNN: So you're in the 50 mark, can I appreciate on that?

MR. PARKER: I'd say it's more than 50-50 that's going to be really bad, but maybe that's not enough for somebody.

MR. FLYNN: Okay. It's enough for me. (Laughter.)

MR. PARKER: I wouldn't say – I wouldn't say 90.

MR. FLYNN: Other questions? Well, I want to thank everybody for coming here today and thank you so much, Dr. Parker, just a great presentation, an important issue. And pick up the book. It's something that I think trying to make this connection between what is happening out there in the natural world and how it impacts on our world, it's something that we need a lot more understanding of, I think, here in the policy community. And I'm grateful for the opportunity to host you today, here at the Center for National Policy.

MR. PARKER: Well, thanks very much.

MR. FLYNN: Thank you. Okay. (Applause.)

(END)