

"NORDIC SAGAS -- SPECIAL FROM SCANDINAVIA"
SHOW 803

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Viking Ships
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TEASE

ALAN ALDA Viking ships like this sailed to America 500 years before Columbus. On Scientific American Frontiers, we dig one up, build another and set sail ourselves. We'll find out how Icelandic sagas -- and Icelandic genes -- may help cure diseases. We'll see how a volcano became home to a bird that spits. Looks like a good spot to take a picture. I use a digital assistant to make new friends. They're all saying, "Here comes the jerk again". And I lasso a slightly radioactive reindeer. I'm Alan Alda. Join me as we tell some Nordic Sagas with a scientific twist.

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VIKING SHIPS

ALAN ALDA We begin our Nordic Sagas here at Roskilde Fjord in Denmark, because it was from places like this that the Viking Age was launched -- literally. The period from the 8th through the 11th centuries saw an explosion of Scandinavian influence throughout much of the known Western world -- and beyond, to Iceland, Greenland and even, briefly, to America. And it was all made possible by a breakthrough in technology...

ALAN ALDA (Narration) I'm helping hoist the sail of the Helga, an exact reconstruction of a Viking warship. About the only thing here that would surprise a 10th century Viking is the crew's strange clothing. Even the sweat's authentic.

ALAN ALDA Cinch!

ALAN ALDA (Narration) The Helga and it's sister vessel, the Roar Ege, are both copied down to the last detail from Viking ships found at the bottom of this fjord 40 years ago. In charge of those excavations was

OLE CRUMLIN PEDERSON. For him the Viking Age began when the kings of 8th century Scandinavia -- who until then had raided each other in oversized rowing boats -- added to their ships a mast and the characteristic Viking square sail.

OLE CRUMLIN PEDERSON Suddenly they found out, well, now we can go much further away, now we can go to Normandy or we can go to England, and raid there.

ALAN ALDA (Narration) Ole found the originals of these two ships about 10 miles farther down the fjord. They'd had been scuttled centuries ago to block the main channel and protect the royal city of Roskilde from unfriendly visitors. In 1962, a temporary dam was built around the site, and water pumped out to reveal the sunken ships. Ole and his colleagues spent five years slowly revealing, and finally recovering, five Viking vessels. Today all five are on display at the Roskilde Viking Ship Museum. The timbers of each ship, chemically treated to preserve them, have been reassembled. An iron frame provides support and suggests the original form where pieces are missing. But more than enough of the ships exist for Ole and his team to have figured out the principles behind their construction.

ALAN ALDA Can you show me in this ship how those principles come into play?

OLE CRUMLIN PEDERSON Yes. In the bottom you have the keel, and then they build up the first four or five planks, with the... just adding one plank at the edge of the other and shaping it so that they got the lines they wanted. And then they would insert the floor timbers across the bottom.

ALAN ALDA (Narration) Employing this same bottom up construction method, a new replica is now being built just outside the museum. Ole is convinced the original shipbuilders worked without drawings or plans.

OLE CRUMLIN PEDERSON To do that they had the concept in their mind of the shape of the ship. You have the stem and stern cut to their final shape before you even start planking up. And you see that for each plank there is a step in the stem piece to take up the plank and to indicate the lines of that leading up to the very top of the stem.

ALAN ALDA So the flow of the boat through the water would be assured by the way they could see it as they built it, rather than as they designed it on paper.

OLE CRUMLIN PEDERSON Yes

ALAN ALDA It was sort of built from experience.

OLE CRUMLIN PEDERSON Yes

ALAN ALDA (Narration) The planks of the replica are fastened together with the same style of iron rivets used in the originals. And not only are the materials of the replicas authentic: so too are most of the tools that are used.

ALAN ALDA What is he using here?

OLE CRUMLIN PEDERSON He's using what's called a Viking broadaxe. That's sort of a tool of the trade of Viking shipbuilders.

ALAN ALDA But they're all cut with the axe aimed toward the workman's feet. Do people have to take a break every once in a while and get bandaged?

OLE CRUMLIN PEDERSON No. Once you get trained with it, if you survive you will be a good shipbuilder!

ALAN ALDA (Narration) The builders of the replica Viking ships have been astonished at their performance under sail.

ALAN ALDA How fast could they get one of these boats to go? MAX WEINER This boat is a very fast boat, because it's a warship, of course, and we have hit speeds of about fourteen knots.

ALAN ALDA What is it about the construction of the boat that allows it to go that fast? MAX WEINER It's a very light ship. We are right now displacing only about four tons, all of us, ship, ballast and everything. We are skimming the surface, so to say, and so we are not making very much fuss in the water.

ALAN ALDA (Narration) How the ships sail so well while only skimming the surface fascinates

LEIF WAGNER SMITT, at the helm of the Roar Ege.

LEIF WAGNER SMITT This is a little merchant vessel. Only a few people were sailing it and it was carrying goods rather than people. It's a wonderful little vessel and I am intrigued by the easy handling of the ship, how well she maneuvers.

ALAN ALDA (Narration) The Viking boats handle well even without the deep keel modern sailboats rely on for stability and maneuverability. Leif has been testing a scale model of the Roar Ege to explore the consequences of having a keel only a

few inches deep. He's setting up the model in the tow tank of the Danish Maritime Institute in Copenhagen, where he's the chief naval architect. The model is being towed through the water at a slight angle to simulate sailing.

LEIF WAGNER SMITT This is five knots, five knots. And this is a very typical speed when beating to windward.

ALAN ALDA (Narration) This 750-foot long tow tank usually tests the very latest in ship designs, not one over a thousand years old. Leif is trying to replicate in the tank something we saw when we were sailing in the warship, the Helga -- a trail of bubbles streaming out behind us a foot or two beneath the surface. And here's that same stream of bubbles behind the model.

LEIF WAGNER SMITT As the water is flowing under the boat it generates a rolling vortex of water. In the center of that is very low pressure, and any air in the water will then collect in the center.

ALAN ALDA (Narration) Viking ships have their rudder at the side, where they are often in the way of that tube of air bubbles. This should in theory make the ship more difficult to steer, as the bubbles boil around the rudder. In fact Viking ships steer well -- and Leif now thinks he knows why. He believes that a previously mysterious projection on the rear of the rudder may help get rid of the bubbles before they cause a problem.

ALAN ALDA So that was invented a thousand or more years ago?

OLE CRUMLIN PEDERSON That was invented at that time, in the Viking Age, and forgotten after that, and only rediscovered when we made these experiments with the working reconstruction of the ships.

ALAN ALDA (Narration) But if the rudder design was important to the Viking ships' performance, another innovation was critical: the ability to quickly lower both sail and mast and switch from wind power to muscle power. The real secret of the Viking warships was their ability to strike almost anywhere along a shore or riverbank. Here the ships' lightness, shallow draft and oar- power as well as sail- power gave them unprecedented speed and flexibility -- assuming an experienced crew!

ALAN ALDA Why do I keep banging you in the back like that? OARSMAN
Technique!

ALAN ALDA (Narration) Our day of playing at being Vikings ended with a row back to Roskilde harbor -- where, just a few days after my visit, excavations began on yet another group of newly discovered Viking ships. One lies out in the

harbor itself, where this section of bottom framing was among the first pieces to be recovered. Another ship was found by workers digging the foundation for an addition to the Viking Ship Museum. Once again, as out in the fjord 40 years ago, an almost complete Viking warship is being recovered after having been buried for a thousand years. The first indications are that this ship could be the biggest ever discovered, twice as big as the Helga. Viking ships and their warrior crews once conquered much of the known world. Now the ships' rediscovery and reconstruction is giving us a glimpse of what made the Vikings so powerful.

ALAN ALDA Do you feel a little closer to them as people? Did you get a new look at them? MAX WEINER Oh yes, I think we are in very close contact with them by doing, trying to do actually, we are trying to do exactly what they do, but we are pretty aware that we are not sailing these boats as well as they did. And you know that gives us a certain respect for our forefathers.

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ICELANDIC GENES

ALAN ALDA The most famous voyage by a Norseman in the Viking age was that of Leif Erikson -- also known as Lucky -- who discovered Vinland -- the land we call America -- around the year one thousand. But this sculpture celebrates another, even earlier voyage, by the Norseman Ingolfur Arnarson, in 874. Never heard of him? Well that means you've never been here to Reykjavik, the city he founded as the official First Settler of Iceland. Following Ingolfur -- who must have been one terrific real estate salesman -- about 25,000 of his fellow Norsemen and Norsewomen settled here in the next 50 years or so. Most of today's Icelanders -- who number about a quarter of a million -- are direct descendents of those early settlers -- and they look like it, too.

ALAN ALDA (Narration) But it's not just the first settlers and their most recent descendents who can be counted.

ALAN ALDA Is it actually true that you know about how many people have ever lived in Iceland?

KARI STEFANSSON Yes.

ALAN ALDA How do you know such a thing?

KARI STEFANSSON Because we know the genealogy, we know the names.

ALAN ALDA You know the names of all the people who ever lived?

KARI STEFANSSON Yeah, we know the names. We know who were their fathers and mothers and daughters and sons, we know where they lived...

ALAN ALDA That's remarkable. How many people ever lived here?

KARI STEFANSSON Three quarters of a million or so.

ALAN ALDA But three quarters of a million -- that's about how many people in the world are born every few days, probably.

KARI STEFANSSON Yeah, but they're not Icelanders!

ALAN ALDA (Narration) Kari Stefansson has brought me to see first hand how the Icelanders' obsession with genealogy began. Which turned out to be in another Icelandic tradition -- the writing down of heroic tales -- sagas -- in books dating back to the settlement of the country.

ALAN ALDA What is this book?

KARI STEFANSSON This is a manuscript of...one of the oldest manuscripts of the Icelandic Sagas.

ALAN ALDA Now what's in the sagas?

KARI STEFANSSON The sagas are, according to the old myths, are stories of the settlement of Iceland, the story of the settlers. The books tell from very complex feuds, and it's very important to know who is related to whom to understand the story. Almost all of them begin with page after page of genealogy which is sort of in my mind at least the beginning of the great interest in genealogy that has prevailed in Iceland ever since then.

ALAN ALDA (Narration) This book, for instance, is a copy of the Book of Settlement, which lists the names of the original settlers and their immediate descendents. And this young man, whose name is Hreinn Stefansson, is one of the many present day Icelanders who can -- astonishingly -- trace their ancestry all the way back to the Book of Settlement. Hreinn Stefansson's lineage, in fact, goes back 31 generations to the year 860 AD and one Bardur Vikingsson, the son of a Viking king. Both Hreinn and the computer program that tracked his ancestry are employed in a new company founded to capitalize on Iceland's uniquely intimate genetic heritage. Called DeCode Genetics, and employing most of Iceland's young genetics researchers, the company is in the thick of the world wide hunt for genes that cause human disease. According to Kari Stefansson, DeCode's founder, it's already hot on the heels of several such genes, including one involved in multiple sclerosis.

ALAN ALDA What are these people doing here for instance? I see people working with vials. How are they finding out about multiple sclerosis?

KARI STEFANSSON They have found genes, and now they are using specific methods to find mutations in these genes that are only found in patients with the disease and are not found in individuals who do not have the disease.

ALAN ALDA What are they doing here, for instance?

KARI STEFANSSON They are isolating DNA.

ALAN ALDA Now this is the blood from one person? And you know that person's medical history?

RESEARCHER I do, yes.

KARI STEFANSSON She knows this person's medical history.

ALAN ALDA (Narration) And this is where Iceland's genetic isolation and detailed genealogies become invaluable. A mutation causing multiple sclerosis in one Icelander is most likely the same mutation that causes the disease in another -- because each inherited it from the same ancestor. This makes tracking and finding such a damaged gene much easier than it is in larger, more diverse populations.

ALAN ALDA What happens if you find this gene, then what?

KARI STEFANSSON Then we know what causes the disease, and our assumption is that knowledge of the cause of the disease is always going to help us both find the cure for the disease and ways of accurately diagnosing it.

ALAN ALDA How will the company profit from the work you're doing here?

KARI STEFANSSON I look at this company first and foremost as a company of Icelanders for Icelanders. And the company benefits by having an opportunity to do extremely good science and contributing to curing diseases. Economically we will benefit by contracting with large pharmaceutical companies that are eventually going to develop the medications for the treatments that will be derived from the discovery of these genes.

ALAN ALDA (Narration) During my brief visit, I found Icelanders to be a highly educated, caring people who -- because there are so few of them-- all seemed to know one other. And now these few thousand descendents of the Vikings may be

giving the rest of us on the planet something unique -- insight into diseases that plague millions.

ALAN ALDA It seems that your ability to find the sources of these diseases is connected to the kind of loneliness of this island, the people on this island.

KARI STEFANSSON It's interesting if you think about this in a social context, that is this isolation that kept the nation genetically homogeneous was one of the major reasons as to why the nation was so desperately poor for all of the centuries. And now the consequence of this same isolation has become a natural resource that we can mine. You could argue that our work on genetics is a search for poetic justice when it comes to this isolation.

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ISLAND LIFE

ALAN ALDA Iceland is a very young country -- and not only because people have been here only a thousand years or so. The land itself is some of the youngest on the planet. Beneath our feet is the crack in the Atlantic Ocean formed by America, over there, pulling away from Europe, which is that way. From that crack, molten magma wells up, and 15 million years or so ago, just a blink of geologic time, magma broke through the surface to create this, a whole island of volcanic lava. Iceland still sits on top of a plume of magma, heating the water that seeps down to it to the boiling point and above. This hot water is one of Iceland's most important natural resources, heating most of the homes through the long winter. But the hot water here, and the pungent smell of sulfur, is also a constant reminder of the magma just below us.

ALAN ALDA (Narration) On November 14th, 1963, the sea 20 miles off the south coast of Iceland exploded, as magma once again surged through the crack in the Atlantic floor. The eruption continued for almost two years -- and when it ended, it had created a new piece of Iceland, an island named for a legendary Nordic fire-giant -- Surtsey. Soon after Surtsey's creation, it was visited by a scientist who saw in its birth a unique opportunity.

STURLA FRIDRIKSSON has been going back to Surtsey for the past 33 years. Today, at the age of 75, he is landing on the island for the 35th time. Sturla was 42 when he first came ashore here, in 1964.

STURLA FRIDRIKSSON It's always quite an experience to come to Surtsey. Because Surtsey is always changing and you find something new every time you come here. When I first arrived, the island was completely nude, it was completely sterile.

ALAN ALDA (Narration) The opportunity that Sturla saw in Surtsey was to see how life would arrive -- as he had no doubt it would.

STURLA FRIDRIKSSON Here is a Mermaid's Purse, the shell of the egg of a skate, the fish. And it acts like a float, and it has been on the beach on the mainland of Iceland, and there it has caught some seed of grasses, and it shows one way of how nature goes about transporting seed to a desolated island, even by the aid of fish.

ALAN ALDA (Narration) Surtsey became a laboratory for studying how life colonizes a new piece of earth. And it didn't take long before the first seeds to wash ashore put down their roots.

STURLA FRIDRIKSSON The second year that I came, I found a plant growing, and that was quite an event, I thought. This is a sea rocket. The very first plant ever to start growth on Surtsey. It's amazing how nature goes about getting living things to a desolate island. And I don't think there are any islands in the world that remain for any length of time without living beings conquering it.

ALAN ALDA (Narration) Surtsey is now dotted not only with plants but also study plots.

BORGTHOR MAGNUSSON And we have just over 20 plots like this on the island. This is one of the oldest areas that was invaded by the plants. And the first plant came here in 1973, and we measure our plots every second year and follow the changes to see what kind of species we have in each quadrant, and what kind of cover they have.

ALAN ALDA (Narration) Here the predominant species is the sea sandwort, one of the hardy pioneers of Surtsey settlement. It owes its success to what's beneath it. Borgthor Magnusson is entering a lava tube, a sinuous cave that once carried molten lava to the sea. The roof over his head is at least 8 feet thick -- yet here in the ceiling are the roots of a sea sandwort.

BORGTHOR MAGNUSSON It has probably gone through three feet of sand, three to four feet of sand, and then it has found a crack in the lava that it has come down. But here it has met a dead end.

ALAN ALDA (Narration) The plant was searching for moisture and nutrients. And it's not alone down here in looking for food.

BORGTHOR MAGNUSSON These spiders probably drifted in on their threads which acted like parachutes. And the reason they are able to survive here on this

stone is that we have a little hole here in the roof and they will get some prey, some small insects.

ALAN ALDA (Narration) Spiders and insects weren't the only things on Surtsey to arrive by air instead of sea. Five hundred feet up in the crater of the volcano, the lava is dense with mosses and lichens. They've grown from spores carried here by the wind. The cracks in the lava are deep and dangerous to the occasional visiting scientist, but home to ferns, whose spores also arrived here with the wind. For his first half dozen visits, Sturla Fridriksson was still one of the few living things to have made it to Surtsey. But then the first of the successful plant pioneers, the sea sandwort, was joined by another.

STURLA FRIDRIKSSON In 1971, we discovered a sea lime-grass plant that looked like this one here, and 27 years later that plant had collected sand around it and formed a sand dune like you see here.

ALAN ALDA (Narration) The grass had collected not only sand around itself, but also the sandwort. Community life had arrived on the island.

STURLA FRIDRIKSSON This was the first association to be formed on Surtsey, and now as a third species you can see that fescue, red fescue grass, is also joining the two, and eventually the fescue will probably take over the whole thing.

ALAN ALDA (Narration) This is how this part of the island looked in 1970. And here it is today. But through the 1970s and early '80s, Sturla's annual expeditions here continued to record only a very few new arrivals on the island. That changed dramatically when Surtsey was discovered by a new and very noisy immigrant.

BORGTHOR MAGNUSSON The gulls started breeding in 1986, and shortly after that, this area became greener and greener every year, the gulls they increase in numbers, they fertilize the ground enormously, they bring in new species, they have an enormous effect on the plant succession here.

ALAN ALDA (Narration) In the 32 years since the island was created, 52 plant species have been recorded here, over half of them since the arrival of the gulls. What's more, the gull's habit of building their nests on the outer edges of their colony is constantly expanding the area covered by vegetation. On this visit, one of Surtsey's youngest arrivals is a rather unfriendly baby fulmar.

STURLA FRIDRIKSSON If I approach it, it will spit at me. Zzit! See how it spat?

ALAN ALDA (Narration) Documenting Surtsey's encounter with life has become Sturla Fridrikson's legacy for the future. Ironically, it's one that will probably

outlive Surtsey itself -- which has already been eroded to a little more than half its original size by the restless Atlantic ocean.

STURLA FRIDRIKSSON Maybe after hundreds of years, just a pillar will stick up out of the ocean with steep cliffs occupied by sea birds. And that will stand there until the Atlantic waves will come and break it down. And that will be the end of Surtsey and its life.

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ISAAC AND FRIENDS

ALAN ALDA (Narration) We are in the charming old university town of Lund in southern Sweden. One of the sights here is the town's 12th century cathedral.

ALAN ALDA I'm going to take a picture of this. This is a perfect postcard. Working...working...smiling. Now I'll press the little butterfly. The butterfly is flying.

ALAN ALDA (Narration) My camera is also-- among a lot of other things -- a cellular phone.

ALAN ALDA Hello, Bodil? Did you get this picture? It's a big church or a cathedral. So where do I go now? To the right? Across the street to the right. OK.

ALAN ALDA (Narration) I'm trying to find my way to the train station, aided by a digital assistant I met just this morning.

LARS PHILIPSON Let me introduce you to Isaac.

ALAN ALDA It really is light, isn't it? It's much lighter than I thought it would be.

LARS PHILIPSON Two kilograms in total, with batteries and everything...

ALAN ALDA (Narration) Isaac is the brainchild of

LARS PHILIPSON and

BODIL JONSSON.

ALAN ALDA If I was wearing this, what would I have to know about it?

LARS PHILIPSON This is the only part that you need to operate...

ALAN ALDA (Narration) Isaac was built to help people who are severally mentally retarded, and can't cope with the world unaided.

ALAN ALDA So are these pictures down here at the bottom are ways of accessing different... Let me see if I can tell you, see how intuitive this is. That's the telephone. This is if I want to take a picture. Do I take it with this?

BODIL JONSSON Yes.

ALAN ALDA I do? That's...where's the... is this the lens?

BODIL JONSSON That's the lens. It's a small one.

ALAN ALDA It's so tiny. And this is a camera, and a telephone, and a computer. And all this information can go back to your central office ...

LARS PHILIPSON To the support center...

ALAN ALDA Including the photographs.

LARS PHILIPSON Right.

ALAN ALDA (Narration) Isaac is meant to be usable even by people who can't read.

ALAN ALDA If I wanted to take a picture of you, I would maybe touch the camera?

LARS PHILIPSON And while it's working you see this cartoon...

ALAN ALDA A happy face and a... it's not quite a sad face...

LARS PHILIPSON A working face

ALAN ALDA Oh, a working face. I couldn't quite interpret that. Oh, oh, there's a picture. Oh, you look good. Oh, that's a nice picture. Now if I want to save it I can probably press one of these boxes...

LARS PHILIPSON The filing cabinet.

ALAN ALDA The filing cabinet, OK. Now this butterfly, does that let me...

LARS PHILIPSON Send it, send it over the air, to the support center.

ALAN ALDA I'm going to press that. And there's the butterfly. And the butterfly is flying. So that means the picture is going back...Actually, it's not only clear, it's kind of fun.

ALAN ALDA (Narration) There's also a built in phone book that uses pictures of things and people you might want to call.

ALAN ALDA What do I do, press the phone?

LARS PHILIPSON Well...

ALAN ALDA Press the green?

LARS PHILIPSON Well...

ALAN ALDA Press the picture!

LARS PHILIPSON Yes!

ALAN ALDA Well if this can work with me it can work with anyone.

ALAN ALDA (Narration) As it happens, my prediction was a bit optimistic. This is where I'm supposed to be using Isaac to help me find the train station.

ALAN ALDA I do not see a train station anywhere near here.

ALAN ALDA (Narration) Things started out promisingly enough...

ALAN ALDA I definitely need help here. Pressing the phone. Let's see if I can get a picture of Bodil...Here's Bodil, OK. Pressing on her face. Actually I pressed right on her nose.

ALAN ALDA (Narration) Bodil is waiting to help back at the Isaac support center.

BODIL JONSSON Hello?

ALAN ALDA Hello, Bodil? Hello? Hello, Bodil? Bodil, I'm talking to you. Very lost. Oh, something's ringing. Oh it's dialing.

BODIL JONSSON Hello, Bodil speaking.

ALAN ALDA Hello.

BODIL JONSSON Is this Alan?

ALAN ALDA Yeah, yeah, Bodil this is Alan. I'm totally lost.

BODIL JONSSON I will try to find you on the map.

ALAN ALDA So what should I do?

BODIL JONSSON Just stand there and wait.

ALAN ALDA Stand here and wait. OK. They also serve...

ALAN ALDA (Narration) So the cell phone was acting up. That happens. The test now was to see if a GPS satellite antenna in that bump in the shoulder pad could locate me on a map back on Bodil's computer. And bingo, we're in business.

BODIL JONSSON Just go down the street, and we will follow you at the map.

ALAN ALDA OK, talk to you later.

ALAN ALDA (Narration) Sadly, my navigation exercise became increasingly an exercise in frustration. The GPS system worked fine, transmitting my location back to Bodil every few minutes. The problem continued to be the phone connection.

ALAN ALDA Looks like a good spot to take a picture.

ALAN ALDA (Narration) Even when I took a picture, I had trouble sending it back to Bodil. The butterfly flew but wouldn't land. Isaac was clearly having a bad day, and my camera crew was more help finding the station than my digital assistant.

ALAN ALDA That wasn't so hard was it? Right there.

ALAN ALDA (Narration) Isaac comes close to being a wonderful example of how technology can help the mentally disabled. Right now though, my experience suggests it isn't a product -- and to my surprise, Lars agreed.

LARS PHILIPSON We put into Isaac a lot of different functions. And they were never meant to be a product altogether but to make it possible for us to do experiments with various people. So some of these functions are useful for some people and others for other people.

ALAN ALDA (Narration) I was about to meet two people for whom Isaac wasn't merely useful -- it changed their lives. This is Stig Nilsson. And this is

TOMAS AKESSON.

ALAN ALDA Is this you?

ALAN ALDA (Narration) Tomas and Stig, both severely mentally disabled, discovered through Isaac the joys of taking pictures. But not just taking them...

ALAN ALDA Is this used to build individual sentences, or what?

BODIL JONSSON Yes, for instance, if you want to build a letter...

ALAN ALDA (Narration) Both Tomas and Stig -- neither of whom once had more than a few words -- are now using the pictures they've taken to communicate.

ALAN ALDA Is this about Lars?

BODIL JONSSON A letter for Lars.

ALAN ALDA So this is to Lars, and it's from Tomas. OK, so the story I guess, here is Tomas with Stig -- is that Stig?-- and they were using Isaac, and then they print out the pictures that they've taken with Isaac? Isaac? And then you use the scanner to put them into the computer and then they put them in the book.

ALAN ALDA (Narration) Stig was happy to show me the system Bodil and Lars have developed to keep track of the thousands of pictures that have now been taken with Isaac. The pictures themselves are displayed in what's called the Pictorium. The bar code on each picture instantly accesses the version stored in the computer.

ALAN ALDA OK, now let me see. Now I should be able to get a message so far from this? This is a picture of somebody pointing at pictures on a computer screen. So that's like somebody using this device.

ALAN ALDA (Narration) Stig chose and put together pictures to tell me of his favorite people and activities during a typical day.

ALAN ALDA Is that your bed? OK

ALAN ALDA (Narration) This from a man who spent most of his adult life in an institution where it was assumed he had nothing to say.

ALAN ALDA Now can I give a message to Stig? Can I use these pictures somehow? Now I don't know where things are, but look, I want to tell him

something. Now just let me look through these pictures for a second, OK, and I'll try to tell him something. Ah, wait a minute now, I'm getting warm.

ALAN ALDA (Narration) Luckily I'd happened on the section of the Pictorium devoted to food. That's a topic I can always talk about. First I found a picture of me taken with Isaac.

ALAN ALDA Here, there's that one. And this one. And this. OK. Today I ate potatoes and herring. And she was calling me. And she was saying stop eating....yes, he was eating too. The camera guy ate a lot of herring today.

TOMAS AKESSON Hey, Tomas!

ALAN ALDA (Narration) Now it was Tomas' turn to tell me something.

ALAN ALDA OK, here's Tomas showing up on the screen here.

ALAN ALDA (Narration) He chose to describe a recent outing with Bodil in her car. While both Tomas and Stig used Isaac to take many of these pictures, today they mostly use a simple digital camera. And for Tomas at least, something profound seems to be happening.

BODIL JONSSON I don't know if you could actually hear, but Tomas he has got the words, and by now he has got some thousand words. Before he just had between ten and a hundred. And the reason why he sits there right now and says "Now they come again" about the pictures, is that something has happened to him that makes him interested to communicate. And not only to communicate, but also to think. Tomas has become somebody, and when we started the Isaac project, that was one of the goals. That the users were to become somebody, individuals.

ALAN ALDA (Narration) Using the pictures, Stig and Tomas can now tell not only of the past.

BODIL JONSSON He wants to show you what he wants to have with his coffee.

ALAN ALDA For the coffee break? Let's see... cookies, cakes.

ALAN ALDA (Narration) They've also begun to express their hopes for the future.

BODIL JONSSON I have to tell you that when I came here together with you, Stiggy asked me if we are going to have coffee. And I promised him that when you have left, we will do whatever he likes. And he told me that he wanted to go

with me to my home and have some coffee with me, and we are supposed to have this kind of cakes which he showed me now. So this is about the future.

ALAN ALDA It certainly is, yeah.

ALAN ALDA (Narration) Future plans for the Pictorium include adding speech to the computer.

COMPUTER VOICE Stig knows how to use it too.

ALAN ALDA (Narration) And both Tomas and Stig can now talk to a wider audience: you can visit them on the Internet at their own Web site.

ALAN ALDA Tomas, tak.

ALAN ALDA (Narration) Isaac, the device that started all this, is now being retired. No doubt others will take up the challenge of building a digital assistant for the mentally disabled. Tomas and Stig discovered for themselves how Isaac could help them.

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RADIOACTIVE REINDEER

ALAN ALDA (Narration) Flying in a helicopter over the tundra of Central Sweden,

ANTARRIS PERSSON is looking for reindeer -- his reindeer. To outsiders, this is the land of the Lapps. To the people who live here, like Antarris, it is the land of the Saami people, whose way of life centers on herding reindeer. During the summer months, the reindeer graze up here in the mountains. In the fall, helicopters bring the herds down to the Saami villages. This group of a hundred or so is a tiny fraction of the hundreds of thousands of reindeer herded by Saami in central and northern Scandinavia. It's just before dawn in Valsjbyn, where

ANTARRIS PERSSON is the leader of the local Saami herding cooperative. Reindeer from several locations grazed by the cooperative are -- if we're quick enough -- about to be herded into a corral. You can see I'm doing my part! That's Antarris' wife Marianne on the horse. I joined her in the corral.

ALAN ALDA Marianne, are looking for a particular one to lasso?

MARIANNE PERSSON Yes, my man's and my own.

ALAN ALDA I don't see any marks on their ears at all.

MARIANNE PERSSON It's difficult to see when they run so fast.

ALAN ALDA (Narration) Each family in the collective owns its own animals in the herd, identified with ear markings or colored collars. A major reason for this round up is to figure out who the calves born since the last round up belong to. A calf is assumed to be yours if it's running alongside an adult female you own. But spotting your calf is only half the battle -- you then have to lasso it so it too can be marked. Marianne snags a calf. Watched by her 11-year old daughter Leanna, she and her reindeer collapse in a tangle. But for the Saami, this is what makes life worth living.

ALAN ALDA How do you feel about this life? What does this life mean to you?

ANTARRIS PERSSON I have friends who live an ordinary life. They are Swedes and have jobs and I don't think I want to change with them. Because their life is like in box. They have everything in it and they don't see any, any... It's so difficult, I have not the words for what I want to say. They won't see the world.

ALAN ALDA (Narration) Almost 12 years ago, the world came crashing in on the Saami with the explosion of the Chernobyl nuclear reactor in the Ukraine, then a part of the Soviet Union. Although Chernobyl is eleven hundred miles away, the radioactive plume it released drifted directly over the Saami reindeer lands of Scandinavia. Four months after the accident, an American news crew visited Valsjbyn, and met with Antarris, Marianne and their brand new baby. They'd never seen that filmed report, so when we came to Valsjbyn, we brought a copy with us.

REPORTER And what is your name, by the way?

MARIANNE PERSSON Marianne

REPORTER Marianne, talk to me for a moment about how you feel about the tragedy of Chernobyl, and how you feel about how it's going to affect our baby.

MARIANNE PERSSON Yes, I'm worried of course for the future. I don't know what's going to happen, but I just hope it will be just like before again.

ALAN ALDA You remember this day?

MARIANNE PERSSON I remember it very well, because I had just come home from hospital too, with my first children...child. And it was a very strange feeling....

ALAN ALDA What kind of thoughts were going through your head?

MARIANNE PERSSON We don't dare to take any meat. Nobody knows how serious, how dangerous it was.

ALAN ALDA (Narration) The report showed Antarris' measuring the radioactivity in the carcass of one of his reindeer.

ALAN ALDA Had they told you yet that you couldn't eat the meat or sell the meat?

ANTARRIS PERSSON They told us we can't use this meat for at least 40 years.

ALAN ALDA That must have hit you like a ton of bricks. That must have been very hard to hear.

ANTARRIS PERSSON Yes it was. We were thinking lots of times what we shall do, if we should leave this life.

ALAN ALDA (Narration) The news crew persuaded Marianne to give them a peek at her infant daughter.

ALAN ALDA And this is...

MARIANNE PERSSON This is the baby. She's too big to carry now!

ALAN ALDA (Narration) The very real fear that it would be 40 years till reindeer could again be harvested for meat came from what the reindeer themselves eat. During the summer, they graze on grasses. But as winter approaches and grass grows scarce, they switch to lichens. And lichens, it turns out, are to radioactive fallout like a sponge is to water.

ALAN ALDA The lichen just grows sitting on this branch? And it doesn't have any roots in the ground?

BIRGITTA AHMAN No roots, and absorbs its nutrients actually from the air and rain.

ALAN ALDA So when all of that radioactivity came over from Chernobyl, it came in the air and just landed on the lichen and the lichen just soaked it up, faster than any other plant around here, apparently.

BIRGITTA AHMAN Yes, and if you look at these, we have some ground lichen here...

ALAN ALDA (Narration) It's this ground lichen that's the reindeer's principal winter diet. After Chernobyl, levels of radioactive cesium in the lichen soared several hundred fold. The critical question of course was how much of that radioactivity was going into the reindeer, whose meat both feeds the Saami and provides them with most of their income.

BIRGITTA AHMAN Some of them don't want to be measured.

ALAN ALDA (Narration) Birgitta Ahman first came here to measure radioactivity in the reindeer within weeks of the accident. She's been continuing to monitor the animals -- when they cooperate -- ever since.

ALAN ALDA That reindeer wasn't cooperative. What about the people when you began doing this, were the Saami people cooperative with you?

BIRGITTA AHMAN Yes, I think so. Often they are very busy as you can see so they don't want to wait.

ALAN ALDA (Narration) In the first round ups after Chernobyl, the reindeer had so much radioactive cesium in their bodies that 80 per cent of them had to be destroyed.

BIRGITTA AHMAN These reindeer come from three different places and it seems that they differ very much in the cesium levels.

ALAN ALDA (Narration) Today, most of them are well below the 1500 units of radioactivity considered to be dangerous for human consumption.

ALAN ALDA This reindeer is from the area where most of them have a high level?

BIRGITTA AHMAN Yeah, but this was low. This was only 150.

ALAN ALDA (Narration) Birgitta's decade-long monitoring program has helped develop several strategies for minimizing how much radioactivity gets into reindeer meat. One is simply to bring the animals to market earlier in the year, before they begin eating lichen.

MARIANNE PERSSON I show you first...

ALAN ALDA (Narration) I couldn't resist: I asked Marianne to show me how to lasso a reindeer.

ALAN ALDA What do you try to hit with that?

MARIANNE PERSSON You can try to hit the horn, or the legs. It's easier with the horn.

ALAN ALDA (Narration) I couldn't come all this way and just watch.

ALAN ALDA You think I'm going to be lousy, don't you? Not bad, huh?

MARIANNE PERSSON Not so bad.

ALAN ALDA (Narration) Well, maybe this wasn't such a great idea.

ALAN ALDA They're all saying, "here comes the jerk again".

ALAN ALDA (Narration) Ah, ha.

ANTARRIS PERSSON Good!

ALAN ALDA Good. Thank you.

ALAN ALDA (Narration) Now it's time to do my bit for science.

ALAN ALDA Are we going to measure him? OK, take it easy. Whoa, whoa! I don't know how to do this. You better help me.

ALAN ALDA (Narration) Birgitta had measured only one animal today that came in over the 1500 limit for human consumption. I held my breath.

BIRGITTA AHMAN Oh it was the highest!

ALAN ALDA Oh great, I get the highest one. That's just great. I petted him. I grabbed his horn!

ALAN ALDA (Narration) One of the first things to happen here in Valsjbyn after Chernobyl was a visit from this vehicle, a mobile human radiation monitoring unit. After handling a radioactive reindeer, it seemed wise to do what many of the local Saami have done over the last decade.

ALAN ALDA Is this where you measure everybody? It's a full body measurement?

GOREN AGREN Yes, we measure the whole activity in your body.

ALAN ALDA (Narration) This monitoring unit has been making the rounds of Saami villages ever since Chernobyl.

ALAN ALDA My head goes here?

GOREN AGREN Yes. And we're going to slide you under.

ALAN ALDA You're going to slide me under. And I keep my hands down here?

ALAN ALDA (Narration) The danger of radioactive cesium finding its way from reindeer to people is an increased risk of cancer.

GOREN AGREN Now you can see the detector above you. A shiny thing.

ALAN ALDA Would you compare the risks for me since Chernobyl? How have the risks gotten any worse?

GOREN AGREN We have calculated that in let's say 50 years after Chernobyl, we will get an extra 300 cases of cancer from Chernobyl. And then you can compare to that that we will have about 40,000 fatal cancer cases a year from all sources.

ALAN ALDA That to me is significant. I mean, I know in terms of statistics it may not be so significant, but it sounds to me well worth not having an accident like that happen again.

ALAN ALDA (Narration) After ten minutes reclining in my little plastic bathtub, it was time for the moment of truth.

GOREN AGREN The energy of cesium 137 is 662 keVs, so we can look at that area and see if we can find any peaks.

ALAN ALDA Huh, huh.

GOREN AGREN So we can see that we have almost a flat line for you.

ALAN ALDA (Narration) A flat line -- I guess that's good.

GOREN AGREN I can show you a spectra from someone who has a higher value for cesium. Here you can see a peak, an actual peak, from cesium.

ALAN ALDA Is that considered high?

GOREN AGREN No it isn't

ALAN ALDA It's not, it's low?

GOREN AGREN Yes that's low. But it's much higher than you.

ALAN ALDA Well that's a relief. I just had my hands all over a reindeer.

ALAN ALDA (Narration) Next to be measured was Leanna, Antarris' and Marianne's daughter, born within weeks of Chernobyl. By now, she's an old hand at this. And despite her mother's fears back when she was a baby, Leanna's cesium levels aren't all that much greater than mine -- thanks in large part to the vigilance of the monitoring program. It was time for the reindeer in the corral to go free again. The Chernobyl fallout has disappeared from the lichen, reindeer and people here more quickly than those early, pessimistic forecasts had suggested. Why this is so is still something of a mystery. But it's meant that a way of life that has supported both reindeer and people here for centuries has been able to continue almost uninterrupted.

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