

Narrator: THEY ARE FOUR OF THE MOST COMMON PLANTS WE KNOW. WE'VE ALWAYS THOUGHT THAT WE CONTROLLED THEM. BUT WHAT IF, IN FACT, THEY HAVE BEEN SHAPING US?

Michael Pollan We don't give nearly enough credit to plants. They've been working on us, they've been using us for their own purposes.

Narrator: FOUR PLANTS THAT HAVE TRAVELED THE ROAD TO SUCCESS...BY SATISFYING HUMAN DESIRES.

Michael Pollan: The tulip, by gratifying our desire for a certain kind of beauty, has gotten us to take it from its origins in Central Asia and disperse it around the world. Marijuana, by gratifying our desire to change consciousness, has gotten people to risk their lives, their freedom, in order to grow more of it and plant more of it. The potato, by gratifying our desire for control, control over nature so that we can feed ourselves has gotten itself out of South America and expanded its range far beyond where it was 500 years ago. And the apple, by gratifying our desire for sweetness begins in the forests of Kazakhstan and is now the universal fruit. These are great winners in the dance of domestication.

A LOOK AT NATURE THE WAY YOU'VE NEVER SEEN IT BEFORE – WITH BEST-SELLING AUTHOR MICHAEL POLLAN.

Michael Pollan vo: This relationship, of the plants learning how to gratify our desires and our working for them in exchange for this, is what I call the Botany of Desire.

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Michael Pollan: It was that very special week in May when the apple trees are in spectacular bloom and they're just vibrating with the attention of bees. And I was planting potatoes. Making my little rows and putting in my chunks. and the bees were working above me. and it occurred to me. You know, what did I have in common with those bees? And when you think about it, um, quite a bit. The bee assumes it's getting the best of this deal with the apple blossom. It's breaking in, it's getting the, getting the nectar, and has no idea that it's picked up this pollen on its, on the hairs of its thighs and it's transporting it to another tree, in the garden or down the street or halfway around the world.

So for the bee to think it's in charge of this relationship is, is really just a failure of bee imagination. And I realized I had the same failure of imagination - I was working for these potatoes, in some sense. I was planting them; I was giving them a little bit more habitat than they had before. And yet I thought that I was kind of calling the shots. So that's when I had this thought that, wouldn't it be interesting to look at our relationship to domesticated plants from the plant's point of view.

Of course, plants don't have consciousness or intention but the act of using our consciousness to put ourselves in their roots or shoes or whatever, helps us to see things from their vantage point. And when you do that, nature suddenly looks very different. We realize we're in the web of nature, not standing outside it. These plants are mirrors in which we can see ourselves in a slightly different way. And as much as this is a story about plants, it's a story about human desire.

Brian: Good morning. My name is Brian. Welcome to Poverty Lane Orchards. First thing we're gonna do is we're gonna head up into the orchard and when we get up there I want to tell you a little bit about the apples and the trees and how to pick apples...

Narrator: FOR CHILDREN IN NEW ENGLAND, IT'S AN AUTUMN RITUAL-- AN APPLE PICKING EXPEDITION TO THE LOCAL ORCHARD.

Brian off-screen: OK when you guys are picking the apples, you want to pick out nice ripe apples, and the way to tell the ripe ones is they're red...

BUT THESE CHILDREN MIGHT NEVER
HAVE HAD A CHANCE TO TASTE APPLES, HAD THE APPLE NOT FOUND A
WAY TO GET US TO DO ITS BIDDING.

THOUSANDS OF YEARS AGO, THE APPLE PUT US TO WORK –
TRANSPORTING ITS GENES FROM ITS NATIVE GROUND IN CENTRAL
ASIA TO THE FAR CORNERS OF THE EARTH.

Michael Pollan: For a plant to do that, it has to be awfully enterprising, willing to adapt to a great many different environments, willing to experiment with a great many different forms and flavors.

Mom in scene: Is there a really good red one up there? What do you see?

Michael Pollan vo: Today it's a fruit iconic and beloved and used in a great many different ways.

Narrator: BUT THE APPLE HAS NOT ALWAYS BEEN REGARDED AS THE WHOLESOME FRUIT WE THINK OF TODAY.

Michael Pollan: The apple tree was the great evil plant because people took these apples and made hard cider, which was the main source of alcohol in rural America for many, many years. The strategy, the evolutionary strategy, that got it from there to here involved producing ever more sweetness.

Sarah: Here's cup four, here you go. If you think it tastes bad or yucky, I want you to give it to Oscar the Grouch.

Oscar, OK.

Here's cup two. And if it tastes good, I want you to give it to Big Bird, because he likes things that taste good.

Narrator: THESE CHILDREN ARE DOING TASTE TESTS - PART OF RESEARCH BEING DONE ON SWEETNESS AT THE MONELL CHEMICAL SENSES CENTER IN PHILADELPHIA. IT SPECIALIZES IN THE STUDY OF TASTE AND SMELL.

Sarah: Good job, doing Great, all right. I'm going to give you another one.

Gary Beauchamp: Some of the fundamental things we've discovered are the desire for sweetness is hardwired in human beings. It's built-in, it's innate. It's not because we feed babies high levels of sweet when they're young. It's part of their biology.

Presumably our response to sweet evolved when sweet things were rare in the environment. They were there in small amounts. And our biggest problem was to make sure we got enough calories and didn't starve to death. If a plant was sweet that meant it wasn't bitter and poison, it meant it was reasonably high in calories because sugars are calorie-rich and so sweetness is the signal for something that's good for us.

Michael Pollan: Sweetness in nature is very rare, very special. It's really limited to ripe fruit and, honey if you're willing to risk, going to a beehive. And apples are a particularly big, portable, long-lasting vessel for sweetness.

Narrator: IT WAS HERE, IN THE ANCIENT FORESTS OF CENTRAL ASIA THAT OUR OWN PURSUIT OF SWEETNESS FIRST BROUGHT US INTO CONTACT WITH THE APPLE. THIS -- SCIENTISTS SAY -- IS THE APPLE'S GENETIC HOME – THE PLACE WHERE IT ORIGINATED.

THESE HIGH FORESTS, IN WHAT IS NOW THE NATION OF KAZAKHSTAN, GAVE RISE TO THOUSANDS OF DIFFERENT VARIETIES – MANY OF WHICH STILL GROW HERE TODAY

Frank Browning: You land in Almaty, the capital of Kazakhstan, and there are apple seedlings pushing up through the broken pavement. If you go up into the hills and there are thousands of different kinds of apples. Great, big, red apples that looked like large McIntosh, and you'd find these sort of knotty little green things that even a rat wouldn't eat.

Michael Pollan: To see these wild apples in all their diversity, is to realize that in these forests, this is, you know, these are God's first drafts of what an apple could be.

Narrator: ONE WAY THE APPLE COULD SECURE ITS FUTURE WAS BY EXPANDING ITS HABITAT. BUT THAT'S A HARD THING TO DO IF YOU'RE A PLANT.

Michael Pollan: You know the apple has the same existential predicament of any plant. It's stuck in place. It's, uh, rooted down. So you had the apple beginning its life in these Kazakh forests in Central Asia, but they would be stuck there, if not for mammals, that they evolved to appeal to. If you're a bear in a forest and you're hungry, you don't pick the little blueberry sized apples. You pick the biggest ones you can get. If you find a particularly sweet one, you're gonna eat more of that one than a sour one. And in their case they eat the whole apple and excrete the seeds and that's how apples spread their genes. And sweetness was the ticket out of that forest.

Narrator: BUT TO MOVE FARTHER THAN BEARS COULD TAKE IT, THE APPLE WOULD NEED A NEW ALLY – AND FOUND ONE IN US.

Michael Pollan: Part of the apple's genius has been to insinuate itself into our culture and art and religion as well. It's kind of a botanical Zelig. I mean, it just kind of shows up everywhere, even when it wasn't, uh, wasn't really there.

Narrator: ONE OF THE BEST KNOWN IMAGES OF PEOPLE AND APPLES TOGETHER COMES FROM THE STORY OF THE GARDEN OF EDEN.

Michael Pollan vo: Though the Bible doesn't specify what the fruit is-we have always imagined it to be apples. And that's because the Northern Renaissance painters, when they thought of a fruit, a desirable fruit that you would put in a garden, they immediately thought apple, but it wasn't an apple. It probably was a pomegranate, because apples don't do very well in the lands where the Bible is thought to have taken place.

Narrator: ONE PLACE WHERE APPLES DID GROW WAS ANCIENT CHINA. THEY'D BEEN BROUGHT THERE FROM CENTRAL ASIA ON THE TRADE ROUTE CALLED THE SILK ROAD.

THE APPLE ALSO TRAVELED WEST...REACHING EUROPE, AND EVENTUALLY, THE NEW WORLD.

IN AMERICA, THE APPLE FOUND A PARTNER – SOMEONE WHOSE LOVE FOR IT WOULD BECOME THE STUFF OF LEGEND:

JOHNNY APPLESEED.

Animated Johnny Appleseed: The Lord is good to me
And so I thank the Lord

Joyce Chaplin: Behind Johnny Appleseed the myth there is a real person, John Chapman. But the myth is so powerful, so compelling, so fascinating that it has completely obscured the real person who's behind it.

Narrator: JOHN CHAPMAN WAS BORN IN 1774, IN MASSACHUSETTS. IN HIS EARLY TWENTIES, HE HEADED WEST.

HE TRAVELED THROUGH THE OHIO RIVER VALLEY, WHICH WAS THEN THE AMERICAN FRONTIER, PLANTING AND SELLING APPLE TREES.

Michael Pollan: He is said to have likened himself to a bee, um, that he had some sense that he like a bee was spreading these plants around.

Frank Browning: Johnny Appleseed was, not to make a terrible pun, a pretty seedy fellow, you know, traveling around often barefoot, you know in a burlap sack sometimes, sleeping in barns, but terribly engaging. People took him in and he planted the orchards, and he told them how to prune. But he was, um, he's a bum.

Joyce Chaplin: This is doubly odd, uh, because he was actually fairly well off.

Narrator: CHAPMAN COULD EASILY HAVE AFFORDED MUCH BETTER CLOTHES. ALL THOSE APPLE TREES HE PLANTED MADE HIM A PROSPEROUS MAN.

Michael Pollan: He wasn't just sprinkling apple seeds wherever he went. He was a nurseryman. He understood that wherever the next wave of settlers would land, they would want apple trees. By law, you were required to plant some fruit., because that was a symbol you were going to stay put. So he would find a piece of land, he would clear it and he would plant apples from seeds and start a nursery a few years before the settlers got there.

So by the time they showed up he had saplings for sale for a few cents apiece. It was a very good business. But when I started learning about the botany of apples suddenly there was a problem with his story. Why would he be planting them from seed?

Narrator: THE MYSTERY STEMS FROM A CURIOUS FACT OF THE APPLE'S OWN BIOLOGY:

ITS TASTE, AND EVEN ITS APPEARANCE, ARE RARELY PASSED ON THROUGH ITS SEEDS.

Michael Pollan vo: In every apple you will find a few little seeds, each in their little chamber. Well, every one of those seeds, if planted, will produce a completely different apple, looking very little, if at all, like its parent. They tend to be sour, bitter, all these other different flavors.

Narrator: THAT'S BECAUSE EACH APPLE SEED CARRIES GENES FOR A WIDE VARIETY OF TRAITS. AND THERE'S NO TELLING WHICH OF THOSE GENES WILL BE TURNED OUT WHEN THE SEED STARTS TO GROW.

THERE IS, HOWEVER, A VERY SIMPLE WAY TO PERPETUATE THE TRAITS OF AN APPLE. AN ANCIENT TECHNIQUE CALLED GRAFTING.

YOU TAKE A BUD FROM A TREE THAT PRODUCED FRUIT THAT YOU LIKED, AND INSERT IT INTO A YOUNG DEVELOPING TREE.

THE RESULT: AN EXACT COPY – OR CLONE – OF THE APPLE YOU STARTED WITH.

MANY AMERICAN SETTLERS GREW THEIR APPLES EXACTLY THAT WAY. BUT NOT JOHNNY APPLESEED.

Joyce Chaplin: He tended to grow seedlings, and then just let them grow wild. He might have done this, we think, because of his religious beliefs. He was a Swedenborgian.

Narrator: THE EIGHTEENTH CENTURY CHRISTIAN THEOLOGIAN EMANUEL SWEDENBORG, PREACHED THAT THE NATURAL WORLD IS IMBUED WITH GOD'S SPIRIT.

Joyce Chaplin: Swedenborg had taught that everything that was here on earth that you could see, feel, taste, touch, had a counterpart in the spiritual world beyond. For Chapman, this seemed to indicate that he should not tamper with, all of the natural things that he could see in the world around him. And this seems to be one reason why he grows apples from their seeds and not from grafting.

Narrator: WHATEVER HIS REASONS, CHAPMAN'S BOTANICAL PRACTICES GAVE THE APPLE A GOLDEN OPPORTUNITY TO ADAPT TO A NEW ENVIRONMENT.

Michael Pollan: by going back to seed, you are going back to the biodiversity of your genes. So all of those apple seeds produced hundreds of different kinds of apples with very different qualities. And so the apple, just like the Englishmen who came over, remade itself as Americans.

Narrator: MOST OF THESE NEW VARIETIES – BECAUSE THEY WERE GROWN FROM SEED – TURNED OUT TO BE BITTER.

BUT THE SETTLERS HAD A VERY GOOD USE FOR THEM: CIDER. HARD CIDER.

Michael Pollan: Now when we use the word cider we picture something very sweet but, of course, it only stays sweet if you have refrigeration. So all the cider they made went into barrels and fermented and became what we call hard cider, alcoholic cider. So Johnny Appleseed, who we think of as the most benign, wholesome kind of character, it turns out-was bringing hard drink to the, to the Frontier.

Frank Browning: That's what people drank. Colonial America was terrified of water. They knew about all the diseases of water in, uh, in, in Europe, and so they didn't drink it.

Joyce Chaplin: Cider, however because it had been fermented, had killed, in the process anything that might make you ill.

Michael Pollan: That was the beer of its time, the wine of its time. That's what everybody drank, and I mean everybody.

Narrator: EVERYONE FROM PAUPERS TO PRESIDENTS CONSUMED CIDER. JOHN ADAMS LIKED TO DRINK IT FOR BREAKFAST.

BUT OVER TIME, CIDER, AND THE APPLE, BECAME VICTIMS OF THEIR OWN SUCCESS.

Joyce Chaplin: Alcohol consumption started to rise in about the 1830s. And there's some public outrage over that that people seemed to be too interested in drinking or are drunk. So, all forms of alcoholic beverage begin to be criticized, um, and cider is among them.

Michael Pollan: People went after apple trees. Suddenly the apple, uh, which had been celebrated for much of American history, is vilified as the evil fruit.-Um, it's back in the Garden Of Eden in a sense. The hatchet wielded by the famous Prohibitionist, Carrie Nation, was not just about breaking down saloon doors, it was also about chopping down this evil tree that was getting Americans drunk.

Narrator: BUT THE APPLE WOULD BE RESCUED FROM INFAMY, BY THE SWEETER SIDE OF ITS NATURE.

Michael Pollan: Even though cider was what happened to most apples, apples were also eaten as a food, and, uh, whenever you were lucky enough to find a sweet one, that's what you did with it.

Narrator: SO WITH CIDER IN DISREPUTE, THE RACE TO FIND SWEET NEW VARIETIES INTENSIFIED.

Michael Pollan: Everyone who had a cider orchard had his eye out for that one good edible apple. It was really well understood that one of the tickets to great success and great wealth in America was to find a good edible apple.

And all the famous apples that we know - the Delicious, the McIntosh, the Baldwin, the Northern Spy, these had all begun in cider orchards. They were the stars. Before 1900, the fate of like 99% of apples was to be drunk. After 1900 it becomes the fruit that we now know.

IN THE TWENTIETH CENTURY, APPLES BECAME A SYMBOL OF WHOLESOMENESS.

Michael Pollan: The apple growers came up with this campaign, an apple a day keeps the doctor away, and essentially re-branded the apple as a health food. That's all well and good, but what it meant is that as soon as you're eating apples you focus on those few varieties that are really tasty and popular.

And the industry shrank down the number of apples over the course of the, the twentieth century. So that by the time I was a boy in the early '60s, There were very few apples in commerce. There was the, the Red Delicious, the Golden Delicious, and the McIntosh.

That was, you know, easy for marketers to get their head around, it was all the public seemed to want. But for the apple, it wasn't very good news because as soon as you kind of freeze its evolution, the apple is kind of a sitting duck for its pests.

Narrator: APPLES WERE INCREASINGLY BEING GROWN IN WHAT SCIENTISTS CALL MONOCULTURES, WHICH CHURNED OUT JUST A SINGLE VARIETY.

Michael Pollan: Once you rely on the genetic uniformity that comes with cloning rather than planting from seed, you restrict the species' natural ability to evolve. So you have your plants with their genetic combination staying still while the pests – I'm talking about insects or diseases, viruses or bacteria – are always trying to pick the lock. And sooner or later, they will be able to get not just one of your plants, but all of your plants, 'cause they're the same.

Narrator: TO DEFEND THEM FROM INSECTS AND DISEASES, MOST APPLES ARE ROUTINELY SPRAYED WITH CHEMICALS.

Frank Browning: The bugs are clearly well ahead of the human controls. If you're talking about a large grower with a couple of hundred acres, they're probably spending a half million to three quarters of a million dollars a year in chemical costs.

Michael Pollan: One of the biggest consumers of pesticide now is the apple crop. Uh, It's the fate of monocultures.

Herb Aldwinckle: We'll have to check the records to see what the resistances are in these because, um, These could be real useful in breeding right now, I think.

Phil Forsline: Definitely.

Narrator: IN GENEVA, NEW YORK, SCIENTISTS HERB ALDWINCKLE AND PHIL FORSLINE ARE LOOKING FOR ANOTHER WAY TO HELP THE APPLE – BY HARNESSING THE DEFENSES THAT LIE HIDDEN IN ITS GENES.

Herb Aldwinckle: Think what it would be like if it was grafted on a dwarfing root stalk.

Phil Forsline: Exactly.
Herb Aldwinckle: Probably double the size and even more color.
Narrator: ALDWINCKLE AND FORSLINE COLLABORATE AT THIS APPLE RESEARCH CENTER, WHICH IS RUN BY THE U.S. DEPARTMENT OF AGRICULTURE. IT'S A BOTANICAL VERSION OF NOAH'S ARK.
Michael Pollan: To walk into this orchard is to, at first it looks like kind of a normal orchard. And then you realize as you look down the rows that, my God, every one of these trees is different. There are yellow ones, and there are red ones, and there are green ones, and there are purplish ones, and they're small and large, and every shape of tree and fruit. It is just this vast library.
Narrator: HERE, THERE ARE MORE THAN FIVE THOUSAND DIFFERENT KINDS OF APPLE TREES – EACH WITH ITS OWN DISTINCT SET OF GENES.
Herb Aldwinckle: A mechanic has a wide variety of tools which he hopes he'll be able to use to fix problems with machines he's working on. It's a similar situation with apples. We need to have a tool chest, and the genes are what provide the tool chest.
Narrator: IN 1989, ALDWINCKLE AND FORSLINE GOT AN UNEXPECTED OPPORTUNITY TO ADD TO THEIR TOOL CHEST SOME OF THE MOST VALUABLE APPLE GENES IN THE WORLD. THE GENES FROM KAZAKHSTAN.
Herbert Aldwinckle: We regard the Kazakh apple forests as the gene bank of the domestic apple. The wild forests were being chopped down. The trees were being destroyed. They just wouldn't be there anymore unless someone went there and collected them, and grew them somewhere else. We had some Jeeps we traveled around in so we were able to visit true apple forests.
Phil Forsline: It was, uh, a bit of a culture shock to be in Central Asia for the first time. My first impressions were this was in the middle of nowhere, what am I doing here. But, uh to just see the diversity in those apples is just, just amazing.
Herbert Aldwinckle: Once an apple tree's chopped down, it's gone forever. But if we can take the seed from that tree and store the seed, we can preserve the genes that were present in that tree and essentially we can preserve that tree forever.
Narrator: ALDWINCKLE AND FORSLINE MADE SEVERAL TRIPS TO THE KAZAKH FORESTS. THEY BROUGHT SEEDS BACK, AND PLANTED THEM.

Phil Forsline: We're standing in the middle of what I call Kazakhstan recreated in Geneva, New York. But we're not only just saving it, we're developing a library of information on every one of these trees.

Frank Browning: The notion of conservation of seed is to conserve it, because you don't know what you might need it for at some future time, maybe nothing. Why do we have museums? Well, because it's a good idea to conserve things. That's the primary value. Then there's a secondary value. And that is to use them as genetic breeding stock to solve problems, to solve problems that might enable growers to use fewer pesticides.

Narrator: IN HIS LAB, ALDWINCKLE IS TRYING TO DO JUST THAT – BY MOVING GENES THAT PROVIDE DISEASE RESISTANCE FROM A WILD KAZAKH APPLE INTO A COMMERCIAL VARIETY.

Herbert Aldwinckle: These are, um, pieces of leaves of Fuji apple. And what we've got here is an experiment to try and transfer some genes for resistance to apple scab into Fuji and therefore make Fuji resistant to apple scab.

Michael Pollan: In the 19th century, the repository of all the genetic diversity of the apple in America was in the cider orchard. Today it's in these collections that are maintained by some visionary individuals who understand the importance of preserving this biodiversity.

There's a vicious circle that we get into, which is we have monocultures in the field, and monocultures on the plate. Monocultures of taste. Fruit now has to compete with soda. So it's got to be super sweet. And the modern apples all are very sweet. We have apples, that as one critic said of the, the Delicious, it has sweetness without dimension.

Frank Browning: The problem is it's boring, sweetness, if that's all you get.

IN LEBANON, NEW HAMPSHIRE, ONE GROWER IS TRYING TO SOLVE THAT PROBLEM BY REACHING BACK INTO THE APPLE'S PAST.

STEPHEN WOOD IS THE OWNER OF POVERTY LANE ORCHARDS.

HE USED TO GROW MOSTLY STANDARD VARIETIES LIKE MACS AND CORTLANDS, BUT FOUND HE COULDN'T MATCH THE PRICES OF THE BIG COMMERCIAL GROWERS.

Steve Wood: We realized in the late '80s that what we'd always done wasn't gonna work any longer, and that we either had to change quite dramatically what we were doing or stop growing apples altogether.

BUT FOR WOOD, GIVING UP ON HIS ORCHARD SEEMED INCONCEIVABLE.

Steve Wood: you know, some people adore antique clocks, I adore apple trees.

We started some grafting trials of what I guess you could call antique varieties – varieties that are not commonly grown anymore but once were. This is Wickson, uh, this apple originated in the Pacific Northwest in the late 19th century. It's got a beautiful acidity. This is Pomme Grise. It has very low acid, high sugar and a sort of, and sort of nutty flavor. This apple is Calville Blanc d'Hiver. It's got a little bit of sweetness behind the acid.

You look at 17th century French still lives um, this is the apple you see beside the dead pheasant and the bottle of wine. There's a huge number of apple varieties, uh, um, it's almost infinite.

Narrator: BUT IT'S TOUGH TO MAKE A LIVING SELLING ONLY ANTIQUE EATING APPLES. SO WOOD TURNED HIS ATTENTION TO ANOTHER LOST CHAPTER IN APPLE HISTORY.

MOST OF HIS ORCHARD IS NOW PRODUCING APPLES FOR HARD CIDER.

Steve Wood: It is a gamble to plant acres and acres of inedible apples. Many of the best cider apples are disgusting, bitter, astringent apples. The decision to plant not just a few trees but thousands and thousands of those trees could be quite a good joke if the cider doesn't make it because these apples are not gonna wind up in a kid's lunchbox. There's no secondary market for this stuff.

Wonderful breakfast drink...

We are trying with a few other colleagues basically to create a category in the U.S. wine trade of fine ciders. I think we're doing quite well in that, but the jury is still out.

Michael Pollan: There are a lot of fruits that have gotten ahead in life by being sweet and gratifying the sweet tooth of, of mammals like us. But there's something about the apple. You know, it's so iconic in Western civilization and so enduring in, uh, in its relationship and its ability, really, to gratify our changing desires – for alcohol and for a a wonderfully sweet food – that my guess is it will succeed for many years to come.

The mystery is why things that bees regard as beautiful we also regard as beautiful. I mean, what are the odds that we would have the same taste as this little bug?

When I say the bee has a concept of beauty, I mean I'm being metaphorical. But the bee and ourselves have a lot in common. We really like symmetry. We like certain patterns of color. And certain scents, we agree about scent as well. The bee loves this flower and moves toward it. And this flower has evolved to attract it.

Well, this plant has also evolved to attract us. To the extent that a flower can gratify our ideas of a beautiful color, a beautiful shape, a beautiful smell, it will dominate the landscape, dominate the flower industry, get many more copies of itself made, and take over the world.

Narrator: AND FEW FLOWERS HAVE TRAVELED THE ROAD FROM OBSCURITY TO FAME MORE SPECTACULARLY THAN THE TULIP.

Joop Zonneveld: 59 years ago, I saw first tulip in my life. And that was in the garden of my father. And now, my whole life is with tulips.

Narrator: NOBODY KNOWS TULIPS BETTER THAN THE DUTCH. AND FEW DUTCHMEN KNOW THEM BETTER THAN JOOP ZONNEVELD. BUT HE HAS A CURIOUS WAY OF DESCRIBING THEIR EFFECT ON HIM.

Joop Zonneveld: You look after every tulip. Step by step, you get the tulip fever. It becomes worse, worse and worse. For me, it was something that is in me – it never stops.

Narrator: ZONNEVELD'S BEEN A TULIP BUYER, A SALESMAN, AND NOW HE'S CONSERVATOR OF ONE OF MOST FAMOUS TULIP GARDENS IN THE WORLD: HORTUS BULBORUM IN THE NETHERLANDS.

A SHOWPLACE FOR THE REMARKABLE DIVERSITY OF THIS SOMETIMES UNDERAPPRECIATED FLOWER.

Joop Zonneveld: In this garden, we have two thousand three hundred varieties. You have dark purple colors. You have almost black tulips You have Lily Flowering Tulips. There's a tulip that has the shape like this, like a lily flower. You have yellow, red, pink, orange, bi-colored, Single Earlies, Single Late, Double Late, so there are so many things in the tulips that once you start you discover every day, even myself, I discover every day new things.

Narrator: TODAY, ZONNEVELD IS GIVING A TOUR TO PHOTOGRAPHER RUTH DUNDAS AND WRITER JUSTIN SPRING, TWO AMERICANS WHO HAVE COME TO HORTUS TO GATHER MATERIAL FOR A NEW BOOK.

Ruth Dundas: This is a lovely viridaflora..

Narrator: TULIPS ARE ABOUT THE LAST SUBJECT THEY THOUGHT WOULD EVER CAPTURE THEIR INTEREST.

Ruth Dundas: I have to say honestly when I first started to photograph, the last thing I wanted to photograph was tulips. It's pretty boring. It's a lollipop on top of a stick. And, you know, you get different colors but that's it. It's only once you come to gardens such as the Hortus Bulborum here that you start to understand that this is a very varied flower and it's adapted and mutated into many different forms. It's a lot of fun to photograph, that is a constant challenge to look into this flower and be able to see new color, new light. You can take a bouquet of tulips and photograph it every hour of the day, and it's something quite different each time.

Justin Spring: Perfect, gorgeous.

It just seems so amazing that you have this, um, extraordinary variety that's been cultivated over centuries. And somehow, you grew up not knowing a thing about it.

Narrator: FLOWERS BEGAN FLAUNTING THEIR BEAUTY LONG BEFORE THERE WERE PEOPLE. IT WAS MORE THAN A HUNDRED MILLION YEARS AGO WHEN THE CLASS OF PLANTS THAT FLOWERS BELONG TO – THE ANGIOSPERMS – FIRST APPEARED ON THE EARTH.

Michael Pollan: I mean the great revolution in natural history is the, is the rise of the angiosperms. This is the class of plants that makes conspicuous flowers, forms fruit and seed. This was a new way of doing business in nature.

Narrator: THE FLOWER OF AN ANGIOSPERM HAS A MALE PART, THE STAMEN, WHICH PRODUCES POLLEN.

WHETHER TRANSPORTED BY WIND, BEES, OR HUMANS, WHEN POLLEN LANDS ON THE FLOWER'S FEMALE PART – THE PISTIL – IT GETS FERTILIZED, AND GIVES RISE TO SEEDS.

THE SEEDS CONTAIN A MIX OF GENES FROM BOTH THE MOTHER AND THE FATHER

Michael Pollan: Before that, you had this greener, sleepier world where things reproduce usually by cloning, by spores that were genetically identical to their parents. Evolution proceeded in a kind of poky pace because you didn't have as much variation.

And then you have this incredible explosion, of diversity that happens with this new strategy. It was an incredibly successful strategy. It allowed you to move your genes around, it allowed you to um, uh, evolve much quicker because you were -- sex creates variation. And the more new combinations you'd try the quicker you can adapt to whatever the environment is.

And one particular group of these angiosperms came up with a really, really clever strategy, and that was to appeal not to you know, bugs or birds or bees, but appeal to us.

Narrator: THE FIRST WILD TULIPS, SCIENTISTS THINK, SPRANG UP IN THE SAME PLACE WHERE THE APPLE ORIGINATED: THE MOUNTAINS OF CENTRAL ASIA.

Michael Pollan: It was typically kind of more open than our tulips, So it had a kind of hourglass-y shape. Often had a scent, often had a slightly different color inside.

Narrator: DRAWN BY THE BEAUTY OF THESE WILD FLOWERS, PEOPLE LEARNED HOW TO CULTIVATE THEM.

Michael Pollan: Under our attention, the flower got bigger. The colors very often got brighter and then, we started experimenting with variation.

Narrator: FROM CENTRAL ASIA, THE TULIP MADE ITS WAY TO TURKEY. IT WAS THERE THAT THIS BEAUTIFUL FLOWER BEWITCHED ONE OF THE MOST POWERFUL MEN IN THE WORLD: THE SULTAN OF THE OTTOMAN EMPIRE.

Michael Pollan: The Turks at various times in history revered tulips. Sultan Ahmed III was famous for his love of tulips. And when they were in bloom every year, there was a festival. Every night there would be some sort of performance to celebrate tulips. It was so extravagant, in fact, that, this helped bring the down the Sultan.

Narrator: FOR HIS SPENDING ON TULIPS – AND OTHER PERCEIVED FAILINGS – THE SULTAN WAS TOPPLED FROM HIS THRONE.

BUT IT WASN'T ONLY ROYALTY THAT GOT SEDUCED BY THE TULIP. IN THE EARLY 17TH CENTURY, THE FLOWER CAUSED A WHOLE COUNTRY TO GO MAD.

Michael Pollan: It was completely irrational. Uh, and, uh, I-I don't think you can explain it according to any logical scheme that this entire society went nuts.

Narrator: BETWEEN 1634 AND 1637, TULIPS SWEEPED THE DUTCH INTO A COLLECTIVE FRENZY THAT HAS BECOME KNOWN AS TULIPMANIA.

THEIR PASSION FOR THE FLOWER SPURRED ONE OF THE BIGGEST INVESTMENT BUBBLES IN HISTORY, AND FOR A BRIEF TIME MADE THE TULIP ONE OF THE MOST VALUABLE COMMODITIES IN THE WORLD.

Michael Pollan: It was a pure, uh, you know, financial speculative bubble. And it was about a flower. I mean, how amazing is that?

Narrator: IT WAS A TIME WHEN THE DUTCH DOMINATED WORLD TRADE. AND A LOT OF THEM WERE GETTING RICH. IT BECAME FASHIONABLE TO GROW FLOWER GARDENS. AND NOTHING SAID SUCCESS LIKE A TULIP.

Joop Zonneveld: In the beginning, the rich people in Holland, they have big houses, and they want to show they're wealthy, at that time, with tulips.

Michael Pollan: It really was about the display of the extraordinary, the gem. And you picture a, you know, kind of gray, uh, cloudy Dutch spring afternoon, and that color against that steel sky is a powerful thing.

NARRATOR: FOR THE TULIP, THE DUTCH FLOWER GARDENS OFFERED A CHANCE TO STRUT ITS STUFF.

AND NO TULIPS DID SO MORE DRAMATICALLY THAN THE TYPE KNOWN AS BROKEN TULIPS. THEY WERE EXTREMELY RARE.

BUT BACK THEN, NO ONE KNEW WHY.

Michael Pollan: A break was when, uh, the background color, the solid, matte, saturated color of a tulip gets a kind of a flame of a second color. And when this happened, this was considered, you know, th-the most beautiful tulip.

NARRATOR: THE MOST PRIZED OF ALL THE BROKEN TULIPS WAS ONE OF THE RAREST: THE SEMPER AUGUSTUS.

Michael Pollan: It was a big white tulip with a splash of carmine red on it, which was really, by general account, considered the, the greatest tulip ever found. This was the epitome of tulip beauty in the eye of the Dutch.

Narrator: IF YOU WANTED A SEMPER AUGUSTUS TO BLOOM IN YOUR GARDEN, YOU'D NEED TO GET YOUR HANDS ON A SEMPER AUGUSTUS BULB.

THAT'S THE PART OF THE TULIP THE LIVES BENEATH THE SOIL. AND PLANTING A BULB IS THE ONLY WAY TO MAKE SURE A TULIP OFFSPRING WILL LOOK THE SAME AS ITS PARENT.

BUT IN 17TH CENTURY HOLLAND, SEMPER AUGUSTUS BULBS WERE VERY SCARCE.

Mike Dash: At that time only one merchant in Amsterdam had examples of this bulb. Eventually, one man prevailed upon him to sell a single bulb, which was valued, at the time, 10,000 florins. And this was at the time when the average Dutch worker would survive with his family for a year on about 300. And the fact that such sales were being made in such colossal sums of money, gradually became more widely known. And this really was the foundation stone of what became the tulip mania.

Michael Pollan: At the height of the tulip mania, one tulip sold for an amount equivalent to the price of one of the grandest canal houses in Amsterdam. Now, just to put it in contemporary terms, this is equivalent to, say, a townhouse on 5th Avenue, \$10, \$15 million dollars for a single tulip bulb.

Narrator: THE TULIP BULB MARKET HIT ITS PEAK IN FEBRUARY, 1637. THERE WERE 40 MILLION GULDERS WORTH OF TULIP DEALS OUTSTANDING; MORE THAN SIX TIMES THE TOTAL AMOUNT OF MONEY THERE WAS IN CIRCULATION.

Michael Pollan: There was an auction held in the winter of 1637, and some great tulip was put on the market at a certain price, and it didn't get that price. And the auctioneer offered a thousand guilders less, a thousand guilders below that, and nobody bid.

Amy Stewart: The flowers were very overvalued, people were risking fortunes. And, of course, the whole thing came crashing down at once.

Michael Pollan: And so very soon after that, all these tulips were worthless, and all these people were ruined. They had put their fortunes in these flowers, and now they were worthless. They were just bulbs of plants and that was the end of the tulip mania.

Narrator: SUDDENLY, THE FLOWER THAT WAS LOVED FOR ITS BEAUTY BECAME A SYMBOL OF HUMAN FOLLY.

Michael Pollan vo: There was a period of tulip hatred (laughs) in Holland after the collapse, because it was blamed for these, uh, you know, this economic disaster.

There was a famous professor in Leiden who went running around with a stick beating tulips and destroying them. And there were all these pamphlets and broadsides about the evils of the tulip mania and the great whore-goddess Flora who was blamed for bringing the Dutch down, as if, you know, it was the flower that did it to them.

It's an extraordinary historical episode. And, we look back, and we look down, and we say, "How could they do this?" But, of course, we've been through our own speculative bubbles. And it really doesn't matter what you're trading. As long as the price is going up really fast, everybody wants in. And as long as there's a greater fool, uh, a lot of money can be made. You just don't want to be left holding the bag, or the bulb, at the end of it.

Narrator: WHAT NONE OF THE RUINED INVESTORS COULD POSSIBLY HAVE KNOWN WAS THAT THE BREAKS IN COLOR THEY SAW AS THE EPITOME OF BEAUTY WERE ACTUALLY CAUSED BY A VIRUS.

THE TULIP BULBS THAT SOLD FOR THE PRICE OF 5TH AVENUE TOWNHOUSES TURNED OUT TO BE DAMAGED GOODS.

Amy Stewart: Well, this is something that nobody understood at that time. I mean no one in the 1600s and the 1700s had any notion of plant diseases, or any idea that the variation in a flower could be caused by something like a disease.

Narrator: TODAY, VIRUSES LIKE THE ONE THAT ONCE DROVE THE TULIP'S VALUE TO RECORD HEIGHTS ARE THE ENEMY OF THE GLOBAL TULIP TRADE, BECAUSE INFECTED BULBS CANNOT BE EXPORTED.

SO PLANT PHYSIOLOGISTS LIKE HENK GUDE ARE WORKING HARD TO COMBAT THEM.

<p>Henk Gude: A tulip that is infected with the virus, is not a healthy tulip. It costs lots of energy for the plant to cope with the, the virus. And if you replant the bulb year after year then its growing potential will, will decline over the years. So in, in, in a few years, you will not have a tulip left.</p>
<p>Narrator: GUDE WORKS FOR THE APPLIED PLANT RESEARCH CENTER AT WAGENINGEN UNIVERSITY IN THE NETHERLANDS.</p>
<p>Henk Gude: To find out if a plant is, is infected by a virus we have to, to, to homogenize it to, to squeeze juice from it, and we can detect the presence of the virus in the juice with lab techniques.</p> <p>When we understand how the plant grows we can try to make the plant do what we want it to do and immediately apply it for the benefit of growers and breeders and exporters.</p>
<p>Narrator: ONE OF THESE PEOPLE IS JAN LIGTHART, WHO HAS BEEN GROWING TULIPS FOR MORE THAN 30 YEARS, AND HAS BECOME ONE OF HOLLAND'S MOST SUCCESSFUL BREEDERS.</p>
<p>Jan Ligthart: What you see from here 'til there are all new seedlings. It's the first time I seen them flowering. I wanted to be a, a carpenter just like my father, working with wood. And when I saw the tulips, I was astonished. I said, 'ahh, that's what I want to be, tulip gardener.'</p>
<p>Narrator: LIGTHART'S FIRST STEP IN BREEDING A NEW VARIETY IS TO ACT LIKE A HUMAN BUMBLEBEE - MOVING POLLEN FROM ONE PLACE TO ANOTHER.</p>
<p>Jan Ligthart: The process is quite simple. We use one tulip as the father and the other just like the mother, and we make pollination.</p>
<p>Michael Pollan vo: The breeders of tulips today are interested in new combinations. They're sex-crazy, right? they're operating these, you know, plant brothels. And out of that comes a great deal of variation. And out of that variation is the future of the species.</p>
<p>Narrator: DABBING THE POLLEN TAKES JUST A FEW SECONDS.</p> <p>BUT IT CAN TAKE YEARS BEFORE LIGTHART CAN BE SURE THAT HIS NEW VARIETY WILL CONSISTENTLY PRODUCE FLOWERS WITH THE QUALITIES THE MARKET DEMANDS – LIKE DURABILITY, DISEASE RESISTANCE, AND BEAUTY.</p>
<p>Jan Ligthart: That's enough. One in a thousand seedlings are, are what I want. The rest is not good enough. That's the hardest part. You have to look out for that first, the only good one.</p>
<p>Narrator: THIS YEAR, LIGTHART IS PINNING HIS HOPES ON THE BULBS FROM ONE OF HIS LATEST BREEDING EXPERIMENTS.</p>

Jan Ligthart: This tulip that is my favorite. I give it a big future. Just the right color, pure pink. This one I started nine years ago with seeds.

When I saw this tulip blooming first for the first time in my seedlings, I was just amazed. I sat down on my knees. I looked at them for a long time. Other tulips you walk buy, and it doesn't meant you to, anything to you. And when you see this one, your heart gets (makes noise) that's, that's makes a difference. Each time I look at it, I fell in love on the tulip.

Narrator: BUT LIGTHART'S LOVE FOR HIS TULIPS DOESN'T STOP HIM AND HIS FAMILY FROM RIPPING THE FLOWERS OFF THEIR STALKS EVERY SPRING.

IF THEY DIDN'T, THE FLOWERS WOULD DIVERT NUTRIENTS FROM THE BULBS – WHICH FOR A BREEDER LIKE LIGTHART, ARE WHAT BRINGS IN THE MONEY.

Jan Ligthart: What I want to do for a tulip is to create a much bigger market for the whole world. Because a tulip must make money. It's a business. You can't have them for fun, uh, because you have to make a living.

Narrator: LIGTHART'S BEST TULIPS OFTEN GET INTRODUCED TO THE REST OF THE WORLD HERE, AT THE KEUKENHOF GARDENS NEAR AMSTERDAM.

EVERY SPRING, HALF A MILLION VISITORS FLOCK HERE TO SEE THE FOUR AND A HALF MILLION BULBS THAT MAKE IT THE LARGEST TULIP GARDEN IN THE WORLD.

Michael Pollan vo: the Dutch have mastered the propagation of tulips and there are people in Holland making great fortunes off of tulips yet again, and it's not a bubble anymore – it's a mature industry.

Narrator: AND A VERY LUCRATIVE ONE... WHOSE BUSTLING NERVE CENTER PROVES JUST HOW HARD WE'RE WILLING TO WORK TO SPREAD FLOWERS AROUND THE WORLD.

ONE OUT OF EVERY THREE FLOWERS BOUGHT AND SOLD IN THE WORLD PASSES THROUGH HERE. THIS IS THE FLOWER AUCTION IN THE DUTCH TOWN OF AALSMEER.

Amy Stewart: You're not allowed on the auction floor because there are a million carts zipping around at alarmingly high speeds and it is like a sea of flowers, it's almost like watching paint being mixed on a palette, you know? You watch this line of yellow sunflowers snaking their way through this ocean of red tulips, and it's just dazzling in that way.

THE FLOOR OF THE FLOWER AUCTION COVERS AN AREA BIGGER THAN TWO HUNDRED FOOTBALL FIELDS – MAKING IT ONE OF THE LARGEST BUILDINGS ON THE PLANET.

SOME 19 MILLION FLOWERS FROM ALL OVER THE WORLD CHANGE HANDS HERE EVERY DAY. IT'S AN EXTRAORDINARILY COMPLEX SYSTEM WITH A VERY SIMPLE PURPOSE: TO MOVE FLOWERS FROM THE FIELD TO THE HOME AS QUICKLY AS POSSIBLE.

Adrienne Lansbergen: In flower business, three things are very important and that's being fast, being fast, and being fast because a flower that's fresh today will lose 15 percent of it's value tomorrow.

Amy Stewart: The minute you cut it, it starts to die. Uh, there is this race on to get it to market.

Narrator: ONCE THE DEAL IS STRUCK, THE PERISHABLE FLOWERS ARE RUSHED TO THE AMSTERDAM AIRPORT, AND FROM THERE, TO FLOWER SHOPS ALL OVER THE WORLD.

Amy Stewart: This incessant unrelenting movement of flowers and money doesn't let up for a second.

Narrator: ALL FOR A PRODUCT THAT HAS ABSOLUTELY NO PRACTICAL VALUE.

Michael Pollan: Flowers are exquisitely useless. They're this great froth or extravagance in our lives. But that there is a multi-billion dollar trade in these wonderfully useless, beautiful things is kind of great.

When you begin to look at the plant's point of view I suppose the greatest threat to your survival is people losing interest in you -- falling out of fashion. You know, the gillyflower or the pink -- you know, these were important Victorian flowers. I don't even know what they look like. So the flower has to -- has to keep us interested, and one of the ways a flower keeps us interested is changing -- the really ingenious ones are the ones that figure out ways to re-engage us every generation.

Narrator: IN THE PLANT WORLD, JUST LIKE OUR OWN, NOT EVERYONE CAN BE BEAUTIFUL.

OR SWEET.

BUT EVEN A LOWLY WEED CAN GET US TO WORK FOR IT – AND QUITE SLAVISHLY, AT THAT– IF IT’S CLEVER ENOUGH TO CASH IN ON A SKILL THAT EVERY PLANT IS BORN WITH:

ITS ABILITY TO MAKE CHEMICALS.

Michael Pollan: The genius of plants is really the arts of biochemistry, creating these really interesting, complicated, original molecules. Some are designed to produce flavors. Others are designed to produce great beauty. And then you've got this class of plants that is producing these molecules that incredibly, have the power to alter what goes on in the human mind.

Narrator: THIS PLANT – BY MAKING JUST SUCH A MOLECULE – HAS GOTTEN US TO SPREAD IT ALL OVER THE WORLD.

SCIENTISTS CALL IT CANNABIS. IT IS BETTER KNOWN AS MARIJUANA.

Michael Pollan: Cannabis recognized, metaphorically speaking, that this was its path to world domination. Produce more of this molecule, and there will be more marijuana plants given more habitat by this creature who likes what this molecule seems to do.

Narrator: AND BY TRYING TO FIGURE OUT JUST HOW THAT MOLECULE WORKS, SCIENTISTS STUMBLED ON AN AMAZING DISCOVERY ABOUT THE WORKINGS OF OUR BRAINS.

Michael Pollan: This plant has opened up this very fruitful path of inquiry into understanding how memory works, how consciousness works, how emotion works. We have unlocked this whole mechanism [170] 07:09:50 which we didn't know existed, and we would not know existed if not for this plant.

Andrew Weil: Human beings are born with an innate drive to experience other states of consciousness periodically. I think you can see this in young kids who begin spinning at early ages. Amusement park rides serve the same purpose. There's an endless stream of activities that, that can shift consciousness, everything from singing, dancing, having sex, jumping out of airplanes, uh, and, and drugs are clearly one way of getting these experiences.

Roger Nicoll: People like to have that altered consciousness. I'm not saying that's good, but it's, individuals seek it out.

Andrew Weil: Marijuana seems to have made an evolutionary decision long ago that it was going to throw its lot in with human beings. From the plant's point of view the psycho activity is an attractive characteristic, which has brought the plant great success. There's a lot more marijuana being grown today. And the reason is that humans like it and they like it because it gets them high.

<p>Narrator: BUT CANNABIS CAN ALSO GET THEM LOCKED UP.</p>
<p>Mark Kleiman: There are about 750,000 arrests a year for Cannabis possession, which makes it about third among all crimes. And so, you've got, 25 or 30,000 people behind bars at any one time for cannabis offenses.</p>
<p>Narrator: BUT MARIJUANA STILL ENTICES NEARLY 15 MILLION AMERICANS TO SMOKE IT EVERY MONTH.</p> <p>AND NEARLY A HUNDRED MILLION HAVE TRIED IT.</p> <p>TO KEEP UP WITH THAT DEMAND, CANNABIS GROWERS CATER TO THE PLANT'S EVERY WHIM...</p>
<p>Female grower: These are beautiful roots.</p>
<p>Male Grower: Yeah, look at that</p>
<p>Narrator: ...PAMPERING IT LIKE A SPOILED CHILD.</p>
<p>Male Grower: We do anything it tells us to. If the plant says it wants something, we listen and we give it to it. And that's the whole thing, listening carefully and we're listening all the time and observing all the time. We work for them.</p>
<p>Narrator: THIS MAN AND WOMAN LIVE IN A STATE WHERE GROWING MARIJUANA FOR MEDICAL USE IS LEGAL.</p> <p>WE AGREED TO CONCEAL THEIR IDENTITIES BECAUSE THEY STILL RISK PROSECUTION UNDER FEDERAL LAW.</p> <p>BUT WHATEVER THE LEGAL RISKS, THE HORTICULTURAL CHALLENGES THEY FACE WOULD BE FAMILIAR TO ANY FARMER OR GARDENER.</p>
<p>Female Grower: It's a daily effort. And there are things like, oh, did we over nutriate the water? Did we under nutriate the water? Everything has really tight parameters and we try to keep as tight as control as possible, but its, its a battle.</p>
<p>Male Grower: My associate is really the green thumb in this enterprise. And I've noticed that when she's not around for a couple of days, the plants know it. I mean, I'm not making that up. They literally know it. I mean, I, I almost hear them whispering, "where is she?"</p> <p>They don't do as well, you know. They don't seem as happy.</p>
<p>Narrator: STRANGE AS IT MAY SEEM, THESE CANNABIS GROWERS ARE PART OF A VERY LONG TRADITION.</p>
<p>Andrew Weil: In every culture and in every age of history, an enormous amount of human energy has gone into the production, distribution and consumption of psychoactive plants.</p>

David Lenson: The only society that we know of for whom there is no native intoxicant are the Inuits. And that's simply because nothing grows up there that they could use.

Andrew Weil: In almost every society, one or two or a small number of, of intoxicants are accepted. And not only accepted, but their use is actively promoted. And the rest are condemned. But, there's no agreement from culture to culture as to which are the good ones and which are the bad ones.

Michael Pollan: You have alcohol, which is an everyday drug used in our society, that has a taboo on it in Islamic society.

Narrator: AND THOUGH CANNABIS IS ILLEGAL IN MOST PLACES TODAY, MANY CULTURES THROUGHOUT HISTORY HAVE TOLERATED IT.

FROM THE TIME THE PLANT WAS FIRST DISCOVERED, IN INDIA AND CHINA THOUSANDS OF YEARS AGO, PEOPLE HAVE SEEN IT AS MORE THAN JUST AN INTOXICANT.

LONG BEFORE THE DISCOVERY OF ASPIRIN, CANNABIS WAS USED AS A MEDICAL TREATMENT, FOR RELIEVING PAIN.

Michael Pollan: Dealing with pain. You know it's a-a tremendous part of human life, and-and it was a bigger part before modern times. We all did physical labor. We didn't have many pain killers. We didn't have antibiotics, and a lot of intoxicants -- even if they don't diminish pain the way opium does, they take your mind off it, and that's very very important.

Narrator: IN NINETEENTH CENTURY AMERICA, CANNABIS WAS A POPULAR TREATMENT FOR CONDITIONS SUCH AS LABOR PAINS, ASTHMA, AND RHEUMATISM.

Michael Pollan: You could walk into any drugstore in America and buy tinctures of cannabis. Cannabis was included in all sorts of medical preparations. And it was legal!

Narrator: BUT EVERYTHING WOULD CHANGE IN THE TWENTIETH CENTURY, WHEN THE PLANT GOT ITS NEW NAME - MARIJUANA.

THE NAME CAME FROM MEXICO, WHERE CANNABIS WAS A POPULAR INTOXICANT. IN FACT, PANCHO VILLA'S REBEL ARMY SANG A MARCHING SONG ABOUT A COCKROACH WHO FUELED HIMSELF WITH MARIJUANA.

Music: La cucaracha, la cucaracha
Ya no puede caminar
Porque no tiene, porque no tiene
Marijuana que fumar.

Narrator: DURING THE 1920S, MANY MEXICANS IMMIGRATED TO THE UNITED STATES.

AND SOME BROUGHT THE CUSTOM OF MARIJUANA SMOKING WITH THEM.

Mark Kleiman: Cannabis was certainly more common, uh, among Mexican Americans, and to some extent, among African Americans, uh, in the '20s and '30s than it was among Whites.

Michael Pollan: I mean, you find it, you know, very popular in the music scene in New Orleans, very popular among African American musicians. The Jazz world was really soaked in cannabis

Narrator: THE GREAT LOUIS ARMSTRONG FELT MARIJUANA ENHANCED HIS ABILITY TO IMPROVISE.

Michael Pollan: Cannabis proposes this idea of time stopping, of being able to explore the present moment Forget the past, forget the future, just be there and see what you can come up with.

David Lenson: Even if it's a song you've played a million times before, it becomes new, strange, wonderful. You see new possibilities in it that weren't there before.

Narrator: IN THE 1960S, USE OF MARIJUANA SOARED. THE DRUG HAD BEEN ILLEGAL FOR MORE THAN TWENTY YEARS. BUT THAT DIDN'T STOP AN ENTIRE GENERATION FROM EMBRACING IT.

Michael Pollan: It was well suited to the spirit of that time. You know, every drug has its character. And, cannabis's character is not about being hyper and working really hard. It is a drug that makes you not want to strive. It's about kicking back, listening to music. So it just kind of fit the spirit of the '60s.

David Lenson: Marijuana seems to second the motion no matter what the motion is.

Narrator: TO MANY AMERICANS, THE FACT THAT MILLIONS OF YOUNG PEOPLE WERE SMOKING MARIJUANA THREATENED THE VERY FABRIC OF SOCIETY.

Newsman: Operation Intercept is designed to make it more difficult to bring marijuana into the country...

Narrator: THOSE FEARS PROMPTED THE GOVERNMENT TO TAKE ACTION. MOST OF THE MARIJUANA WAS COMING IN FROM MEXICO...AND THE PLANT SOON FOUND ITSELF UNDER ATTACK.

THE WEAPON: A TOXIC CHEMICAL CALLED PARAQUAT.

Michael Pollan: We have to remember that in the evolution of a species,

<p>everything counts as a factor of national selection including things like oh, the decision by the United States government in the '70s to pressure Mexico to spray herbicide on their pot fields.</p>
<p>Narrator: FROM 1975 TO 1983, MEXICAN PILOTS DOUSED THE COUNTRY'S CANNABIS FIELDS WITH THE POISON.</p>
<p>Michael Pollan: There was some concern that it would get into the product coming north, uh, if it was cut right after it was sprayed and that as people inhaled this, uh, it probably wasn't very good for you.</p>
<p>Newsman This is a drug testing lab in Palo Alto, California. The people here are receiving three hundred samples of marijuana a say from smokers who want to know if their pot is contaminated.</p>
<p>John Kotecki: People are extremely anxious about this problem and frankly I don't blame them.</p>
<p>Narrator: MEXICAN MARIJUANA BEGAN TO DEVELOP A VERY BAD NAME.</p>
<p>Michael Pollan: This had the unintended consequence of creating a domestic marijuana industry that hadn't really existed before.</p>
<p>Narrator: IT WAS CONCENTRATED IN CALIFORNIA, HAWAII, AND OTHER STATES WHOSE CLIMATE WAS FAVORABLE FOR THE TROPICAL PLANT.</p>
<p>Michael Pollan: Once this American marijuana agriculture got started, it was very, very successful and the government was kind of shocked to find one year that the total amount seized exceeded their estimate of the total size of the crop.</p> <p>And they realized, 'oh, I think we're missing something. There must be a lot more marijuana out there.' And indeed, there was all over the West Coast.</p>
<p>Narrator: THE GOVERNMENT DISPATCHED HELICOPTERS TO FIND THE FIELDS AND FORCE THE GROWERS OUT OF BUSINESS.</p>
<p>News Correspondent: When local and Federal agents raided this marijuana field in Northern California today, they found more than \$50,000 worth of marijuana ready to be harvested. A Task Force is waging an all out war against pot.</p>
<p>Michael Pollan: So with the rise of the drug war, in a way, you've got a threat to this plant, and, it's very interesting to see how the plant coped.</p>
<p>Narrator: CANNABIS – AS PLANTS SO OFTEN DO – FOUND A WAY NOT ONLY TO SURVIVE THE THREAT – BUT TO COME OUT AHEAD.</p>
<p>Michael Pollan: And what happened? Well, the growers and the plant adapted, they moved indoors. The problem of moving indoors is -- this is a 12-foot-tall plant. So what they needed were the genes of a shorter cannabis plant to breed with their tall plant.</p>
<p>Narrator: SO THE PIONEERS OF INDOOR GROWING CROSS-BRED THE TALL WARM-WEATHER SPECIES, CANNABIS SATIVA, WITH A LOW-GROWING MOUNTAIN SPECIES FOUND MOSTLY IN ASIA, CANNABIS INDICA.</p>

Michael Pollan: They brought together these two great strains in the marijuana family and created a plant that was short, fast, and strong.
David Lenson: The plant, which had once been a skinny little piece of ditch weed, is now a pampered, spectacularly good-looking multicolored, rich, resinous being. Hardly the species it was before at all. It's turned completely into something else.
Narrator: NURTURED BY CREATIVE INDOOR GARDENERS, CANNABIS IS NOW A FAR MORE POTENT PLANT THAN IT WAS A GENERATION AGO. THE KEY TO THAT TRANSFORMATION WAS STRIPPING AWAY THE RULE OF NATURE, AND REPLACING IT WITH OUR OWN.
Male Grower: It's an artificial environment—completely artificial. Everything about our natural world is unnatural. Everything.
Female Grower: It's really like a super plant...
Male Grower: In the natural world, the plants here would be 6 to 9 months from seed to harvest. That's just simply inefficient. You couldn't justify an operation with such a slow turnaround. So, instead of 6 to 9 months, in my world, these plants, uh, live their entire life cycle in 90 days.
Narrator: TO GET THEM TO DO THAT, THE PLANTS ARE SUBJECTED TO PRECISELY CONTROLLED AMOUNTS OF NUTRIENTS, WATER, AND LIGHT.
Michael Pollan: They are under lights that are blindingly bright, thousands of watts 24 hours a day. And these plants are just, like, soaking up this light. They love it. I mean, they're just bathing in light and growing so fast you can almost hear the creak of their cells as they stretch and divide.
Narrator: ALL THAT LIGHT GENERATES A TREMENDOUS AMOUNT OF HEAT.
Male Grower: If I didn't have air conditioning and air circulation and ventilation fans moving the heat out of that room, these plants would cook in a matter of hours. It's so complicated, we're not smart enough to do it. We have to have a full time electronic nanny watching the plants all the time. So these aren't normal plants. These are super, hybrid plants that are right on the edge at all time.

Narrator: IT'S NOT JUST A QUICKER HARVEST THE GROWERS ARE AFTER – BUT A BIGGER BUD AND A STRONGER HIGH.

TO ACHIEVE THAT, THEY INTERFERE WITH A NATURAL PROCESS. FEMALE MARIJUANA PLANTS PRODUCE A STICKY RESIN THAT CATCHES THE POLLEN THAT MALE PLANTS PRODUCE.

THAT RESIN IS HIGHLY PSYCHOACTIVE. TO TRICK THE FEMALES INTO MAKING MORE OF IT, THE GROWERS KEEP MALE PLANTS EXILED FROM THE GROW ROOM.

Male Grower: So in essence what you're seeing is extreme sexual frustration. This is room full of women who are looking for some guy to come by and give them some pollen so they can create seeds and they try harder and harder as time passes and the more unsuccessful they are, the more the production of the resins that is intended to attract pollen, increase. And that increases the psychoactive elements of the plant.

Michael Pollan: They are the best gardeners of my generation, I realized at a certain point. You know, that the best gardeners of my generation are not hybridizing roses, are not, you know working with orchids, they're working with this incredibly valuable, incredibly interesting plant called cannabis.

Female Grower: If this turns into anything good though, look at it, I mean this is how thick the stock is when it's just gone to bloom...

Male Grower: If you think about it, this thing's a weed. It's a weed! It's a weed that's worth, you know, in the open market, like six, seven thousand dollars a pound. Pretty good for a weed.

Narrator: BUT CANNABIS ONLY FETCHES THAT PRICE BECAUSE OF THAT ONE PARTICULAR MOLECULE IT MAKES THAT GETS PEOPLE HIGH.

ITS NAME IS THC – AND IT WAS DISCOVERED BACK IN 1964 IN A LAB IN JERUSALEM BY CHEMIST RAPHAEL MECHOULAM.

Raphael Mechoulam:

Cannabis had not been well investigated, which was strange, after all, it was being used legally, illegally, by millions of people. And yet we didn't know that much about it. So I thought it's a good idea to, uh, look at it again from a modern point of view.

Narrator: IN THE LAB, MECHOULAM AND HIS COLLEAGUES BROKE CANNABIS DOWN, AND ZEROED IN ON THE CHEMICAL COMPONENTS THAT MIGHT BE CAUSING ITS EFFECTS.

Raphael Mechoulam: We isolated about ten compounds. Surprisingly, uh, out of the ten compounds we isolated, only one, which now is known as Delta 9 Tetra Hydro Cannabinol, in short, THC, causes the well known high. We tested it in humans, many of my friends, and we see that the compound is effective as we expected it to be.

Narrator: THE IDENTIFICATION OF THC ANSWERED ONE QUESTION, BUT RAISED ANOTHER: JUST WHAT DID IT DO TO THE BRAIN?

Allyn Howlett: I had always assumed that people knew how marijuana worked. It surprised me actually when I began looking in the research literature that, that it was really clear that no one really knew how it worked.

Narrator: IN 1988, ALLYN (*ah-LYNN*) HOWLETT FOUND THE ANSWER.

SHE DISCOVERED THAT DEEP INSIDE THE BRAIN, THC MOLECULES ACTIVATE A PREVIOUSLY UNKNOWN NETWORK OF SPECIALIZED CHEMICAL RECEPTORS.

Roger Nicoll: So that was proof that there is a receptor protein in the brain that can bind to the, uh, THC, like a key in a lock.

Allyn Howlett: It was very exciting, because what that meant to us was we had a tool that could be used for studying. And other researchers could use it as well. and people could study where the receptor was in the brain.

Narrator: HOWLETT AND OTHER SCIENTISTS FOUND THE RECEPTORS IN THE HIPPOCAMPUS, WHICH FORMS MEMORIES; THE CEREBELLUM, WHICH CONTROLS MOVEMENT, AND THE FRONTAL CORTEX, WHERE WE THINK.

Michael Pollan: Here were these receptors that this chemical produced by a plant out in the world just so happened to have the precise combination to unlock. What an extraordinary thing that is. Is that why that receptor network existed, so that people could get high?

Allyn Howlett: We don't have those receptors just so that people can get high smoking pot. Receptors are developed in neurons so that they can communicate with a chemical that the body makes.

Narrator: AND IN 1992, PROOF CAME THAT THE BRAIN *DOES* MAKE A COMPOUND VERY MUCH LIKE THC. IT WAS DISCOVERED BY NONE OTHER THAN RAPHAEL MECHOULAM, WHO NAMED IT ANANDAMIDE.

Roger Nicoll: We call it the brain's own marijuana, uh, because the compound that is made by the brain, anandamide, uh, shares all the properties in terms of, at the receptor level, and cellular level, that, uh, THC has.

Narrator: IT TURNS OUT THAT WHEN ANANDAMIDE IS RELEASED IN THE BRAIN, LIKE MARIJUANA, IT AFFECTS SUCH BASIC THINGS AS APPETITE, PAIN AND MEMORY.

AND IT PLAYS A CRITICAL ROLE IN A SOMETIMES UNDERAPPRECIATED MENTAL FUNCTION: FORGETTING.

Michael Pollan: When I first heard that, it didn't seem adaptive to me to have a drug for forgetting. Memory, we understand, has great survival utility. You know, you learn that that's a poisonous mushroom, or, that's a dangerous animal and you stay away and you remember that. But why would forgetting be adaptive and I asked Mechoulam this question. And he said, 'Well tell me. Do you really want to remember all the faces you saw on the subway this morning?'

Forgetting well, is almost as important as remembering well. Forgetting is about editing. It's about taking the flood, the ocean of sense information coming at you and forgetting everything but what's important. And so life is not just about accumulating new memories. Memory can cripple us, too.

You have soldiers returning from war zones that are traumatized by experiences that in effect, they can't unlearn. So if you could help them unlearn that, essentially a productive kind of forgetting, either with a drug or, uh, some other kind of regime, that would be incredibly useful.

Narrator: AND THAT'S EXACTLY WHAT ARON LICHTMAN IS TRYING TO DO. HE'S STUDYING HOW MICE REMEMBER... AND FORGET.

FIRST, HE TRAINS THEM TO FIND AN UNDERWATER PLATFORM.

Aron Lichtman: Mice are natural swimmers but they're looking for a way out. They swim all around the perimeter of the tank. They're swimming, swimming, swimming sometimes they bump into the platform by mistake and they climb onto it. Other times they never find it.

So at this point he's been at it for awhile... and the experimenter has to gently guide them to it or place them on the platform.

Narrator: THEN LICHTMAN TAKES THE PLATFORM. AWAY. A NORMAL MOUSE QUICKLY REALIZES THE PLATFORM IS GONE.

BUT A MOUSE WHOSE ANANDAMIDE RECEPTORS HAVE BEEN BLOCKED IS UNABLE TO FORGET.

Aron Lichtman: They don't learn to give up. They keep on looking for that platform even though it's gone.

Narrator: SCIENTISTS LIKE LICHTMAN HOPE THAT LEARNING HOW TO REGULATE ANANDAMIDE MAY ONE DAY LEAD TO TREATMENTS FOR PEOPLE WHO ARE HAUNTED BY THEIR MEMORIES.

Aron Lichtman: If they can elevate naturally occurring anandamide in humans

we might be able to then have whole new therapeutic targets to treat Post Traumatic Stress Syndrome.
Raphael Mechoulam: By using a plant that has been around for thousands of years, we discovered a new physiological system of immense importance. We wouldn't have been able to get there if we had not looked at the plant.
Michael Pollan: These plants are constantly undergoing this revision and this re-revision in our, in our cultural imagination, depending on what uses they're playing for us. Are they, demons or are they, you know, saviors? We see it with the apple, which went from evil to wholesome to evil. And we see it with marijuana, which also has had these periods of evil and this period of being celebrated, uh, by the counterculture.
Counterwoman: Is more uplifting or more relaxing for your body that you're after.
Customer: More uplifting
Narrator: ONE PLACE THAT'S WELL KNOWN FOR CELEBRATING CANNABIS IS AMSTERDAM. THOUGH MARIJUANA IS NOT <u>FULLY</u> LEGAL HERE, IT <u>CAN</u> BE LEGALLY SOLD AND SMOKED IN LICENSED COFFEE SHOPS – DRAWING TOURISTS FROM AROUND THE WORLD.
Customer: Fantastic, let's do that for ten. Wonderful.
Michael Pollan: You can walk down the street and, and catch the, a whiff of marijuana smoke coming out of bars, cafes, as they're called
Michael Pollan: And you can choose exactly what kind of experience you want,
Counterwoman: That's mild indica so it's more dreamy...
Customer: I think taste bud
Counterwoman: OK bye bye. Enjoy.
Michael Pollan: You look at the scene and you marvel at it. It is no different than people sitting around enjoying their glass of wine or cigarettes.
Narrator: AMSTERDAM EVEN HAS SPECIAL GARDEN SHOPS FOR CANNABIS GROWERS.
Counterman: Repot it into a bigger pot.
Customer: Yeah?
Tim A'Court: You put this one straight in the pot. You don't have to break it or...
Counterman: No just go straight in.
Narrator: ITS OWNER, TIM A'COURT, CAME HERE FROM NEW ZEALAND – WHERE HIS PASSION FOR GROWING CANNABIS HAD RUN HIM AFOUL OF THE LAW.

Tim A'Court: We sell everything for the home grower here, from the smallest setup to, to really large, setups. And included in that is, um, is as much of the, the high-tech stuff as we, as we can get. This one's a nutrient monitor these are obviously for two lights, for four lights, for six lights, eight lights, this goes right up to 100 lights if you so require. Beside that is a second timer, sometimes we need to have timers right down to the second.

This is a camera, and it's the same sort of camera that you would buy from the spy shop for spying on your wife or whatever. In this case we're spying on our crop and making sure people aren't coming in and out.

Michael Pollan: You can also buy seeds You can buy, you know, all female seeds of any given strain you want. They're out there in little six packs just like at your garden center buying, you know, selling petunias.

Tim A'Court: I don't think there would be plant on earth that comes near to the amount of equipment and technology available to grow it to its potential. It's more than just a hobby. It's a whole life's work, for some people, that is their whole life. They're so enthusiastic about their, their so-called hobby.

It's unexplainable. It's not just something about drugs or money. But there really is a deep fascination with the marijuana plant.

Michael Pollan: The way I see plants, they're just as advanced as we are, from an evolutionary point of view. While we were working on consciousness language, tool making, all these things we judge to be so wonderful and important, they were working on different tools and their tools are just as sophisticated as ours.

The fact that this plant, cannabis, for example can actually change the texture of consciousness is, you know, this is ingenious. We would not be the same if not for cannabis and cannabis is certainly very different for its relationship with us. It's one of the great winners in this, in this dance of domestication.

Narrator: LOOKING DOWN AT IT FROM THE AIR, YOU MIGHT NOT GUESS THAT SOUTHERN IDAHO IS A DESERT.

THE BIG GREEN CIRCLES ARE CROP FIELDS. THEY GET THEIR WATER FROM A VAST IRRIGATION SYSTEM OF UNDERGROUND PIPES AND GIANT SPRINKLERS.

THIS IS ONE OF THE MOST PRODUCTIVE FARM AREAS IN THE UNITED STATES...AND ONE OF THE PRINCIPAL SOURCES OF A FOOD CROP THAT FEEDS MILLIONS OF PEOPLE.
THE POTATO.

Michael Pollan: The desire, I think, that the potato has evolved to gratify in large part is our desire for control, control over our fate. It gives us that by providing an immense amount of food per acre. An individual, with half an acre of potatoes can grow enough food to keep himself alive or his family alive for a year. It's kind of extraordinary.

Mike Thornton: When you lift up the soil and you see these beautiful potatoes that are so nutritious growing underneath them it's just, it's really, you know, exciting to see how productive and how amazing this crop is, that it can take this little tiny plant and produce this great food.

Michael Pollan: The story that we've been telling so far is the story of the symbiotic relationship between humans and plants. Well, with the potato, we enter into a very new chapter in that relationship, the genetic modification of plants. For the first time, we are taking genes from one distant species and introducing it into another. That represents a real quantum change in our relationship to plants.

Narrator: OUR RELATIONSHIP TO THE POTATO BEGAN IN THE ANDES MOUNTAINS OF SOUTH AMERICA.

IN PLACES LIKE PISAC, IN PERU, PEOPLE HAVE LONG DEPENDED ON THE POTATO FOR SURVIVAL.

TO MAKE SURE THEY GROW ENOUGH POTATOES, THEY'VE DEVELOPED AN ASTONISHING DEGREE OF AGRICULTURAL CREATIVITY.

We reckon that there are more than 5,000 different potato varieties in the Andean region. There are tremendous combinations of colors as well as shapes. You find very elongated potato tubers that don't look potatoes at all. To very, very, strange with very different protuberances that look very, very strange to you.

Narrator: IT WAS IN THE ANDES THAT PEOPLE FIRST DOMESTICATED THE POTATO PLANT, AROUND EIGHT THOUSAND YEARS AGO. TO DO THAT THEY HAD TO OVERCOME A BIG OBSTACLE.

Michael Pollan: The potato in the wild is poisonous, you know, it's one of those crops that produces Solanine, which is an alkaloid which is poisonous. And in fact, potatoes still produce it, by the way if you allow your potato to get exposed to light and it turns green it's producing Solanine and you shouldn't eat it.

Narrator: BUT IN THE PLANT WORLD, THERE ARE ALWAYS EXCEPTIONS TO THE RULE.

GENES INEVITABLY MUTATE – AND PLANTS CHANGE.

Michael Pollan: People did a lot of trial and error tasting potatoes and spitting them out or getting sick. And then, eventually, you find one and go, 'hey, this one doesn't have that taste, maybe this one's all right.' And those would be the potatoes that we would save.

Narrator: OVER TIME, THE PERUVIANS ACHIEVED GREAT SUCCESS AS POTATO FARMERS – NOT BY TRYING TO CONTROL NATURE, BUT BY ADAPTING TO IT.

Michael Pollan: Whenever you're moving up in altitude you're having a radical change in climate. And one side of a hill will have a very different climate than another. How the early Peruvians dealt with that was to grow many different varieties of potatoes, and preserve the diversity so that on a plot of this kind of facing toward the sun at this kind of altitude you plant this one and on this plan, on the, just on the other side of the hill you plant this potato, and this was a way of gaining control over their fate,-because if something happened on that one plot at that altitude, they would still have other potatoes.

William Roca: The Andean region has so many niches for growing crops. And the potato was able to adapt to different areas, that's why there were so many varieties developed for different uses and different purposes along the Andes.

Narrator: FAUSTINO PACCO IS TWENTY-FOUR. HIS FAMILY HAS BEEN GROWING POTATOES HERE IN THE ANDES FOR HUNDREDS OF YEARS.

Faustino Pacco: There are many cultures that exist in Peru, we are one of many cultures. We are the potato culture. —It is our treasure—the richness that exists in our community.

Native Man: Now brothers and sisters I will blow these leaves toward the gods as an offering for our potatoes.

Native Woman: speaks in Quechua
With your spirit and your blessing we are gathering and harvesting these potatoes....

Faustino Pacco: The ritual of the potato harvest comes to us from ancestral times — and it is a custom that we practice to this day

Native Man 2: speaks in Quechua
Cheers my brothers cheers.

Group: speaks in Quechua

Faustino Pacco: Our communication is with Earth Mother because we live on this earth and depend on her for our subsistence.

THESE ANDEAN FARMERS ARE THE DESCENDANTS OF ONE OF THE GREAT CIVILIZATIONS OF HISTORY: THE INCAS.

THEY PRESIDED OVER ONE OF THE MOST SOPHISTICATED AGRICULTURAL SYSTEMS ON EARTH – BASED IN LARGE PART ON THE POTATO.

BUT WHEN THE SPANISH INVADED, IN THE SIXTEENTH CENTURY, THEY DESTROYED THE INCA EMPIRE – AND SET THE POTATO – AND OUR RELATIONSHIP WITH IT – ON A NEW PHASE OF ITS JOURNEY.

Michael Pollan: When the potato got to Europe, it changed the course of European history. Before the potato the northern tier of Europe, the population was relatively small and was held back by regular famines caused by failures of the grain harvest.

The further north you go, the dicier it is to grow wheat. And so the center of gravity in Europe, before the potato, was the Mediterranean, where you could grow grain more reliably. The potato did very well at the more northerly areas. It did very well in wetter areas, and it did very well in really poor soils.

So suddenly there was this vast new source of calories that could underwrite the growth of the population, such as never would have happened without the potato.

Since one individual can grow so much food, you need fewer people in the fields to support an urban population. So it's really hard to imagine the Industrial Revolution proceeding as it would without the potato to kind of support it. This new world food remade the old world.

Narrator: THE POTATO THRIVED IN THE SOILS OF NORTHERN EUROPE. MOST DRAMATICALLY IN IRELAND, A COUNTRY SORELY IN NEED OF A HEARTY FOOD.

Michael Pollan: For the Irish the potato initially was a Godsend.

Narrator: IRELAND'S POOR FARMLAND AND BAD WEATHER MADE IT A TOUGH PLACE TO GROW CROPS. BUT THE POTATO PLANT ACTUALLY PROSPERED IN THIS SOGGY ENVIRONMENT – AND SEEMED TO END THE COUNTRY'S LONG STRUGGLE WITH HUNGER.

Michael Pollan: And if you had potatoes and cow's milk, you had a complete diet. You had calories, obviously, and you had the full complement of vitamins. So they became very dependent on the potato and in fact the population grew. The problem was, however, that the Irish were planting almost exclusively one kind of potato, a potato they called the Lumper. And they planted the Lumper all over Ireland. So the Irish had really made themselves dependent on this one strain of potato.

And in 1845, some ship from South America was carrying a fungus, and it was a wind spread spore. It was a wind spread spore. And over the course of a very few weeks, the spore spread across all of Ireland and within days of infection the fields went black and the potatoes in the ground turned to mush.

Narrator: THE IRISH POTATO FAMINE LASTED FOR THREE YEARS. IN THE END, THE FAMINE KILLED ONE MILLION PEOPLE – ONE OUT OF EVERY EIGHT PEOPLE IN IRELAND.

Michael Pollan: So the Irish famine, is, in a way, the great cautionary tale, of putting all your eggs in one basket. And the great cautionary tale about monocultures of all kinds. It's a parable about the importance of biodiversity and the dangers of monoculture, and it's a parable we forget at our peril, but, in fact, we're in the process of forgetting today.

Narrator: AND WHAT'S MAKING US FORGET IS ONE OF OUR FAVORITE FOODS.

EACH YEAR, AMERICANS CONSUME ABOUT SEVEN AND-A-HALF BILLION POUNDS OF FRENCH FRIES.

THEY ARE THE MOST POPULAR FAST FOOD IN THE COUNTRY.

Michael Pollan: We love our French fries. We like them really long. McDonald's kind of pioneered that beautiful red box and the long French fries that have to be tall enough to kind of sprout out of the box like a little bouquet of potato flowers.

Narrator: AND TO MAKE THOSE LONG FRENCH FRIES, THE FAST FOOD INDUSTRY RELIES ALMOST EXCLUSIVELY ON ONE VARIETY OF POTATO:

THE RUSSET BURBANK.

Michael Pollan: And that's what McDonald's buys all over the world, because McDonald's wants people to have the same experience, the same beautiful golden McDonald's French fries, whether you're in Prague or London or Beijing or New York or Idaho.

Narrator: McDONALDS BUYS ITS FRENCH FRIES FROM POTATO PROCESSING COMPANIES LIKE THE J.R. SIMPLOT COMPANY.

THIS IS ONE OF ITS PLANTS, IN NAMPA, IDAHO.

Dale Baker: The potato we process the most is the Russet Burbank. The Russet Burbank gives us pretty much the ideal quality attributes if we're going to convert 'em into the product that our customer wants.

Michael Pollan: So you see how monocultures on the plate lead to monocultures on the land. And that desire for something like that perfect French fry has a whole, you know, carries a whole chain of consequences, all the way back to the farm.

Narrator: THIS IDAHO FARM – WHOSE FIELDS EXTEND FOR NEARLY A HUNDRED MILES – IS RUN BY RYAN CRANNEY AND HIS FAMILY.

Mike Cranney: How much to the right?

Ryan Cranney: I think you'll head about two-tenths...

Narrator: LIKE MOST IDAHO POTATO FARMERS, THE CRANNEYS SELL MOST OF THEIR CROP TO THE PROCESSING COMPANIES THAT MAKE FROZEN FRENCH FRIES.

Ryan Cranney: If you want to get 'em in before they get frozen then we need to keep diggin'.

Narrator: SO TO SATISFY THEIR CUSTOMERS, THE CRANNEYS GROW MOSTLY RUSSET BURBANKS.

Mike Cranney: That oughta make good French fries.

Ryan Cranney: I think there are other varieties that are easier to grow. But that's what the consumer demands is the Russet Burbank. And I'd be shot for suggesting otherwise.

Narrator: DESPITE THE DEMAND FOR RUSSET BURBANKS, THE BUSINESS OF GROWING THEM IS FAR FROM A SURE THING. EACH YEAR, CRANNEY AND HIS FAMILY HAVE TO SHELL OUT MILLIONS OF DOLLARS FOR WATER, SEED, FERTILIZER, CHEMICALS AND LABOR. BUT THEY HAVE LITTLE CONTROL OVER THE PRICE THEIR POTATOES WILL SELL FOR AT HARVEST TIME.

Ryan Cranney: It's very risky growing crops. We had some really huge losses, economically, here on the farm. I don't even like to think about it, how bad it was. A lot of the people in the community, farmers that we grew up with that had been here as long as we have, no longer have their operations. Many of us, the only way we could survive was to remortgage our farms and remortgage our land. And that's how we stayed in business.

You can only do, dip into the well for so long until the well goes dry. And many of us have been to that point.

Mike Cranney: Well, it's not too bad here 'cause you're running enough volume. They're flowin' pretty good.

Narrator: IN ADDITION TO THE ECONOMIC PERILS HE FACES, CRANNEY MUST CONTEND WITH BIOLOGICAL ADVERSARIES: THE INSECTS, FUNGI AND VIRUSES THAT PREY ON HIS PLANTS.

AND HIS RUSSET BURBANKS ARE ESPECIALLY VULNERABLE BECAUSE THEY ARE GROWN IN A MONOCULTURE, JUST LIKE THE LUMPER POTATOES WERE BACK IN IRELAND.

IF AN ENEMY CAN KILL ONE OF CRANNEY'S RUSSET BURBANKS, IT CAN KILL THEM ALL.

Ryan Cranney: Well, our role as a farmer is to, is to help the plant outcompete the different pests, whether that be weeds or whether it be insects or a fungus of some sort. It's a constant battle that we have to fight, fight those off and to protect against those. And it's a race to the finish line, and whether the pests win or whether the, the potato plant wins.

Narrator: TO HELP HIS POTATOES WIN THAT RACE, CRANNEY, LIKE THE GREAT MAJORITY OF LARGE-SCALE POTATO GROWERS IN THE UNITED STATES, USES CHEMICAL PESTICIDES. THE CHEMICALS THE CRANNEYS USE CAN BE TOXIC. BUT THEY FOLLOW EPA GUIDELINES THAT ESTABLISH LEVELS THAT ARE CONSIDERED SAFE TO USE.

Ryan Cranney: I don't necessarily like to apply the insecticides or any chemical of any sort. But it's something that needs to be done in order to keep the plants healthy.

Mike Cranney: You know, we don't use a chemical unless we need to. And it's kind of by prescription by field. So, you just don't go in and just blanket excessive amounts of, uh, chemicals and fungicides on. If the potato doesn't need any, we won't apply it. If it does we do. You know, we love our children too. And we don't want to put anything on the food that we eat any more to taint it for us, any more than you.

Michael Pollan: You know, the control of nature is expensive. To spray all those pesticides. To have 10 sprayings of fertilizer over the course of the season. To water.... To buy all that water and pump all that water, it's enormously expensive. So these, these farmers are really living on, on very thin margins and very little room for error. And, you know, it's easy for us to sit here and criticize them for spraying these chemicals on our food, but the fact is if they were to give up on a single spraying, they risk their livelihood.

Narrator: IN 1995, RYAN CRANNEY AND FARMERS LIKE HIM WELCOMED THE NEWS OF AN AGRICULTURAL BREAKTHROUGH THAT PROMISED TO CUT DOWN THEIR USE OF SPRAYS.

MONSANTO, THE WORLD'S BIGGEST BIOTECHNOLOGY COMPANY, CAME UP WITH A MUCH LESS TOXIC METHOD FOR KILLING ONE OF THE

POTATO'S MOST DEADLY ENEMIES:
THE COLORADO POTATO BEETLE, WHICH CAN PICK THE LEAVES OFF A PLANT VIRTUALLY OVERNIGHT.

Michael Thornton: Colorado Potato Beetle worldwide is probably the most serious insect pest in potatoes. We still estimate that, you know, out in the Western U.S., and probably across the U.S. as a whole, about 40 percent of the insecticides that were applied were applied for Colorado Potato Beetle control.

Narrator: MONSANTO'S INNOVATION WAS TO CREATE A NEW KIND OF POTATO, CALLED THE NEW LEAF POTATO. IT WAS THE FIRST POTATO TO BE GENETICALLY ENGINEERED – TO CONTAIN GENES FROM A DIFFERENT BIOLOGICAL SPECIES

Margaret Mellon: Genetic engineering is a radically new technology compared to traditional breeding. It allows us to move genes without regard to species' barriers. It allows us to move a gene from a butterfly, you know, into a corn plant. From a starfish into a wheat plant.

MONSANTO'S NEW LEAF POTATO USED A GENE FROM A COMMON SOIL BACTERIUM – ONE THAT MAKES A PROTEIN THAT KILLS POTATO BEETLES WITHOUT CAUSING HARM TO HUMANS.

THE BACTERIUM IS CALLED BACILLUS THURINGIENSIS, OR BT FOR SHORT.

TO HELP MARKET ITS BT POTATO, MONSANTO HIRED PLANT PHYSIOLOGIST MICHAEL THORNTON TO BE ONE OF ITS LIAISONS TO FARMERS IN IDAHO.

Michael Thornton: Monsanto was able to identify the gene in that bacterium, the B.T. gene that was responsible for production of that protein. And they could use a process to insert that gene into a potato variety, one that growers were already familiar with.

The Beetle eats that leaf and gets that B.T. protein inside it and it disrupts its digestive system. So then that eventually kills the Colorado Potato Beetle. I came from the standpoint that technology and new improvements were a good thing for the potato industry. So I was very excited to see something that was kind of a quantum leap in technology for the industry be introduced.

Michael Pollan: The promise here was that you could diminish spraying. You might pay a little bit more for these potatoes, but since they generated their own pesticide you could give up some of your sprayings. And this was very attractive to a lot of potato farmers.

Ryan Cranney: We were really excited about it and thought that it was really gonna take off.

Narrator: IN 1996, THE NEW LEAF POTATO BEGAN MAKING ITS WAY INTO FAST FOOD CHAINS AND SUPERMARKETS.

AS TIME WENT BY, MILLIONS OF PEOPLE WERE EATING THE GENETICALLY MODIFIED POTATOES. BUT HARDLY ANY OF THEM REALIZED IT. BECAUSE THE GOVERNMENT HAD RULED THE POTATOES DIDN'T NEED TO BE LABELED.

Michael Pollan: I realized as I did my reporting, I had eaten them already. I'd been in a McDonald's. I'd bought Frito Lay chips. And the thing I learned that I hadn't been aware of, because we hadn't been told, is that we Americans have been eating these potatoes already for a couple of years.

Michael Thornton: The potato was the same nutritionally, had the same level of vitamins, things like that. It just had this one additional gene that codes for a protein that makes up less than a tenth of one percent of the total protein in the plant.

And the decision by the Food and Drug Administration was that unless it's substantially different, unless there's a new toxin, unless you've changed the nutrient profile, it does not need to be labeled.

Michael Pollan: Now it seems to me that the potato never before produced this

pesticide, so to say that potatoes producing pesticide are substantially equivalent to potatoes that don't, uh, seems to involve a certain suspension of disbelief.
Crowd: Hey hey, ho ho, We don't want no GMOs
Narrator: IN THE LATE 1990S, AS THE NEW LEAF WAS MAKING INROADS INTO THE MARKET, THE ISSUE OF GENETICALLY MODIFIED ORGANISMS – OR GMO'S – WAS AROUSING INTENSE OPPOSITION ALL OVER THE WORLD.
Crowd: Hey hey, ho ho, We don't want no GMOs Hey hey, ho ho,
Concerned Dad: I want to know what's going on in my body and my daughter's body when they feed corn to, into us that's been genetically altered. They don't know. They can't tell you.
Chanter: What do we want?
Crowd: Safe food.
Chanter: When do we want it?
Crowd: Now!
Margaret Mellon: The Bt potato offers those farmers reduced costs. It doesn't offer consumers anything. And so a lot of consumers, if they were given a choice, might say 'Well it doesn't provide an advantage for me and therefore not knowing a whole lot about it, I might, uh, I might simply say no.'
Michael Pollan: I do know McDonald's was getting a certain number of calls and letters asking them, is it true that you are serving genetically modified potatoes?' This is a company, like many food companies, exquisitely sensitive to public opinion. And they probably saw a potential, public relations disaster. They didn't want to ruin Monsanto's business, but they very quietly told their suppliers that after the following year, they would no longer be taking them. And with that, the new leaf potato was over. That was it.
IN 2001, MONSANTO STOPPED SELLING THE NEW LEAF POTATO. IT HAD CAPTURED ONLY ABOUT FIVE PERCENT OF THE MARKET.
BOTH MCDONALD'S AND MONSANTO DECLINED TO BE INTERVIEWED FOR THIS PROGRAM.

Michael Thornton: I was very disappointed. To see this whole dream just kinda being shut down over a relatively short period of time seemed to me to be a, a tragedy.

Margaret Mellon: I don't think it was a tragedy. I think it was part of a very large debate about how our society ought to respond to the use of a radically new technology like genetic engineering in agriculture.

Narrator: BUT SINCE THE DEMISE OF THE BT POTATO, MONSANTO HAS BEEN VERY SUCCESSFUL SELLING OTHER GENETICALLY ENGINEERED CROPS...

...LIKE CORN...SOYBEANS... ...AND COTTON.

ENTOMOLOGIST BRUCE TABASHNIK HAS BEEN STUDYING THE BT COTTON CROP IN ARIZONA.

Bruce Tabashnik: We're in a special situation in Arizona right now, where about 98 percent of the cotton grown is BT cotton. It's being used as part of a program to eradicate, or at least greatly suppress, pink bollworm.

Narrator: THE BOLLWORM IS AS DANGEROUS TO THE COTTON CROP AS THE COLORADO BEETLE IS TO POTATOES.

Bruce Tabashnik: We have lots of damage inside the boll here. Uh, one or more caterpillars has been feeding on the seeds inside the boll, which is great for the insects but not good for the plant or for the farmer.

Narrator: TABASHNIK HAS BEEN INVESTIGATING ONE OF THE MAJOR CONCERNS ABOUT BT CROPS: THE DEGREE TO WHICH INSECTS EVOLVE RESISTANCE TO THE BUG-KILLING PROTEIN.

SOME OF HIS WORK IS PARTLY FUNDED BY MONSANTO, WHICH IS LEGALLY REQUIRED TO MONITOR BT RESISTANCE.

FOR YEARS, ORGANIC FARMERS HAVE CONTROLLED PESTS WITH A SPRAY FORM OF BT.

BUT NOW THAT BT HAS BEEN ENGINEERED INTO CROPS, EXPOSING INSECTS DAY IN AND DAY OUT, TABASHNIK HAS FOUND THAT THE BUGS ARE MORE LIKELY TO DEVELOP RESISTANCE.

Bruce Tabashnik: In the decades of use of BT sprays, there is only one insect that evolved resistance. On the other hand, after about a dozen years of BT crops, we already have three examples of insects that have evolved resistance.

Narrator: BUT TABASHNIK STILL THINKS GENETICALLY ENGINEERED CROPS DO MORE TO HELP THE ENVIRONMENT THAN TO HARM IT.

Bruce Tabashnik: I think that ultimately you can't be absolutely sure that no harm will come. But when you're using BT crops, the benefits are reduced insecticide use. The risks are much more difficult to quantify and much more uncertain.

Ryan Cranney: In my own mind, it seems like it makes sense that we could go to more genetically modified type plants, that would allow us not to apply these chemicals on the plants. And they would have a natural resistance to these insects. It seems like a logical way to go for man and I, I assume someday it will go there.

Narrator: BUT FOR FOOD CROPS LIKE THE POTATO, GENETIC ENGINEERING AND CHEMICAL PESTICIDES ARE NOT THE ONLY CHOICES.

Michael Pollan: You know, as long as you're growing monocultures, you sort of have to choose between lots of pesticides to keep 'em going or genetically modified crops to keep them going. But if you're willing to abandon monoculture, there are other ways to do it.

Narrator: MIKE HEATH, WHO GROWS POTATOES IN IDAHO JUST SIXTY MILES FROM THE CRANNEYS, IS AN ORGANIC FARMER.

Mike Heath: In a conventional system, you're trying to control, (laugh) you're, you're, you're trying to control nature. We're, we're trying to work with it, uh, as best we can.

Narrator: WHILE HIS NEIGHBORS DEVOTE MOST OF THEIR ACREAGE TO THE RUSSET BURBANK, HEATH IS MORE OF AN EQUAL OPPORTUNITY GROWER.

Mike Heath: We have 16 varieties all together this year. So we're pretty diversified. As far as I'm concerned, that's our main strength, is our diversification.

Narrator: HEATH GROWS NORKODAS...RED NORLANDS...ALL BLUES...AND ELBAS.

BY PLANTING LOTS OF DIFFERENT VARIETIES, AND CONTROLLING PESTS WITH NATURAL ENEMIES LIKE LADYBUGS, HE FARMS WITHOUT USING TOXIC CHEMICALS.

Mike Heath: The conventional farmers certainly know how to farm with chemicals. I, myself, if I had to go back to that, I, I would quit.

Narrator: HEATH'S LABOR COSTS ARE HIGH. HE DOESN'T CULTIVATE AS MANY ACRES, OR GROW AS MUCH FOOD, AS THE CRANNEYS.

BUT SINCE HE SPENDS NEXT TO NOTHING ON PESTICIDES, AND GETS GOOD PRICES FOR HIS ORGANIC POTATOES IN SPECIALTY MARKETS, HE USUALLY EARNS MORE MONEY PER ACRE.

Mike Heath: I used to be really pretty, pretty stupid, you know, as far as my neighbors were concerned. Pretty silly. But I have a lot more respect now than I did, 10 to 15 years ago. They can see that I'm still in business and we've got good markets and we grow a good product. And I'm proud to be an organic farmer.

Michael Pollan: So there, you know, there are other ways to skin a cat. And farmers are figuring it out. And they're figuring out how to grow food without pesticides. And the key, the key insight that you find in all the creative farmers who have solved this problem, is getting away from monoculture. The answer to the problems of monoculture is not new technologies, it's not band-aids, it's getting away from monoculture.

Margaret Mellon vo: I think if we could learn from the Peruvians, if we could step back and appreciate the diversity that they've given us in the potato and take advantage of it, in our agriculture that is the way forward.

Mike Thornton: I think some of the methods they've developed in Peru to use genetic diversity by planting a whole range of varieties within one field is a very good strategy. But I just don't see how we readily adapt that to a production system that not only has to feed people in the U.S., but feed a worldwide population with a product that's a certain quality.

Michael Pollan: The order we impose on nature is never more than temporary or illusory. In the end, the logic of nature will win out over the logic of capitalism, the logic of the factory, the logic of efficiency. It's always been so, and it always will be so.

Nature is stronger than any of our designs. And nature resists our control. For me the most important, lessons to take away from these tales, is that we are not simply standing outside the web of life. But that we are part of that web of life and that everything we do - what we chose to eat, what flowers to put on our tables, what drugs we chose to take - these are evolutionary votes we are casting every day. In many many different ways.

When we use these metaphors and we talk about plants having a strategy to this, or wanting this, or desiring this, we're being metaphorical obviously. I mean plants do not have consciousness. But this is a fault of our own vocabulary. We don't have a very good vocabulary to describe what other species do to us because we think we're the only species that really does anything.

But to the extent that you can put yourself in the place of these other species and look at the world from their point of view. I think it frees us from our sense of alienation from nature and we become members of the biotic community, one among many species. All of them together, creating this wondrous web that we call life...