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Lo and Behold, Reveries of the Connected World

By Werner Herzog

This is the campus of University
of California in Los Angeles.
Today, no one of the students is aware
that this is ground zero of
one of the biggest revolutions
we as humans are experiencing.
One of the science buildings here
is considered the
birthplace of the internet.
This picture of some of
the scientists involved
was taken at this very moment.
The corridors here look repulsive
and yet this one leads
to some sort of a shrine
reconstructed years later
when its importance had sunk in.
Let's enter this very special place.
We are now entering a sacred location.
It's the location where the internet began.
It's a holy place.
And we've just come back to 1969
when the critical events
of the origin began.
That machine over there is the first piece
of the internet equipment ever installed.
It's a mini computer,
which we now call a packet switch.
This is a...
military hardened machine.
You can't break it.
And it was meant to sustain itself,
unattended, for years at a time.
This particular machine
is so ugly on the inside,
it is beautiful.
It has a unique odor.
A delicious old odor
from all the old parts.
It consists of modems,
CPU logic units, memory,
power supply... all the things you need
to make an efficient computer work.
This machine served as the first

node of the internet for decades.
And it was from here
that the first message was sent.
A revolution began.
And the only record we have
of what happened that day
is in this log.
On October 29th, 1969 at 10:30 at night
we enter that we "talked
to Stanford Research Institute
host to host" computer to computer.
It's very much like when on Columbus' ship,
the fellow up on top who
first spotted land,
he noticed it was and he
basically made an entry
saying "we spotted land".
That document and this document have
at least the same equivalent importance.
Now what was that first message?
Many people don't know it.
All we wanted to do
was log in from our computer
to a computer 400 miles to the north,
up in Stanford Research Institute.
To log in you have to type "LOG"
and that machine is smart
enough to type the "IN".
Now to make sure this
was happening properly,
we had our programmer and the programmer
up north connected by a telephone handset
just to make sure it was going correctly.
So Charlie typed the L and he said
"You get the L?" Bill said,
"Yup, I got the L."
He typed the O. "Get the O?"
"Yup, I got the O".
He typed the G. "Get the G?"
Crash! The SRI computer crashed.
So the first message ever
on the internet was "Lo"
as in "Lo and Behold".
We couldn't have asked for a more succinct,

more powerful, more prophetic message than "Lo".

Well, I've been involved with the internet really since the very beginning.

Um, there are a number of things that would characterize that involvement.

One was I started out being the, essentially the system designer of the ARPANET, the very first packet net.

I joined DARPA in the early 1970s and started two other networking programs:

one a ground base packet radio net

like today's cellular

phones and a satellite net

on Intel's Dot4 based on packets.

And the internet was about

connecting them all together

and the essential elements there

were the protocols that

would make that possible

and the technology that would be needed

inside the net to enable these

different nets to work together.

Vint Cerf, here in 1973,

and Bob Kahn collaborating together

created the fundamental

protocol for the internet.

For this they received

some of the highest honors

our society can bestow.

Imagine, if you will,

sitting down to your morning coffee,

turning on your home computer

to read the day's newspaper.

Well, it's not as far

fetched as it may seem.

Seventeen stories up in his

fashionable North Beach apartment,

Richard Halloran is calling a local number

that will connect him with

a computer in Columbus, Ohio.

Meanwhile, across town in this

less than fashionable

cubby hole at The San Francisco Examiner

these editors are programming
today's copy of the paper
into that same Ohio computer.
When the telephone connection
between these two terminals
is made, the newest form of
electronic journalism
lights up Mr. Halloran's television
with just about everything
The Examiner prints in its regular edition.
Of the estimated two to three thousand
home computer owners in the Bay Area,
The Chronicle reports
over 500 have responded
by sending back coupons.
This report,
considering the numbers
of internet users today,
sounds already like pre-history.
No one at that time had a clue
about the explosion of
information technology.
Today if you would burn CDs
of the worldwide data
flow for one single day
and stack them up to a pile,
this pile would reach up to Mars and back.
The internet is already
permeating everything.
Even on the International Space Station
a phone call from one module to the next
goes via the internet.
But how do we keep it running?
How do we guard it?
I still have a copy of the phone directory
from the late 1970s of everybody
who was on the internet and it
was a document about that thick
and it had the name, address,
and telephone number of
every single person.
Actually it had it twice because it had it
once sorted by their email address
and once sorted by their actual name.

So if you had a problem with anybody, you could look them up, you could find them. You could find who the actual person was associated with that email address. And still today I thumb through that and a surprising fraction of the people I actually knew. For example, there were two other Danny's on the internet, and I knew them both. I still know them both. Of course now you can't even comprehend the idea of a directory that contains the name of everybody. Today, we couldn't know exactly, the directory might be some 72 miles thick. The capacity on the ith channel should be the traffic on the ith channel over the speed of the ith channel plus how much is left over, that's how much capacity is left over, and you split it according to the square root of the traffic on that channel over the summation of the square root over all channels. The way the internet works, there's no fixed route that a message takes. In the early days of the protocol there was a kind of a bug and one of the computers actually had a hardware failure that made it believe that it could get a message to some place in negative time. So, of course, every message in the internet did better by sending it through that computer because it subtracted the time net required to send the message. And so all the messages in the internet started getting sent through that computer, which of course got slower and slower and slower.

So the internet kind of started to grind to a halt. The mean response time now will look like this. It will be equal to the average path length times the summation of the square root of the traffic on the J channel over the sum of all traffics summed over all channels squared over $uc (1 - \bar{\rho})$. Whatever that equation means, it tells you what the minimum response time will be for a network once it's optimized. The computer was claiming that it could deliver the message before you even sent it. So if you had a post office like that of course you would use it, right? This was a simplified but exact model at the time. Now we have other aspects of it. But it's basically the underlying principles of the network, and one of the things we found, surprisingly, was that the larger the network is the far more efficient it becomes. Like a gambling casino that certainly makes money if you have millions of gamblers at the slot machines? Very much so. You've articulated what we call the law of large numbers. The law of large numbers says that a large population of unpredictable players, or messages, collectively behaves in a very predictable fashion, a fashion we can write down exactly. And therefore we can predict the performance of a network when its large. The underlying technology has scaled by a factor of a million in computational speed,

in bandwidth of communications,
in storage capacity and it
may go for another decade
to a factor of a billion
or even a trillion.
Nothing in the history of
mankind has ever worked
as a technological contribution
over that span of growth.
Back to the very early times,
times of speculative concepts
of a connected world...
in the early 60s,
many years before the first
Apple personal computer,
a young thinker, Ted Nelson,
had his own ideas about
creating a computer network.
The web as we know it
took a different route,
but Nelson's ideas are still dormant.
It was an experience
of water and interconnection.
I was with my grandparents
in a rowboat in Chicago,
so I must have been five years old
and I was trailing my hand in the water.
And I thought about how the water
was moving around my fingers,
opening on one side and
closing on the other,
and that changing system of relationships
where everything was kind of similar,
kind of the same and yet different.
That was so difficult to
visualize and express,
and just generalizing that
to the entire universe that
the world is a system
of ever changing
relationships and structures
struck me as...
a vast truth... which it is!
And...

so interconnection and
expressing that interconnection
has been the center of all my thinking,
and all my computer work
has been about expressing and representing
and showing interconnection
among writings especially.
And writing is the process of reducing
a tapestry of interconnection
to a narrow sequence.
And this is in a sense illicit.
This is a wrongful compression
of what should spread out.
And today's computers they've betrayed that
because there's no system for decent
cut and paste and they've changed
the meaning of the words "cut and paste"
and pretended it was the same thing.
So a guy named Larry Tesler,
whom I consider to be a good friend,
nevertheless changed those words
and I consider that to be a crime against
humanity and he doesn't understand why.
Because humanity has no
decent writing tools.
In any case, this is the problem:
interconnection and representation
and sequentialization all...
similar to the issue of water.
So here we have a parallel presentation
that shows the quotation
connected to its original context.
"In the beginning God created
the heaven and the earth"
and where is that from?
That is from the King James Bible.
So we can step down to the next quotation.
"Adam and Lilith immediately
began to fight"
and that is from the Alphabet of ben Sira.
And so as we pull back we
can see successive pages
coming up to connect with their sources
or with their linked contents.

His vision of links never materialized.
By some he was labeled
insane for clinging on.
There are two contradictory slogans.
One is that continuing to do the same thing
and expecting a different result
is the definition of insanity.
On the other hand, if at
first you don't succeed,
try, try again.
I prefer the latter because I don't want
to be remembered as the guy who didn't.
No, to us you appear to be
the only one around
who is clinically sane.
No one has ever said that before.
Usually I hear the opposite.
Thank you very much for talking with us.
It was wonderful.
Marvelous.
What a team.
Yes, now it's your turn.
Today the sheer numbers
of unpredictable players on the internet
has led to some of its greatest glories.
Fundamental research into cancer, AIDS,
and other diseases,
has been slowed down by a complex problem
which has to do with
the intricate folding of molecules.
Scientists using super computers
could not solve it.
Adrien Treuille was one of the creators
of a video game calling upon the community
of video gamers out there in the world.
Here we can see an RNA molecule
folded up into
this beautiful helical pattern,
it forms a helix,
and the amazing thing is that this pattern
is formed out of very, very simple rules
which pull it together
and create this shape.
And so it's a little bit like...

you can think of your hands
as there are simple rules
which determine how it can bend,
and then there are certain ways
in which it loves to come together
to form a compact shape
and that's just what these molecules
are doing in the body.
And your shirts, for example,
you are into shirt folding?
These molecules
fold up in much the same way
that a shirt folds.
You can imagine it starts
completely unfolded
and not at all suitable
to put in your drawer,
but if you follow very, very simple rules
it becomes this beautiful package
that you can then store and show.
We took the latest scientific models
of a biomolecule folding
and we created a game
and we put it on the web without
knowing what would happen
and without knowing if
it would be fun at all,
if anyone would come, and...
instantly people arrived
and they broke down the computers.
We had to build new computers.
And they played and they
spoke with one another
and they taught one another
about the science as non-experts,
and they began reading papers and they
began studying and understanding.
We have lawyers, we have school kids,
we have retired people,
we have bedridden people,
we have grandmas.
It's really everyone
from age 10 to age 100.
This idea was impossible

before the internet and
the response was stunning.
Within days, hundreds
of thousands joined in
and they solved the puzzle.
The world responded,
and it was beautiful.
And here is where you'd
design a new molecule
and in many ways we tried to...
subliminally, you might say,
help the players understand
and inhabit the world of the molecule.
So we placed the whole game in this water
and we put all of these little bubbles
in the background,
but they're part of the
story of what's happening.
Each molecule has its own sound,
and these sounds are specifically designed
so that when the molecule is well-folded
they form harmonies.
And if something doesn't fit together
it will form a dissonance.
It's actually kind of
hard to make it do it.
These are real chemical results
of actual molecules that we,
players designed and we built them.
So we say, EteRNA
is played by humans but scored by nature.
In other words,
nature determines
who wins and who loses the game
and that's science.
The solutions of the video
gamers are not just fantasies.
They are verifiable
and can be synthesized in the lab.
Sebastian Thrun is also
reaching out into the world.
Originally he's become famous
with self-driving cars.
My dream is to go and

give every human being a chance
and the best way to do this is education.
So we built this little
company that we called Udacity
that offers education for free.
We have hundreds of thousands of students
staying with us at any given point in time.
We've been amazed how fast
our student base has grown.
There's a real thirst for education, like,
as the machines are becoming smarter
I think people want to become smarter.
People want to make a contribution
and it's harder and harder
to make a contribution today
and it'll be even harder in the future
so we've really got to go and do
something for ourselves
and the best thing we can
do I think is education.
In the very beginning of
my journey into education,
I had a chance to teach a class online
and teach a class at Stanford.
At Stanford you got 200 students.
I considered myself an
extremely great teacher
so I got a large class,
but online we got 160,000 students.
160 thousand.
And when we finally finished this class
we were able to stack
rank the Stanford students,
who are the most privileged
and most selected students,
with the students from the open world.
And the top 412 students,
they weren't at Stanford.
The best performing
Stanford student was number 413
out of a class of 200.
That kind of opened my eyes and I realized,
my god, for every great Stanford student
there is 412 amazingly great,

even better students in the world
that don't make it to Stanford.
Just before heading into
the mountain section
of the course, Stanley tracked down
and passed the crippled Highlander,
putting Stanford racing
team's Volkswagen Touareg
into the leader position and effectively
ending the Highlander's bid for glory.
As Stanley crosses the finish line,
the Stanford racing team
has made its way into the history books.
This was Sebastian Thrun's
moment of glory back in 2005.
Most of his competitors were a sorry sight.
History has already been made
as Highlander crosses the 8-mile mark,
further than any vehicle traveled
in the inaugural Grand Challenge.
20 more teams followed
the big three out of the gate,
all hoping to complete the
132-mile course in a winning time.
Team Dad, with its rotating cluster
of sensors, sped off the line,
making up ground and passing
team Axion in the process.
Team ENSCO's buggy style robot, Dexter,
also left the line with a full head of steam,
fiercely attacking the desert terrain.
Kat-5, the Ford Escape hybrid
from Louisiana's Gray team,
eased its way past the crowd,
and TerraMax, the 16-ton cargo hauler,
left the gate determined
to finish the course.
Autonomous cars are developing rapidly.
Today you don't see big radar installations
or tons of equipment.
So the primary objective
when we built this car
was to basically make it look very normal
on the outside and the inside.

The vehicle can send information about what it is seeing to the internet.

This can be useful to other vehicles on the road.

It can also download information about what is happening on the roads before it reaches an accident area or a traffic jam, for example.

So the internet will be decisive very soon?

The internet will play a very important role in this, yes.

Can you open it?

It must be packed with electronics.

- Show us.

- Yes.

So just like we humans have brains to basically process the incoming signals, we need to have computers, basically, which process all the signals from the lidars and the radars and the cameras.

I can't see anything.

It turns out there really is nothing to see.

It's a completely useable empty trunk space, but hidden behind...

under the... trunk,

is a set of computers.

There are four computers, each with four so called processing cores which is really equivalent to 16-piece personal computing machines which basically crunch all the data coming in from the sensors.

These dots that you see are basically reflections from laser beams from the laser lidar sensors on the car.

They emit light beams, hit obstacles, and they come back as reflections and they show up as dots.

It really sees a virtual world.

It literally sees a virtual world.

The big question basically is that does it understand the ethics of a human? Does it understand the values of human society? For example, our vehicle, what it would like to do basically is not hit anybody as the highest priority. And then if it has to hit something it would prefer to rather hit some thing than somebody, but what it really wants to do is basically not hit anything at all or anybody at all. But who is going to be liable in case of an accident? The on-board computer? Its designer? The GPS system? The internet? Or the driver who eats his breakfast? When a car makes a mistake and learns from it, that experience is instantaneously shared with all the other cars, so all the other cars learn from it as well. It's actually something that people can't do very well. So, if I make a mistake, which I've made many in driving, then I can commiserate and I can improve, but nobody else learns from it. When a self-driving car makes a mistake automatically all the other cars know about it, including all future unborn cars, will never make that same mistake again. Which means the ability for cars to develop an artificial intelligence is so much greater than the ability of people to keep up with them. Let me show you one of our robots. This robot essentially has four wheels and each of these wheels have these tiny rollers on them and what this allows this robot to do

is essentially it allows it to drive sideways as well as forwards, as well as turn, without having to do anything like parallel parking maneuvers. So that makes these robots extremely versatile in their motion. To kick the ball, what these robots have is a main kicker, which slides the length of the robot and kicks the ball forward. We also have a chip kicker, which can kick the ball upward and that makes the ball go up into the air. These robots are autonomous. Nobody steers them with a joystick. Once a defender is in place, it'll be a bit more challenging for this robot to score. RoboCup this year we have not let in a single goal, although we scored 48 goals in total against our opponents. So you are world champion? We are. We came first this year in the RoboCup international competition. The blue robots need to have an indirect free kick so they're figuring out how they should pass between themselves. Could this team eventually beat the real Brazilian football team? That is the goal of RoboCup. That is, by 2050 to have a team of soccer playing robots which can defeat the FIFA world champions. And we'll see it happen. I'm very hopeful that we'll actually get a team of robots which are competent enough and smart and intelligent enough to actually beat the world champions in 2050. Better than Messi, Ronaldo and Neymar?

It sounds difficult but we can get there.
We can get there.
We have a certain reverence for robot 8.
I mean, to us, saying robot 8 is equivalent
to someone saying Messi
or Ronaldo or something...
it's the same.
This here is robot 8.
It's very identifiable because
its pattern includes four
green dots on top and it's...
one of our favorites, actually.
Beautiful.
- Do you love it?
- Yes, we do.
We do love robot 8.
The day Nikki passed away
we were scheduled to see a psychiatrist.
She'd had some...
psychotic issues where she had
a brain tumor when she was very young
and it was time to do some research on her.
I think she was feeling nervous
that if she were to go to this appointment
she might get stuck in the hospital
because that had happened before.
And at some point
a couple hours before her appointment,
she left the house.
She took Christos' Porsche and drove away.
I saw all the police
and I started to walk down
the on-ramp and they stopped me
and they said I wasn't allowed down there.
And I asked if it was
my daughter in the car,
what car it was, and they
wouldn't give me any information.
And then a crane lifted up the car
and once it lifted up the car,
I realized it was the Porsche.
Adding to the tragedy,
the first responder took photos
of the nearly decapitated head of the girl

and emailed it to some friends.
Almost instantly the pictures
were out on the internet,
and hundreds of thousands,
possibly millions, clicked on them.
Hoping to avoid a new
wave of sick curiosity,
we are here not even showing
a picture of Nikki alive,
only a place in the house she liked.
Up until I saw the pictures on the internet
I had an image of Nikki...
as a perfect...
as a perfect face, perfect, uh...
condition.
The coroner told us,
the only thing the coroner told us
is that a portion of her thumb
had been severed in the accident
and that she had head trauma,
but they never gave us any detail.
So I always focused on the thumb.
I received emails with
the pictures attached
and it was a short time after the accident.
Um...
It was disguised. I didn't know
who the email came from,
and I opened it up.
And the bad ones were very, um... hateful,
very hateful... towards me,
towards Nikki, towards our family.
It said "Dead girl walking.
Woo hoo, daddy, I'm still alive".
- Woo hoo?
- Woo hoo.
Do you still feel the pain
when you received this?
Yes.
And it's never gonna leave you?
Never.
Some of the hate mail was
so unspeakably horrifying
that we cannot repeat it here.

We were told there was
nothing that could be done
because... there's no law in place for...
pictures of deceased people
because when they pass away,
their privacy rights go with them.
I didn't know such
depravity existed in humans,
and I think dogs treat their kind
better than humans treat their kind.
It's just... there is no dignity
or respect on the internet
because we're not held accountable.
Nobody's there to tell us not to.
I have always believed that the internet
is a manifestation of the antichrist,
of evil itself.
It is the spirit of evil.
And I feel like it's running through...
everybody on earth and it's...
claiming its victories
in those people that are also evil.
West Virginia,
the small town of Green Bank in Appalachia.
What you're seeing behind me
is a very large telescope,
a hundred meters in diameter,
but instead of picking up the light
as normal telescopes do,
it picks up the radio waves that
are coming from the universe,
from objects out there
as close as the planets
but as far as actually the Big Bang.
The telescope discovered the black hole
in our own galaxy, the Milky Way.
In the Visitor Center
you can roll your coins into a funnel,
which resembles a black hole.
Your coins indeed disappear irretrievably.
If there was a civilization like ours
on a nearby planet, we could
almost certainly pick up
some of their television stations perhaps,

some of their radar... who knows what.
This collecting area is
several acres in size
and it can pick up enormous signals
from an enormous distance,
but they've traveled so far
that they are so faint that
typically they contain a lot less energy
than the energy of a falling
snowflake settling on the ground.
The enemy of radio astronomy
is the natural radio signals
that we make on earth
either deliberately or accidentally.
Things like microwave
ovens can emit radiation
which can blind us to the signals
that are coming from the stars.
Cell phones are billions
of billions of times stronger
than the faint signals we're looking for.
Satellites, they beam straight down on us.

- Music stations?
- Music stations, yes.
- Playing Elvis?
- Playing Elvis.

We've managed to keep
cell phone transmissions out.
Your smart phones are dumb here;
they just do not work.
We really try to keep
wireless transmissions
of any kind suppressed
within about ten miles of the observatory.
For a long time we had a fleet
of Checker diesels
and these were the standard
New York City cabs
and they were precious to us
because they were the perfect
vehicle for radio astronomers.
These do not have spark plugs,
they don't make noise.
In the forest near the telescope

we met a modern day hermit.
So, see, I've finally gone high tech.
I've got a faucet installed.
It really makes a
difference, I have to say.
I became very ill
from radiation sickness in 1996
and I lost 50 pounds.
I nearly died three times
and I became reactive
to all the wireless radiation signals
when all the cell phones went up.
They went up in massive numbers in 1996
and I tried to do all kind of treatment,
I moved, I'd lost my career.
I was working as an architect in Honolulu.
I had to be separated
from my family and children
and finally I heard about this in 2011
and... as soon as I heard there was
a place with no cell towers,
I was here in 48 hours.
Sometimes if I have really bad
reactions to radiation,
I actually will sleep on the ground.
I feel better on the ground.
And there may be a science to this.
They say the ground emits 7.83 hertz
and it's the natural rhythm
for animals and humans.
I also sleep in my car,
which I instinctively did in the beginning
and I later learned that it acts
like a partial Faraday Cage.
The metal keeps out the radiation.
This place in Green Bank is wonderful.
It's not perfect but I can go outside.
I can see the trees, I can see the sky,
I can see the stars.
When I lived in the Faraday Cage,
I had to live in a box and I only left the
box when I wanted to go to the bathroom
or to use the shower, otherwise
I stayed in that box day and night.

- In a cage?
- In a Faraday Cage.

How long?

A couple years.

Several years.

I had a mattress and I didn't have a place to stand up.

I had to stay on the bed the entire time.

My husband went grocery shopping, he cooked the food, he would bring and serve me the food.

We'd open the door, he'd hand me the plate and I'd eat inside the Faraday Cage.

I've heard it also called as a super sense, that we just have this ability to, for whatever reason, feel these frequencies.

It's a very legitimate illness.

But at this point I don't consider it a gift.

I would give anything to give it back.

You're the refugee now?

I... Yes, I don't know what to call myself.

This is brand new

and I just want people

to know that this type of illness

and doctors... I really want them to hear that this is a legitimate illness.

Um, and it affects our lives tremendously, you have no idea.

When you go home today

after this interview,

you have the luxury of going home to your familiar surroundings.

You have that luxury to go back to your families.

I haven't had that in four and a half years.

I haven't had any stability.

And I just have to impress upon you how serious this is for those of us that are suffering.

And I'm extremely grateful that there is a location here

where I am no longer in pain.
Or whatever type of irreparable harm may be
being done to my body
will be either suspended
or temporarily arrested.
There's a lot more community
interaction in a place like this.
I think because of the absence
of cellular technology
and also because of the isolation
of a rural community
in such a beautiful place like this.
And, yes, I do play the fiddle
and the banjo at night.
My old lady gets mad at me
She gets hotter than ginger tea
She is good and she is bad
She can be the devil when she gets mad
Goin' up t' Cripple Creek, goin' on a run
Goin' up t' Cripple Creek, have a little fun
Raise my britches high to my knees
Wade in ol' Cripple Creek when I please
The state of Washington
across the continent,
in an idyllic forest not far from Seattle,
a rehab center for internet addiction
named Restart was established.
Well, there are so many
of these severe cases.
For instance in South Korea
there was the case of a couple
that had a young baby
and they were very much addicted to a game
that they went to play while
neglecting their child at home.
And this baby eventually starved to death
and they went to jail for this,
but it is because they
were hooked on a game
and ironically it was a game in which
they were taking care of
and nurturing in the game
a young girl,
but as they were doing that

their own child was starving to death.
Shortly after we opened Restart,
we got a call from a stepmom.
Her stepson was living with his grandmother
and had just had his leg amputated
because he'd developed
a thrombosis in his leg
from lack of movement.
So we know of cases, many cases happening
in Korea and China, people who are dying
at the computer because
they are playing for
40, 50, 60 hours at a time
and completely neglecting
their body's physical needs.
It is not uncommon
that in South Korea teenage
video gamers put on diapers.
This way they avoid losing
points by going to the bathroom.
Tom, you do not need
any further introduction.
This was great.
My lowest point came at the beginning
of this year.
New Year's Eve I had lost a job,
I was losing my girlfriend, my family,
my relations were very strained
and I tried to drink myself to death.
Suicide?
I was playing video games
16 hours a day, often drunk.
I watched porn a lot
and I just had given up.
I had no future, I had no will to live.
I was just waiting for
the timer to run out.
I was in my spring quarter in college
and I was doing nothing except
sleeping about six hours a day
and playing video games and absolutely
not attending any of my classes,
not doing any of my work
and lying to my parents about my progress.

So it was a lot of lying, manipulation,
isolation especially,
which are all common things for addicts
but mine were pretty much sleep
and you know, interact with my addiction.
Did you adopt certain characters
that became almost like you?
I'm not sure I'm comfortable
with that 'cause I'm still in the phase
where thinking too deeply
about my own intricacies
could set me off,
could really start that cravings
and start those withdrawal symptoms again.
I wanted very much to discuss
fictional characters with Chloe,
like the malevolent Druid Dwarf
or whoever these figures are,
but I had to desist.
The real danger to gaming is when...
you... or when I stopped
being present in the real world
more often than I was in the game world.
If...
If you get to the point where...
you're thinking about the game more
than you're thinking about real life...
what you're gonna do for food,
what you're gonna do the next day or two,
you're not thinking about
a relationship or a job or a career.
If you're thinking about the game...
it's a problem...
because eventually it'll get
in the way of everything real.
Our sun, the giver of life.
At the same time it is
hostile, destructive.
Protuberances unimaginable in size
are being hurled into the universe.
These flares may become the
undoing of modern civilization.
The best known historical example
of a very large solar flare

is an event called the Carrington event which happened in 1859. This was observed by an astronomer named Carrington who saw a patch of the sun as he was monitoring sun spots, grow brighter. In those days, the predominant form of technology was a telegraph, that was our main form of communication, and this very, very large flare that happened, that created a brightness change so great that Carrington could actually see it with his eye, which is very uncommon, actually induced currents in telegraph wires that created fires in the paper of the telegraph machines. There's even reports from that time of Aurora being seen as far south as the equator, and there being Auroras so bright at the Northern latitudes that it was possible to read by them at night. We've been fortunate that nothing as large as the Carrington Event has happened in these times of modern technology but even the smaller solar flare events that we do see do disrupt our communications and create outages in our power grid and disruptions for our satellites. What the fuck? New York City. What Hurricane Sandy caused here could happen on a worldwide scale and much worse. No electricity, no internet, no drinking water, no flushing of toilets,

no gas and no shopping.
All you could see was the outline
of the hospital against a darkened sky.
A lone flashlight up in one
of the hospital rooms there
as doctors and nurses rushed
from patient to patient.
Out front, ambulances.
These images from my iPhone
as we approach the hospital,
just one of the nearly
300 patients who were
one by one brought out and taken to safety.
What we got going on here is a complete
blackout in New York City, and um...
I'm on the third floor of Clear Channel
where Z100, KTU, Lite FM, Q,
we're all located on the third floor.
Every station is off the
air in New York City.
I don't think it's ever happened in the
history of broadcasting in New York.
It's like a Will Smith movie, man.
It's very weird. Very weird.
And I feel kind of helpless because
I'm glad I'm here and I'm safe,
but there's a lot of crap going on at home.
My neighbors tell me it's a big mess.
So I'm nervous about what I'm
gonna head home to tomorrow.
Wassup?
This is a control room.
Meet Lawrence Krauss.
As a cosmologist
he is studying the origins of our universe.
Much of his attention
has been focused on our planet.
If there's a solar flare...
if you destroyed the information
fabric of the world right now,
modern civilization would collapse.
Hundreds of millions of people will die.
Billions of people will die.
The world will become,

for people like you and me,
unimaginably ugly, difficult, and...
there's great likelihood
that I couldn't survive.
If the internet shuts down,
people will not remember how
they used to live before that.
I start to think of Maslow's
hierarchy of needs.
I mean, let's get back
to the base of the pyramid
and think about food and shelter.
You have food networks
that are hugely dependent
on being able to route digitally
what the needs are and where
and, through efficiencies created
when the network is working well,
you don't have warehouses near people
stocked to the brim with food.
If you disrupt those networks I imagine,
what do they say?
"Civilization is always about four
square meals away from utter ruin"?
That's something
that it wouldn't be bad to prepare for.
As we've thought about
an internet of things
where often for purely,
looked at at this moment,
unnecessary reasons,
we not only attach daily
objects to the internet
but make them reliant on
that internet connection
in order to function properly.
So the idea that our standard appliances
couldn't work without connectivity,
that we wouldn't be able to get...
to a restaurant that in turn would be able
to get to food and to organize staff...
I suspect, however,
that some individuals will survive.
Let us remember that we

come from a background where
at one point
there were less than a thousand
individuals alive,
probably down in the
southern part of Africa,
and we were a hair's breadth away
from disappearing as a species.
We have no control over
what the sun chooses to do.
We do know that there is a solar cycle,
so there are times of high activity
when there are many flares and
there are times of low activity
when there are relatively few.
Events like the Carrington Event appear to
be fairly uncommon but not non-existent,
they're not single isolated events.
We do see that flares are repeatable,
it's just that the large ones are
less common than the small ones.
So by observing other stars actually
we can get some idea
of how frequently these things happen
and it seems to be
every few hundred years or so.
So it's really a matter of time
before we have a large solar flare.
- Um, not a matter of...
- it's when.
Yes, not a matter "if"
we'll have a large solar flare.
Will we disappear as a species?
Again, Werner, I can't tell you
because I don't make predictions.
It would be...
unimaginably bad
and I prefer to not think
about it right now.
Las Vegas, Nevada.
One of the casinos is
preparing to host DefCon,
the annual convention
of the hacker community.

In less than two decades it has grown to 20,000 participants. At least a thousand of them will be FBI, the CIA, Chinese secret service, and other interested parties. We are about to meet Kevin Mitnick, a demigod among the community of hackers. Just mentioning his name here makes everyone fall silent in awe. Am I proud of being the world's most famous hacker? Um... It's a title that's kind of cool to have, but I had a lot of trials and tribulations to get to that point. A lot of bad things happened in my life, like, for example, going to a federal prison. So it's a title that was earned, but I took the hard road. When I was a federal fugitive I was really concerned obviously about getting arrested so what I did is I hacked into the cell phone company, one of the cell phone companies in Los Angeles, and through what we call metadata... It's interesting because nowadays with the revelations of Edward Snowden, he talked about metadata being very critical in the NSA's ability to track us and surveil us and the NSA says, oh, it's only metadata, it doesn't mean anything. Let me tell you how I was able to use metadata to track the FBI in the 1990s. I was able to hack into the cell phone company and I was able to identify the phone numbers that belonged to the FBI white collar crime squad in Los Angeles.

And I was able to look at their...
I couldn't get the contents of the call
but I could see who they called
and who called them
so I was able to get a lot of intelligence.
And then what I was able to do is,
through this device, I was
able to program this device
with all the FBI cell phone numbers
of the people that were
in charge of my investigation.
It would start sending me pager alerts
that the FBI cell phone is here,
you know, within a mile.
So what I did that night is
I took all my computer stuff:
my floppy disk, my CDs,
anything that's technology related...
I put it at a friend's house and then I went
to Winchell's Donuts and I got a big...
I think it was a 24 box
of, you know, donuts.
I took a Sharpie and
wrote "FBI Donuts" on the box,
I put it in the refrigerator and on a big
post-it note outside the refrigerator
you know the logo for
Intel says "Intel inside"?
I put "FBI donuts inside" and
stuck it on the refrigerator.
And it just so happens at 6:00 that morning
I wake up... And how I wake up is
I hear somebody jiggling the door.
The FBI knocks, they don't jiggle doors,
and I go "who is it?" just instinctively
because I thought someone
was trying to break in.
"FBI, open up! Open up!"
And they're looking for
anything electronic...
a computer, a cell phone,
and nothing's there.
And as soon as one of the guys
gets to the refrigerator...

he just goes... he goes "what the fuck?"
You know, he's pissed because they
obviously knew I knew they were coming,
so they were not happy.
I was arrested and I was in court
and I thought I was going home that day
and then this federal prosecutor
tells the judge
that we not only have to
hold Mr. Mitnick without bail
but we have to make sure
he can't get to a telephone.
And I was really paying
attention at this point,
and then the prosecutor
starts telling the judge
that if we let Mr. Mitnick
near a telephone,
he can dial up to NORAD, dial up the modem,
whistle into the phone and launch an ICBM.
Facing 400 years in prison
I had nothing to lose.
I ended up being held in federal prison
without bail in solitary
confinement for a year.
After his time in solitary,
Mitnick languished four more
years in federal prison.
Because the internet was designed
for a community that trusted each other
it didn't have a lot of protections in it.
Uh, we didn't worry about spying
on each other, for example.
We didn't worry about
somebody sending out to us spam
or bad emails or viruses because
such a person would have been,
you know, banned from the community.
It would be really nice when I got a message
if I knew where the message came from.
But the way that the protocols
of the internet work,
that's fundamentally impossible.
And so I kind of have

to look at the message and guess,
is this somebody pretending
to be somebody else.
We can design systems
that are really anonymous
or that are utterly identifiable
down to the person
and it's time for us to think about what
contexts we'd want to support what.
A system that is utterly identifiable
at all times is a nightmare.
It's exactly what we don't
want to hand a country
that doesn't embrace the rule of law...
ready made for them to
employ with their populace.
At the same time, a system that can provide
no accountability at all...
We have pockets of that online
and most people do not find that appealing.
In any frontier, before the law gets there,
there's always people seeking
to take advantage of the system.
I've seen in the United
States, for instance,
probably something like five
or six billion identities lost
but there aren't that
many people in the United States
which makes everyone a little
inured to it every time.
What does it really mean when they hear
their identity's been compromised?
It's not always an identity
compromising totality.
Sometimes it's just a small portion of it.
Your identity comprises many, many things.
There is one you and
there are many components
that represent you digitally.
Some compromises in that system have very
little impact on you, and some huge,
but the line between your physical life
and digital life is

becoming far more blurred
and there will come a point
where the threats online
will hamper your ability
to embrace new technology.
That's what my colleagues
and I have to push back.
Governments who can achieve
all the same effects they would
for international affairs
or foreign affairs
without having to rely on tools of war...
it's another tool at the table, right?
War is an extension of
politics by other means?
Well, now there's another
one with much less risk,
easier to fund, and it puts even some
smaller nation states on the same
playing field as larger ones.
So dozens of nation
states have an ability to hack others
and they use this as an extension
of foreign policy.
We became curious to look into
the biggest cyber attack known until today.
You were at the Sandia National Laboratory.
What sort of a company is
Sandia, can you explain?
Sure. Sandia National Laboratories
is a government research laboratory,
a Department of Energy Research laboratory
that does work in the national interests:
weapons work, there's
solar energy research,
micro machine research,
cyber security research,
those sorts of endeavors.
Nuclear weapons?
Nuclear weapons, yep.
It's part of the nuclear weapons complex
for stockpile stewardship along
with some of the other laboratories
just to ensure that the weapons

will function properly and...
as they age through the years.
So a wonderful target for cyber-attacks.
- It is.
- It can't get any better.
It's, uh, it has a big target on it, yes.
You stumbled over a problem?
A problem, yes.
Terrifying in scope, basically, you know,
hundreds of organizations...
military, defense, industrial based
compromised as far as their networks
and, you know, just...
people maintaining a
presence on the network
for the sole purpose of
siphoning off information of value.
But we know World Bank was affected,
NASA was affected, military was affected.
That's correct.
I just cannot talk about it. I'm sorry.
Alright, but...
we do know a name.
We do have a beautiful name: Titan Rain.
Mm hmm.
- Can you at least nod?
- Yes.
The scope of our conversation
was extremely reduced,
but some of the information here
became part of court proceedings.
The transcripts are public record,
including the name coined by the FBI.
You were not up at night in the office,
you were up at night at home?
Up at night at home, yes.
Lots of coffee?
Lots of coffee.
Lots of Nicorette.
And how rewarding is it to trail the enemy?
To find the track?
It's very rewarding.
It's like a puzzle,
finding patterns within chaos

that shouldn't be there
and finding these anomalies.
And once you scratch the surface,
you start to put together clues
and develop a better picture.
You can be certain that you're pursuing
a certain person or a certain entity
and it could just be a ghost.
Until you have some physical proof,
you have someone that kicks a door down
and sees that this is the person
that's actually behind the keyboard,
it can all be a myth or an illusion.
It could be, you know,
a layered sort of thing
or all at once, you know,
just to bring down power,
financial systems,
and just degrade, corrupt them.
Sometimes it's even worse, rather
than bringing it down you corrupt it
and undermine faith, let's say,
in the stock market.
Don't bring it down,
you start altering prices,
you start altering records,
and you delete them en masse
and just cause chaos
so the markets cannot even
restore and come up for days.
The possibilities of taking over spacecraft
and lowering the orbits of the spacecraft
so they burn up, and
vital GPS communications
and other sorts of communications are...
there's nothing there
to replace them anymore.
Could it be that we are
right now already in a cyber war
that we don't even notice?
Sure.
It doesn't matter how much money
a company invests in technology.
You can spend tens of thousands of dollars

on your firewall, on your
intrusion prevention systems
and your spam, on your anti-virus,
and if I could just manipulate one person
inside that company, I'm in.
95% of the work, when I used
to do this in the past,
is research and finding out about
the human element and gathering information
and emails and their personal
emails and the conference
that they were just at
and who spoke before them
and that person's email address
so I can send that person
a rigged PDF attachment
that may look perfectly normal and forge it
because I just spoke with
this guy so I'm gonna open it.
And nothing happens on my computer but in
the background a little Trojan is dropped
that starts communicating
that allows me access
and then I, you know,
gather more information.
I grab his contact book,
I find the people that know the information
that I'm interested in exploiting,
and then I send an email from him
with the same type of attachment
and eventually I have what I want.
People are the weakest link in security.
People. Not the technology.
Now through this special
TV offer you can receive
a Motorola flip phone with Cellular
One service for just pennies a day.
Now everyone can enjoy the freedom
of a personal cellular phone.
You can make a call anywhere...
Or get a call anytime.
So I'm living in Denver, Colorado,
incidentally I'm not living
under the name Kevin Mitnick,

I'm under the name of Eric Weiss.
Why Eric Weiss?
Because at the time I
was a federal fugitive
I was hiding from the FBI
and my idol was Harry Houdini
and that's Harry Houdini's real name,
so I thought I had a sense of humor.
So I call directory assistance,
I get the number to Motorola.
I'm now talking to the Vice President
for Research and Development
for all of Motorola Mobility
and I go "Hey, this is Rick over
at Arlington Heights"
because I found out they had
an Arlington Heights facility.
"I'm looking for the project manager
of the MicroTAC".
And the VP goes "Oh, that's Pam.
She works for me,
would you like her extension?"
I go "Sure, give it to me",
and he gives me the extension.
So my next call is to Pam
but I don't get her,
I get her outgoing greeting
on her voicemail and she told her callers
that she just left on a two week vacation,
the date she's returning, and if
you need any help whatsoever
please call Alicia
at extension blah, blah, blah.
So of course my next call is to Alicia
and she answers the phone
and I go "Hey, Alicia,
this is Rick over at Arlington Heights.
Did Pam leave on vacation yet?"
Of course, I already knew she had.
And she goes "Yes" and I go
"Well, before she left,
she said that you could help me get a copy
of the MicroTAC source code.
She said you would help me out".

About five minutes later she goes "I found the source code". You know, she gave me the release number and she goes "but there's a problem. Rick, I'm gonna have to talk to my security manager about what you're asking me to do. I'll be right back". And I go "No, wait, wait!" 'cause I didn't want her to talk to any security manager because obviously they'd figure out what's going on. About eight minutes later she comes back on the line. I'm nervous, thinking they hooked up a tape recorder and that's gonna be Exhibit A in the court case later. And she goes "Rick?" And I go "uh-huh?" and she goes "That IP address you gave me to do the file transfer is not inside Motorola's campus, it's outside, and because of that I can't transfer the file because we need to use a special proxy server to do so and I don't have an account". And I go "Uh-huh", you know and I just go "Alright, thank you very much" and she goes "Wait, wait, I have some great news for you". I go "what?" She goes "My security manager gave me his personal user name and password so I could log onto the proxy server to send you the file!" Motorola had a bunch of security, technical security, but it only took me 15 minutes with a good gift of gab to get the crown jewels. So that's how that worked. But you didn't sell it. It was curiosity.

- No.

- It was a sport.

Trophy.

This is Taurus, the concept that has evolved from the work of these teams of scientists and engineers. They believe the huge space colony could be built before the year 2000.

Constructed almost entirely from ore mined on the moon, the Taurus colony would become home for 10,000 people.

Ideas of creating colonies outside of planet Earth have been around for a long time.

The problem of water, air and shelter looks already solved. In fact, nothing looks inviting out there.

There is a private company, SpaceX, which is pursuing this idea in practical terms.

Here rockets are being assembled for the transport.

The founder of SpaceX, Elon Musk, is not just a dreamer.

He made his fortune with PayPal, he's building Tesla electric cars, and is now constructing the largest factory for batteries on this planet.

After setbacks, he's now successfully launching rockets.

For the first time in the history of Earth, in 4.5 billion years, the window of possibility is open for us to extend life to another planet.

To the best of our knowledge life exists only on Earth.

You know, there's a good argument that it exists elsewhere but we've seen no sign of it.

I think it's important for us to take advantage

of that window while it is open
and to establish life
on another planet in the solar system
just in case something
goes wrong with Earth.

Um...

And, uh...

You know, there could be either
a natural or manmade disaster
that knocks the technology level
below that where it's possible
to travel to another planet.

The key to establishing
a self-sustained large civilization
is getting the cost-per-unit-mass
low enough that there's
an intersection of sets:
the set of people that wish to move to Mars
and the set of people that can afford to
move to Mars inclusive of government aid.
I mean, right now we can't
even get one person to Mars.

- So, clearly...

- I would come along.

I wouldn't have a problem.

- One way ticket.

- That sounds great.

- I'd be your candidate.

- Okay.

I do think we'll want to...
offer round trips because
a lot more people would be willing to go
if they think that if they don't like it,
they can come back.

But how would we talk to them
who chose to stay?

Who would tell them the
outcome of the World Series?

Mars is actually a comparatively easy
internet thing to establish,
at least for local internet because
you wouldn't be living everywhere on Mars
so you'd really just need
maybe four satellites

to have global internet coverage
because of how sparse
the civilization would be on Mars.
And then some relay
satellites to get back to Earth.
Particularly when Mars
is on the other side of the sun,
you'd need to sort of bounce it
off a relay satellite,
you couldn't communicate directly with it.
The skyline of Chicago.
It looks devoid of its inhabitants.
We have to assume that nearly everyone
has left for a colony out there.
Are you lonesome tonight?
Do you miss me tonight?
Are you sorry we drifted apart?
Does your memory stray
To a brighter sunny day
The planetarium is the
only point of contact.
Inside, a monument for those
who have levitated and left.
Yes, things must be real good out there.
Do the chairs in your parlor
Seem empty and bare?
But then we met some
stragglers left behind.
They're all on their smartphones.
Have the monks stopped meditating?
Have they stopped praying?
They all seem to be tweeting.
Shall I come back again?
Tell me, dear, are you
lonesome tonight?
How could we communicate
with stars out there
that potentially have life?
Well, we can think of creating
a kind of long range internet
either through the use of radio waves
or perhaps visible light.
So these would be the kinds of signals
that we could generate in

the case of lower energy signals
like radio waves relatively cheaply
and we could broadcast,
if we came up with a suitable code
some way of transmitting information
over galactic and intergalactic distances.
But we would get an answer
back in 800,000 years?
Maybe 2.5 million years?
Well, I think that the more one looks for
planets in the universe
beyond our solar system
that are potentially places
that might be hospitable to life,
the more you appreciate
the wonderful planet
that we have here that
allows us to do things
like swim in an ocean,
breathe the air without
the help of our technology,
and so, while I would like us
to explore Mars more,
I think the only thing
that we've demonstrated is
that we're very good at
destroying the habitability of earth,
rather than improving the habitability
of a completely alien world.
The idea that Mars will somehow save us
from the decisions we've made
here is a false one.
And it's a little like saying that
you're going to go live
in the lifeboat when, you know,
even lifeboats need somewhere to land.
I don't think I have good dreams.
I'm sure I have good dreams sometimes,
but I don't seem to
remember the good dreams.
The ones that I remember
are the nightmares.
The Prussian war theoretician, Clausewitz,
Napoleonic times,

once famously said,
"sometimes war dreams of itself".
Could it be that the internet
starts to dream of itself?
Great question.
To think about dreaming,
there are maybe two aspects.
One is... what I'll call awareness,
when you wake up and you say
"I was just dreaming this" and you know it.
Another aspect is just...
some kind of pattern of
activity that emerges,
not because of some external stimuli
but just because of something going on
in unpredictable patterns.
I think already the internet
has the second of those,
has unpredictable patterns all the time.
They cause things like flash crashes
on the financial markets.
So we have plenty of kind of currents
running around in the internet
that are unpredictable,
in some cases unstoppable.
Imaginative?
Now it comes to what do
we mean by imaginative.
But if we mean...
We call a person imaginative
if they come up with ideas
that we didn't think of
and that we nevertheless admire.
If they can...
Usually admiration is part of it.
So for the internet, so far I think
it's mostly just unpredictable.
I haven't seen anything the internet
did on its own that I admire.
Does the internet dream of itself?
It does in the sense that it can beget
additional networks layered on top of it
that have the characteristics
of the underlying internet.

So just as the basic internet
is a series of computers
that happen to talk internet to each other
so that you can move
a bit from here to there,
there's a fellow named Sir Tim Berners-Lee
who could conceive of
something called the World Wide Web
and choose not to copyright it,
not to patent it, to allow
anybody to speak "server"
and some people speak "client"
and then before you know it,
you've got websites.
The web is the internet dreaming of itself.
Could it be that the internet
dreams of itself?
It's a fascinating idea.
In fact, there was a wonderful
science fiction story
which later got turned into a movie,
Blade Runner, and I think it was called
"Do Androids Dream of Electric Sheep?"
The robot's dream,
but the internet is
nothing but connections.
Will it have its own consciousness?
Will it have its own set of rules?
And perhaps...
on an even more scary realm,
a science fiction realm,
will the internet therefore make
its own decisions?
And will the decisions about
how communication happens
go out of human hands?
That's certainly a possibility.
But since we don't even
understand consciousness,
I am hesitant to make any predictions
and I think anyone who claims
they know what's going to happen to
the internet, is not worth listening to.
Pittsburgh.

The Industrial Age...
the steel mills are long gone.
A new industry has established itself.
Here robots are being designed.
This one, named Chimp
is testing its limbs on its own.
Soon battalions of them
connected via internet
could perform rescue missions
in disaster zones.
I think it's gonna run through
the lift joints momentarily.
We're still a long ways away from a robot
having a complete understanding
of the world, of cause and effect,
of desires and hopes and dreams,
and those are the things that
still make humans human
and robots on a much lesser scale.
Well, you could think of this scenario
almost as robot dreaming.
This is, you know, a robot
conceptualizing what is gonna
happen in the future
and thinking about different scenarios
and for any of these
motions it's considering
thousands and thousands
of scenarios per second
that might happen,
especially when you get to the point
of robots exchanging information
with one another,
then you might have a robot
dreaming about places
it hasn't even been.
This is the Chimp view of the world now
using a high resolution laser scanner
and it has to really build up its...
its learning of what's going on
in the environment.
In this case it's a valve
that it's trying to turn
and we see the pre-planning...

this is like the robot imagination
of what's gonna happen:
where the gripper is gonna be,
how it's gonna come into that valve,
and how it can manipulate it.
It could have opened the valve in
Fukushima and prevented an explosion?
That was one of the key things
that spurred this research...
realizing that it was
too dangerous for humans to go in
but if you could have had a robot
go in and just do some simple things,
straightforward things that
the humans were unable to do:
open valves to change
the cooling flow patterns,
maybe turn on pumps again.
That would have made all the difference
in preventing the hydrogen build-up
and the subsequent explosion.
How valuable is the cockroach for you?
I think any insect is amazingly, uh...
advanced, compared to the state
of the art robots right now.
If you think about a cockroach, the fact
that it can scurry around on the floor,
it can avoid dangers, it
can find food for itself,
it can reproduce,
and it can live for
several years on its own,
robots are nowhere near that point yet
and I think it'll be
great when we have even
as much capability as a cockroach.
I can not only imagine
artificial intelligence
evolving spontaneously on the internet
but I can't tell you it
hasn't happened already.
Because...
it wouldn't necessarily
reveal itself to us.

I think that the biggest risk is not that the AI will... develop a will of its own, but rather that it will follow the will of people that establish its utility function, its optimization function, and that optimization function, if it is... not well thought out, I mean even if it's relatively... if its intent is benign, it could have quite a bad outcome. For example, if you were... a hedge fund or a private equity fund and you said, well, all I want my AI to do is maximize the value of my portfolio, then... the AI could decide, well, the best way to do that is to short consumer stocks, go long defense stocks, and start a war. And that would obviously be quite bad. Such an attack would be much more prosaic than an invasion of these aliens in the SpaceX reception area. I think we're gonna get to the point where almost everything we do will be done by machines. And we'll still need people but if you ask the question about will there ever be... an artificial intelligent machine that makes movies? Absolutely yes. Will it be quite as good as yours? No one can even come close. Of course not. But actually I think almost everything we do, we find machines doing better, and the reason why that's the case is because machines learn faster

than people can learn.
But they cannot fall in love as we can.
And will it be useful for
machines to fall in love?
Would we want to have machines
that are just like people? I would say no.
Honestly, if a dishwasher
came to me and said
"look, I'm falling in love
with the refrigerator and,
as a result, I have no
time to wash the dishes".
I wouldn't like that dishwasher.
We're going to have a revolution
not only in our technology,
but in our theology.
We don't even have a name for it
but it's around the internet,
it's around connectivity,
it's around building
machines to think for us
and I think we're due for another shift
in our morals, in our....
in our definition of what
it means to be human.
We're right just at the beginning of that,
and so you can see us trying to kind of...
feel out and invent this new society
and invent these new ideas
of what's right and wrong.
What can we depend on each other for...
or what can we expect from each other?
How much do we want to do that?
So I think it's an incredibly creative time
in human history... not
just technologically
but also morally and culturally.
This room should know I'm here.
I should be able to talk to it.
It should be able to give
me an answer verbally.
I should ask where, for example,
is a high-speed printer?
Or where did I leave my keys?

Or where's a book on this subject?
And it should answer me with speech,
with a hologram, with a display,
in a very natural way.
I should maybe use gestures and touch,
and even smell and all my senses
to interact in a very humanistic way
with this technology around us.
And once that technology
comes out into our physical world
and becomes embedded in our walls,
in our desk, in our bodies,
in our fingernails, in our cars,
in our offices, in our homes,
it should disappear and become invisible.
Whereas electricity...
there's a socket in the wall,
you plug in, you get electricity.
You don't care how it's made.
It's not a complicated interface.
It's invisible.
The internet is yet to evolve to that goal
I was hoping for of being invisible.
What's interesting about the internet
is what you're gonna build
on top of it for you and for me.
I call it the internet of me.
It is a world where when you walk into a room
the lights dim to your preference level.
You may have music that starts up.
It may even have complex
protocols for having to interact
with somebody else's internet of me.
That's interesting,
and the world that will emerge as a result,
eventually you won't even need phones.
The environment will be so wired that
your experience will be brought to you.
Your calls will be brought to you,
your advertising, your
content, your work...
all of it will come with you.
That's an internet of me.
It is going to take a leap of thought,

a leap of courage... societally
for us to accept a generation
that's always had an egotistical world.
We tell children very often you have to
play with others, you have to share,
your worldview isn't unique.
But when the world, the objects in it
start to tell them that they are,
that they're different, that's egotistical.
But it will also be a magical world,
one where the wave of a
hand creates doors moving
and objects changing position.
Imagine a generation that's never known
anything else but that.
I deeply regret the fact
that deep critical thinking
and imaginative thinking,
that creative thinking is lost.
In my opinion, computers
and in some sense the internet
are the worst enemy
of deep critical thinking.
Youth of today are using machines
to basically replace
their examination
of the things they're observing.
They don't understand
what they're looking at
or what they're hearing
or what they're learning.
They depend upon the internet
to tell them and decipher it.
They look at numbers instead of ideas.
They fail to understand concepts,
and this is a problem.
My hope would be there
are still going to be
the appeal of deep immersion in something,
that through the school system
we still subject our kids to,
we can really to turn them onto its charms
so they become intrinsically
self-motivated to pursue it.

Whether we use science or ancient Greek
or philosophy,
it's those tools that are important.
Those are the things that people are
gonna be able to use in the future.
The actual information they learn in school
won't be important because it'll be dwarfed
by the information that's coming out
on the internet every single day.
Historians I think will also see
an interesting thing.
They'll probably call the time
around now the Digital Dark Age.
It will be very mysterious because
a lot of things happened quickly
but the records will all be lost.
We don't have the handwritten letters
like we have from, you know,
the founders of the Constitution,
The founding fathers.
We have their letters with each other.
We can see the sort of
background conversation
in creating the United States government.
We don't have the equivalent
for the background conversation
in creating the internet
because it was all done on email.
There's a playful project called
the Wikipedia Emergency Project
that if there's ever going to be possibly
a world changing event,
a big volcanic eruption,
Wikipedia volunteers are supposed to
start printing out Wikipedia pages madly
and storing the paper in places
that their heirs could find it later.
MWhat this scanner measures,
it's an MRI scanner,
and it measures magnetic resonance energy
that's emanating from the brain.
So it's really extra sensory.
It's precise enough to tell us
what activity is occurring

in each little volume element
the size of a peppercorn.
When you read a sentence that says
"There are two elephants
walking across the savanna"
a computer program can
tell that the same thought
is going on in your brain
whether you're watching the video
or reading the sentence.
At a conceptual level it's the same.
It's also the same for
people across languages.
There's a universality of
the alphabet of human thoughts
and it applies to the videos that Jack
Gallant and his colleagues have found
but also applies to
spoken and written speech
and it crosses languages.
We have a vocabulary,
the brain has a vocabulary
and we're beginning to discover it.
Right now we need this
two million dollar machine
that weighs 16,000 pounds,
but you ask, in the future
will some genius biophysicist
invent a little cap or
helmet that'll do it?
I think that that's likely.
The energy, the electromagnetic energy,
is just sitting there. It's sitting there.
So when you talk about telepathy...
telepathy is communication
across a distance.
Well, we can already go a few millimeters
and it's just a matter of time
before we can go thousands of miles.
You could essentially,
in the not too distant
future, tweet thoughts.
So not type your little
tweet, but think it,

press a button
and all your followers
could potentially read it.
Could you detect,
this woman who is passing by
and spots you, is just about
to fall in love with you?
Now that would be an innovation.
That would be the...
the killer application
I guess you would say.
Well, I try not to make predictions
about anything less than two trillion
years from now for good reasons.
One is that no one will be able
to know if I'm wrong.
But that's one of the wonderful things
about the future is you don't
know where it's gonna go.
And the internet is, like most
results in science, out of control.
And if you think about predictions
about the future as done in the past,
they always miss the important stuff.
In fact, most science fiction
missed the most important thing
about the present world,
which is the internet itself.
They had flying cars,
they had rocket ships.
None of that exists,
but the internet governs our lives today.
It used to be that when
you communicated with someone
the person you were communicating with
was as important as the information.
Now on the internet,
the person isn't important at all.
In fact it was developed so that
scientists could communicate
scientists like me could
communicate with each other
without knowing where the other person
was or even who the other person was.

There's a famous cartoon from
The New Yorker which says
"On the internet no one
knows if you're a dog".
And in the future you won't know
if you're communicating with dogs
or robots or people, and it won't matter.
But becoming your own filter
will be the challenge of the future.
Because the filter isn't provided with you.
There's no controls on the internet.
No matter what governments do
or no matter what industries do,
the internet is gonna propagate...
out of control
and people will have to
be their own controls.
I think in the future, one next step
from computation to communication
will be to sensing and remote sensing.
And mind reading via the internet?
One of those sensors will
be brain imaging sensors.
And you will transmit thoughts?
The two of you.
Will our children's children's children
need the companionship of humans
or will they have evolved in a world
where that's not important?
It sounds awful, doesn't it?
But maybe it'll be fine.
Maybe the companionship of robots,
maybe the companionship of an
intelligent internet will be sufficient.
Who am I to say?
I'm standin' on a corner shovel in my hand
I'm lookin' for a woman or a workin' man
Honey, let me be your salty dog
Oh, let me be your salty dog
I won't be your man at all
Honey, let me be your salty dog
Let me be your salty dog
I won't be your man at all
Honey, let me be your salty dog

Well, let me be your salty dog
I won't be your man at all
Honey, let me be your salty dog
I want you do some pickin'
'cause I like that.