

KURZWEIL INTERVIEW  
WXXI  
9/17/08

FROM WXXI NEWS, IT'S 1370 CONNECTION.

SMITH: I'M BOB SMITH AND MY GUEST THIS HOUR IS GOING TO GIVE YOU A LOOK INTO OUR FUTURE THE WAY WE MAY VERY WELL SHAPE IT AND SHAPE OURSELVES. AUTHOR AND FUTURIST RAY KURZWEIL IS THE INITIAL SPEAKER IN THE CAROLYN WERNER GANNETT LECTURE SERIES THIS YEAR AT RIT. YOU'RE GOING TO BE HEARING HIM AT FOUR LATER THIS AFTERNOON AT KURZWEIL FEST AT THE ENGLE AUDITORIUM ON THE RIT CAMPUS AND LATER TODAY AT 7PM ON THE TOPIC 'THE SINGULARITY IS NEAR: WHEN HUMANS TRANSCEND BIOLOGY' AT RIT'S GORDON FIELDHOUSE. BUT YOU HAVE THE OPPORTUNITY TO SPEAK WITH HIM RIGHT NOW. MR. KURZWEIL, THANK YOU FOR JOINING US, WE APPRECIATE IT.

KURZWEIL: GREAT TO BE WITH YOU.

SMITH: NOW WE FIRST HEARD FROM YOU BACK IN THE MID 1960'S. YOU WERE A TEENAGER AND CREATED A COMPUTER PROGRAM TO COMPOSE MUSIC WHICH WAS I GUESS AT THE TIME SHOCKING TO PEOPLE WHO DIDN'T EVEN THINK IT WAS POSSIBLE TO DO SOMETHING LIKE THAT WITH THE COMPUTING POWER WE HAD AT THE TIME. YOU REMEMBER BACK TO THOSE DAYS AND EVEN THE TIME WHEN THEY INVITED YOU TO APPEAR ON A TELEVISION SHOW TO DEMONSTRATE WHAT WAS, I GUESS, TREATED AS A CURIOSITY, EVEN THOUGH IT HAD THE PORTENDS OF SOMETHING REALLY INTERESTING AND SERIOUS.

KURZWEIL: THAT WAS STEVE ALLEN'S "I'VE GOT A SECRET" SHOW AND THAT WAS MY FIRST PROJECT IN PATTERN RECOGNITION, TEACHING COMPUTERS TO RECOGNIZE PATTERNS. I WOULD FEED IN MELODIES FROM FAMOUS COMPOSERS AND IT WOULD RECOGNIZE PATTERNS THAT DISTINGUISHED A CHOPIN MELODY FROM A MOZART MELODY FROM A RANDOM SEQUENCE OF NOTES AND THEN WE COMPOSED ORIGINAL MUSIC IN THE SAME STYLE AND IF IT CREATED SOMETHING SAY BASED ON CHOPIN, IT WAS RECOGNIZABLE AS A THIRD RATE STUDENT OF CHOPIN. THAT WON ME SOME SCIENCE PRIZES; I GOT TO MEET PRESIDENT JOHNSON, GO TO WASHINGTON SO IT WAS AN INTERESTING EPISODE.

SMITH: BUT IT HAD SOME REAL IMPACT, REPERCUSSIONS, FURTHER OUT BECAUSE OF WHAT YOU LEARNED FROM THAT TECHNOLOGY IN A SENSE THAT THAT LEADS YOU TO YOUR FIRST BREAKTHROUGH AS FAR AS RECOGNIZING CHARACTERS AND OPENING UP THE WORLD OF

LITERATURE AND READING TO PEOPLE WHO PHYSICALLY COULDN'T READ.

KURZWEIL: WELL THAT DID GET ME INTO PATTERN RECOGNITION, IN FACT I LOOKED RECENTLY AT MY PAPER ABOUT THAT AND IT TALKED ABOUT HOW PATTERN RECOGNITION WAS THE HEART OF HUMAN INTELLIGENCE AND THAT WAS WHAT WE REALLY NEEDED TO CRACK BECAUSE EVEN IN THE 1960'S, COMPUTERS COULD DO A GOOD JOB OF LOGICAL THINKING. I MEAN TODAY, FEW MATHEMATICIANS COULD HOLD UP TO A COMPUTER DOING MATHEMATICA AND SOLVING THEOREMS AND SO ON, BUT COMPUTERS STILL HAVE AN EDGE IN RECOGNIZING PATTERNS. THAT'S WHAT THE HUMAN BRAIN IS GOOD AT. SO THIS GOT ME INTO PATTERN RECOGNITION AND THEN IN THE 70'S I UNDERTOOK WHAT WAS THEN A CLASSICAL UNSOLVED PROBLEM WHICH IS RECOGNIZING PRINTED LETTERS AND ALL THE HUNDREDS OF DIFFERENT TYPE STYLES AND DEALING WITH PRINTING ERRORS AND DEVELOPED THE FIRST OMNI FONT, ANY TYPE STYLE OPTICAL CHARACTER RECOGNITION AND THEN PUT THAT TOGETHER INTO THE FIRST PRINT TO SPEECH READING MACHINE FOR THE BLIND, WHICH WE INTRODUCED IN 1976 AND THAT'S A GOOD EXAMPLE OF THE EXPONENTIAL PROGRESSION OF COMPUTER AND INFORMATION TECHNOLOGY WHICH IS A MAJOR THEME THAT I'LL TALK ABOUT TONIGHT BECAUSE THAT MACHINE WAS THE SIZE OF A WASHING MACHINE, IT COST \$50,000. WE NOW HAVE A MORE CAPABLE READING MACHINE IN A CELL PHONE, 5000 TIMES SMALLER AND A LOT LESS EXPENSIVE SO THAT'S TYPICAL OF THE PROGRESSION OF COMPUTER TECHNOLOGY. WHEN I WENT TO MIT LATER THAT SAME YEAR IN 1965, ALL OF OUR THOUSANDS OF STUDENTS AND PROFESSORS SHARED ONE COMPUTER, WHICH TOOK UP HALF THE BUILDING. THE COMPUTER IN YOUR CELL PHONE TODAY IS A MILLION TIMES SMALLER, A MILLION TIMES CHEAPER AND A THOUSAND TIMES MORE POWERFUL. THAT'S A BILLION FOLD INCREASE IN CAPABILITY FOR THE SAME COST AND PRICE PERFORMANCE OVER THE LAST 40 YEARS. AND WE'LL DO IT AGAIN: WE'LL MAKE ANOTHER BILLION FOLD INCREASE, IN CAPABILITY IN THE NEXT 25 YEARS. WE'VE SHRUNK THE SIZE OF THESE TECHNOLOGIES 100,000 FOLD IN 40 YEARS AND WE'LL DO THAT AGAIN IN 25 YEARS. SO WHAT NOW FITS IN A CELL PHONE WILL FIT IN A BLOOD CELL 25 YEARS FROM NOW.

SMITH: I CAN REMEMBER THAT LINE THAT DREW SOME LAUGHS AT THE TIME FROM 'STAR TREK: THE NEXT GENERATION', I THINK IT WAS A REMARK MADE BY COMMANDER REICHER ABOUT A PIECE OF COMPUTER EQUIPMENT. 'OH, 4TB CAPACITY?! A CHILD'S TOY!' NOW 4TB IS STILL A SUBSTANTIAL AMOUNT OF CAPACITY NOWADAYS, BUT IS IT GOING TO BE A CHILD'S TOY?

KURZWEIL: BUT IT'S NOT SO SUBSTANTIAL. I MEAN, WE HAVE TERABYTES THAT FIT IN A SMALL BRIEFCASE THAT USED TO REQUIRE A BUILDING. IN FACT, THERE WAS A HUGE ROOM SIZED DEVICE JUST TO STORE 5MB

IN THE LATE NINETEEN FIFTIES. COMPUTER TECHNOLOGY, AND THIS IS TRUE OF EVERY FORM OF INFORMATION TECHNOLOGY, NOT JUST COMPUTERS, DOUBLES IN POWER EVERY YEAR. AND PEOPLE DON'T THINK IN EXPONENTIAL TERMS AND THIS IS A KEY ISSUE. SO WHEN PEOPLE CONTEMPLATE THE FUTURE, THEY KIND OF LEAVE OUT THIS EXPONENTIAL AND THEY THINK LINEARLY AND IF YOU TAKE 30 STEPS LINEARLY, ONE, TWO, THREE, FOUR, FIVE, YOU GET TO 30. IF YOU TAKE 30 STEPS EXPONENTIALLY, WHICH REALLY DESCRIBES HOW THE INFORMATION TECHNOLOGY PROGRESS IS, TWO, FOUR, EIGHT, SIXTEEN, YOU GET TO A BILLION, IT'S QUITE A DIFFERENCE BETWEEN THE LINEAR AND THE EXPONENTIAL PERSPECTIVE. AND THAT'S WHY THE FUTURE TURNS OUT TO BE VERY SURPRISING AND I'VE MADE VERY ACCURATE PREDICTIONS BASED ON THIS EXPONENTIAL PROGRESSION FOR 30 YEARS. I SAW THE ARPANET, WHICH IS THE PREDECESSOR OF THE INTERNET, DOUBLING IN POWER EVERY YEAR IN THE EARLY EIGHTIES. I PREDICTED A WORLD WIDE WEB CONNECTING HUNDREDS OF MILLIONS OF PEOPLE EMERGING IN THE MID NINETEEN NINETIES. THAT WAS HEAVILY CRITICIZED AS RIDICULOUS AT THE TIME, BUT IT CAME RIGHT ON SCHEDULE.

SMITH: YOU WERE RIGHT ON TIME WITH THAT ONE. AND IT'S A WONDERFUL THING, BUT DO PEOPLE STILL FEEL A LITTLE BIT INTIMIDATED OR SCARED BY THIS EXPONENTIAL LEAP IN THE POWER THAT TECHNOLOGY GIVES US?

KURZWEIL: WHEN YOU DESCRIBE FUTURE SCENARIOS, PEOPLE SOMETIMES FIND IT DAUNTING. IT'S IMPORTANT TO REALIZE THAT WE'RE NOT GOING TO TAKE ONE LEAP, ONE UNTESTED LEAP FROM HERE TO THE FUTURE WORLD. WE DO IT THOUSANDS OF STEPS AT A TIME AND EACH STEP IS TESTED OUT, IT'S TESTED IN THE MARKETPLACE, AND IT'S A RELATIVELY BENIGN, AND BY THE TIME THESE THINGS HAPPEN THERE JUST PART OF REALITY AND PEOPLE TAKE FOR IT FOR GRANTED. WE'RE ADJUST VERY QUICKLY.

SMITH: IT IS, IN A SENSE, A WONDERFULLY EMPOWERING THING TO BE ABLE TO ACCESS SO MUCH INFORMATION FROM EVERYWHERE AND LEARN SO MUCH AND KNOW SO MUCH UNFILTERED AT THE SNAP OF A FINGER.

KURZWEIL: THAT'S RIGHT. YOU CAN TAKE A DEVICE OUT OF YOUR POCKET TODAY AND WITH A FEW KEYSTROKES ACCESS ALL OF HUMAN KNOWLEDGE AND THAT WAS NOT DONE EVEN FIVE OR SIX FOR YEARS

AGO. MOST PEOPLE DIDN'T USE SEARCH ENGINES AND THINK OF THE WORLD WITHOUT SEARCH ENGINES. THAT SOUNDS LIKE THE ANCIENT HISTORY FOR, BUT THAT WAS ONLY FIVE OR SIX YEARS AGO AND IT'S NOT JUST INFORMATION AND COMPUTERS, IT'S AFFECTING EVERY AREA THAT WE CARE ABOUT. FOR EXAMPLE, OUR HEALTH AND BIOLOGY AND LONGEVITY. THAT DID NOT USED TO BE AN INFORMATION TECHNOLOGY; HEALTH AND MEDICINE WAS HIT OR MISS. WE WOULD JUST FIND THINGS. 'OH, HERE'S SOMETHING THAT LOWERS BLOOD PRESSURE. WE DON'T REALLY KNOW WHY THIS WORKS, BUT IT SEEMS TO WORK.' AND WE WOULD LOOK FOR THINGS THAT WORKED WITHOUT ANY THEORY OF THEIR OPERATION. NOW HEALTH AND MEDICINE IS AN INFORMATION TECHNOLOGY. WE HAVE THIS SOFTWARE THAT RUNS IN OUR BODIES, THE 23,000 GENES, WHICH ARE LITTLE SOFTWARE PROGRAMS, THEY EVOLVED THOUSANDS OF YEARS AGO WHEN CONDITIONS WERE QUITE DIFFERENT. WE'D LIKE TO UPDATE THEM NOW, JUST LIKE WE UPDATE THE SOFTWARE IN OUR COMPUTERS AND WE HAVE TECHNOLOGIES THAT CAN DO THAT NOW. RNA INTERFERENCE CAN TURN GENES OFF, NEW FORMS OF GENE THERAPY CAN ADD NEW GENES, FOR WEEK AND DESIGNED AND SIMULATES BIOLOGICAL PROCESSES AND COMPUTERS. SO HEALTH AND MEDICINE IS NOW AN INFORMATION TECHNOLOGY AND EVEN THOUGH THIS IS IN AN EARLY STAGE, IT'S GOING TO DOUBLE IN POWER EVERY YEAR JUST LIKE EVERYTHING ELSE IN INFORMATION TECHNOLOGY, SO THAT MEANS THESE TECHNOLOGIES WILL BE A THOUSAND TIMES MORE CAPABLE IN TEN YEARS, A MILLION TIMES MORE CAPABLE IN TWENTY YEARS AND ACCORDING TO MY MODELS, FIFTEEN YEARS FROM NOW WE WILL BE ADDING MORE THAN A YEAR EVERY YEAR, NOT JUST TO INFANT LIFE EXPECTANCY, BUT TO YOUR REMAINING LIFE EXPECTANCY. SO THE SANDS OF TIME WILL START RUNNING IN RATHER THAN OUT.

SMITH: THIS GETS VERY INTERESTING AND I WANT TO TALK ABOUT IT IN A MOMENT. I WANT TO REMIND THE FIRST OF ALL FOR WE HAVE WITH US RAY KURZWEIL, WHO IS GOING TO BE SPEAKING THIS EVENING FOR ON 'THE SINGULARITY IS NEAR: WHEN HUMANS TRANSCENDED BIOLOGY', AT RIT. HE'S SPEAKING WITH US NOW HERE ON 1370 CONNECTION FROM WXXI AM AND FM HD2. I'M BOB SMITH AND WE GO TO THE PHONES AT 263 WXXI. 263 9994. OR WRITE TO US AND [ASKTALK@WXXI.ORG](mailto:ASKTALK@WXXI.ORG), OUR INTERNET MAIL BOX AND OUR LIVE LINES ARE OPEN ALL DURING THE SHOW. WE'RE GOING TO HEAR FROM BILL FIRST OF ALL, CALLING IN FROM THE CITY. HELL BILL, YOU'RE ON THE AIR.

BILL: GLAD TO BE HERE. WELL RAY, I WONDER, YOU HAVE THE MOST POWERFUL COMPUTER THAT'S BETWEEN YOUR SHOULDERS AND IT'S PORTABLE, AND IT HAS INVENTED ALL KINDS OF OTHER COMPUTERS, I WONDER WHEN WE'RE GOING TO GET LIKE NORWAY AND USE OUR CRYOGENIC GRID WE'VE DEVELOPED HERE. AND ALSO, ANOTHER

QUESTION, DENMARK'S ENERGY, IN 1974 THEY HAD 100% DEPENDENCE ON FOREIGN OIL; NOW THEY HAVE ZERO.

KURZWEIL: I WILL COMMENT ON ENERGY, BUT WHAT WAS YOUR FIRST QUESTION AGAIN?

BILL: ABOUT OUR CRYOGENIC GRID WE DEVELOPED HERE IN NEW YORK.

SMITH: CRYOGENIC?

BILL: ALBANY HAS IT. IT'S ALBANY OR A SMALL TOWN OUTSIDE OF ALBANY.

KURZWEIL: WHAT DOES IT DO?

BILL: WHEN DO YOU THINK IT WILL BE POWERING MOST OF OUR GRID?

KURZWEIL: LET ME SAY SOMETHING ABOUT ENERGY BECAUSE ACTUALLY I JUST HEADED UP A PANEL FINE ENERGY FOR THE NATIONAL ACADEMY OF ENGINEERING AND WE MADE, WE ISSUED A PLAN FOR WHAT WE SHOULD DO ABOUT ENERGY. WE NOTED THAT, AS IT IS WELL KNOWN, THAT FOSSIL FUEL COSTS ARE GOING UP. SOLAR COSTS ARE COMING DOWN, THEY'VE BEEN COMING DOWN STEADILY FOR A DECADE AND THE AMOUNT OF ENERGY THAT WE'RE GETTING OUT OF SOLAR IS SUBJECT TO AN EXPONENTIAL. IT'S DOUBLING, NOT EVERY YEAR, BUT EVERY TWO YEARS AND IT'S BEEN DOING THAT FOR TWENTY YEARS AND IT IS ONLY NINE DOUBLINGS AWAY FROM MEETING 100% OF OUR ENERGY NEEDS. AND WE HAVE PLENTY OF SUNLIGHT TO DO THAT WITH; WE HAVE 10,000 TIMES MORE THAN WE KNEW. IF WE CAPTURED ONE PART IN 10,000 OF THE SUNLIGHT THAT FALLS ON THE EARTH WE COULD MEET ALL OF OUR ENERGY NEEDS.

BILL: IN THE UNITED STATES THAT'S GETTING FROM HERE TO THERE; GETTING TO PLACES THAT ARE DARK WHERE IT'S NEEDED, LIKE HERE, FROM THE DESERT. TRUE?

KURZWEIL: WELL, ENERGY STORAGE IS ALSO IMPORTANT, BUT THIS IS BECOMING AN INFORMATION TECHNOLOGY JUST LIKE HEALTH AND MEDICINE IS BECOMING AN INFORMATION TECHNOLOGY BECAUSE WE'RE APPLYING NANO TECHNOLOGY, WHICH IS A FORM OF INFORMATION TECHNOLOGY, TO BE ABLE TO CREATE NEW MATERIALS AND DEVICES, LIKE SOLAR PANELS AND THE NEW GENERATION THAT IS EMERGING BASED ON NANO TECHNOLOGY IS MUCH MORE EFFICIENT THAN THE OLD GENERATION. TURN

BILL: I HOPE SO!

KURZWEIL: BUT IT HAS BEEN ACTUALLY DOUBLING FOR THE LAST TWENTY YEARS EVERY TWO YEARS AND IT'S EASY TO DISMISS THESE THINGS WHEN WE'RE AT AN EARLY POINT OF THE EXPONENTIAL, JUST LIKE THE GENOME PROJECT. HALFWAY THROUGH THE PROJECT WE HAD FINISHED 1% OF THE PROJECT AND PEOPLE SAID THIS ISN'T WORKING! BUT IN FACT IT HAD BEEN DOUBLING, LITTLE NUMBERS, AND IT ONLY NEEDED SEVEN MORE DOUBLINGS TO BE 100% OF THE GENOME AND THAT'S EXACTLY WHAT HAPPENED OVER THE NEXT SEVEN YEARS. WE WILL CONTINUE TO DO THAT IN THESE RENEWABLE FORMS OF ENERGY.

BILL: IF YOU CAN ANSWER MY QUESTION ABOUT HOW FAR AHEAD IN TIME DO YOU THINK WE WILL BE USING THE CRYOGENIC GRID?

SMITH: WHEN YOU SAY CRYOGENIC GRID, ARE YOU TALKING ABOUT SUPER COOLING THE CONDUCTOR SO IT WILL PASS ELECTRICITY MORE EFFICIENTLY?

BILL: PLUS THEY'VE BEEN TRYING TO GET HYDROGEN INTO IT TOO FOR ANOTHER FUEL.

KURZWEIL: I THINK THAT'S A PRETTY EXPENSIVE WAY TO GO. A BETTER WAY TO GO WILL BE TO GET SUPERCONDUCTING MATERIALS THAT CAN OPERATE AT ROOM TEMPERATURE.

BILL: AT ROOM TEMPERATURE THAT WOULD BE GREAT, BUT THAT'S IN THE FUTURE TOO.

SMITH: APPRECIATE THE CALL, BILL. 263 WXXI. WE HAVE RICH ON THE LINE FROM THE CITY. HELLO RICH, YOU'RE ON THE AIR.

RICH: HI RAY, HOW ARE YOU DOING?

KURZWEIL: GREAT.

RICH: THE QUESTION I WANT TO ASK IS THE CONVERGENCE OF THE SCIENCES: AS YOU KNOW, IT SEEMS THAT BIOLOGY, PSYCHOLOGY, THE BIOLOGICAL SCIENCES ARE CONVERGING INTO THE MORE PHYSICAL CHEMICAL AND PHYSICS, THOSE TWO SCIENCES AND IT SEEMS AS THAT THAT'S HAPPENING WE ARE MAKING GREAT ADVANCES BUT THERE SEEMS TO BE BECAUSE THEY'RE NOT, THERE SEEMS TO BE BECAUSE OF THE METAPHYSICAL WORLD PEOPLE SEEM TO BE RETARDING THAT CONVERGENCE BECAUSE WITH THAT CONVERGENCE THERE ARE QUESTIONS THAT ARE ASKED AND MAY BE ANSWERED THAT PEOPLE DON'T WANT ANSWERED. HOW DO WE STOP THAT RETARDING OF THAT

FROM HAPPENING BECAUSE I THINK WITH THAT CONVERGENCE COMES GREAT LEAPS AND BOUNDS IN KNOWLEDGE AND PROBLEM SOLVING.

KURZWEIL: YOU BRING UP A NUMBER OF INTERESTING QUESTIONS. ON THE ONE HAND, THERE IS CONVERGENCE IN TERMS OF FOR EXAMPLE APPLYING INFORMATION TECHNOLOGY TO UNDERSTANDING THE BRAIN AND THEN RECREATING THAT IN COMPUTERS, THAT'S A VERY IMPORTANT TREND, BUT WE'RE ALSO, THERE'S A TREND TOWARDS INCREASING SPECIALIZATION IN THE SCIENCES AND PEOPLE IN ONE FIELD DON'T TALK TO PEOPLE IN ANOTHER FIELD EVEN IF THEY HAVE RESULTS THAT WOULD BE APPLICABLE. SO WE NEED TO BUILD BRIDGES BETWEEN THE DIFFERENT DISCIPLINES AND THAT'S SOMETHING I'VE TRIED TO DO IN MY WRITING. A VERY IMPORTANT TREND IS IN FACT UNDERSTANDING THE HUMAN BRAIN IN PRECISE MATHEMATICAL TERMS AND THERE WE SEE AN EXPONENTIAL ALSO WITH DOUBLING THE SPATIAL RESOLUTION OF BRAIN SCANNING EVERY YEAR, WE'RE DOUBLING THE AMOUNT OF INFORMATION WE'RE GETTING ABOUT THE BRAIN AND WE'RE SHOWING THAT WE CAN ACTUALLY SIMULATE BRAIN REGIONS. I'LL TALK ABOUT THAT TONIGHT, BUT THE VISUAL CORTEX, THE AUDITORY CORTEX, THE CEREBELLUM WHERE WE DO OUR SKILL FORMATION HAVE ALL BEEN SIMULATED AND TESTED AND SO WE'RE MAKING RAPID GAINS IN UNDERSTANDING HOW THE BRAIN WORKS AND THIS WILL HAVE A NUMBER OF BENEFITS: GREATER INSIGHT INTO OURSELVES, WHICH HAS BEEN GOAL FOR THE ARTS AND SCIENCES FOR A MILLENNIA, BETTER MEANS OF FIXING THE BRAIN, BUT MOST IMPORTANTLY IN MY VIEW, THIS WILL BE THE SOURCE OF METHODS AND ALGORITHMS TO UNDERSTAND HOW TO CREATE INTELLIGENT MACHINES FOR BY BASICALLY EMULATING THE MOST INTELLIGENT SYSTEM WE KNOW ABOUT, THE HUMAN BRAIN.

RICH: ONE MORE QUESTION CONCERNING THAT. HOW ABOUT THE INTERFACE BETWEEN MIND AND COMPUTERS? WE ALWAYS TALK ABOUT INTERFACES IN THE SENSE OF KEYBOARDS, MICE BUT I THINK IT WILL BE GREAT LEAP FORWARD WHEN WE CONVERGE ON FOR THE PHYSICAL ATTRIBUTES OF THE BRAIN.

KURZWEIL: THAT'S A VERY GOOD POINT AND ONE OF THE THINGS I WILL TALK ABOUT TONIGHT AT RIT. WE ARE MERGING WITH OUR TECHNOLOGY. ALREADY THERE ARE PEOPLE WALKING AROUND WITH COMPUTERS IN THEIR BRAINS. IF YOU'RE A PARKINSON PATIENT YOU CAN HAVE A PEA SIZED COMPUTER THAT INTO YOUR BRAIN FOR THAT REPLACES SOME OF THE FUNCTIONALITY DESTROYED BY THE DISEASE AND THE LATEST GENERATION OF THIS FDA APPROVED NEURAL IMPLANT ALLOWS YOU TO DOWNLOAD NEW SOFTWARE FOR THE COMPUTER INSIDE YOUR BRAIN FROM OUTSIDE THE PATIENT. AND IF YOU LOOK AT WHAT WE CAN DO TODAY AND APPLY THIS BILLION FOLD INCREASE, WE

WILL SEE IN CAPABILITY OVER THE NEXT 25 YEARS, A 100,000 FOLD SHRINKING IN SIZE, THESE DEVICES WON'T BE PEA SIZED, THEY WILL BE BLOOD CELLS SIZED. WE WILL BE ABLE TO SEND INTELLIGENT COMPUTERS INSIDE OUR BRAINS, NON INVASIVELY, WITHOUT SURGERY, THROUGH THE BLOODSTREAM, THROUGH THE CAPILLARIES, DEVICES WILL INTERACT WITH OUR BIOLOGICAL NEURONS, THEY WILL PUT OUR BRAINS ON THE INTERNET, THEY WILL PROVIDE FULL IMMERSION VIRTUAL REALITY FROM WITHIN THE NERVOUS SYSTEM, THEY WILL EXPAND OUR MEMORIES, THEY WILL GIVE US ACCESS TO SEARCH ENGINES AND ALL OF HUMAN KNOWLEDGE DIRECTLY FROM INSIDE OUR BRAINS. AND THIS WILL BE ROUTINE 25 YEARS FROM NOW.

SMITH: THANK YOU VERY MUCH FOR CALLING IN AT 263 WXXI. OF COURSE AT THAT POINT WITH THAT ENHANCEMENT OF OUR CAPABILITY AND IN OUR ABILITY TO ESSENTIALLY FROM WITHIN TAP IN TO THE WHOLE UNIVERSE OF KNOWLEDGE, THERE IS ALWAYS THAT SORT OF DESPOTIC IDEA THAT A MALEVOLENT FORCE WITHIN THAT UNIVERSE CAN ALSO TAP INTO US AND TRY TO CONTROL US AND THEN THE QUESTION BECOMES HOW DO WE PREVENT THAT? HOW DO WE ACCESS THIS CAPABILITY WITHOUT HAVING SOMEBODY ELSE USING IT IN A NEGATIVE WAY?

KURZWEIL: THIS ISSUE OF PRIVACY IS ALREADY AN ISSUE, BECAUSE CONSIDER THE INTIMATE THINGS YOU DO ON YOUR CELL PHONE, YOUR PERSONAL COMPUTERS, ALL WHICH IS COMPUTERIZED SO EVEN THOUGH THESE DEVICES ARE NOT YET IN YOUR BODY'S AND BRAINS, THEY ARE NONETHELESS AN INTIMATE PART OF OUR LIVES AND PEOPLE DO TAP INTO THEM. WE'RE ACTUALLY TECHNICALLY MAKING MORE PROGRESS ON PRESERVING PRIVACY THAN BREAKING IT. IT'S A TECHNICAL ISSUE, BUT ENCRYPTION, FOR EXAMPLE, WHICH CAN PROTECT THE PRIVACY OF THIS INFORMATION, IS MAKING MORE RAPID PROGRESS THAN BREAKING THESE CODES. PEOPLE THOUGHT QUANTUM COMPUTERS WOULD FOREVER BREAK ENCRYPTION, BUT IT TURNED OUT QUANTUM ENCRYPTION NOW WORKS AND QUANTUM COMPUTERS STILL DON'T WORK AS WELL FOR. SO THERE IS ALWAYS A STANDOFF BETWEEN IMPROVING THE METHODS OF KEEPING INFORMATION PRIVATE AND METHODS OF BREAKING IT AND THEN THERE ARE SOCIAL DEBATES AND DIALOG AS TO HOW MUCH ACCESS AUTHORITIES SHOULD HAVE TO PREVENT ABUSE OF INFORMATION SUCH AS TERRORISM. SO THIS WILL CONTINUE TO BE A VITAL ISSUE AND AS WE GET MORE AND MORE INTIMATE WITH OUR MACHINES IT WILL BECOME MORE IMPORTANT.

SMITH: WE'LL JUST NEED KIND OF A 512 BIT ENCRYPTION OF OUR MINDS I GUESS OR SOMETHING LIKE THAT.

KURZWEIL: WELL THAT'S NOT SO HARD TO DO, ACTUALLY.

SMITH: 263 WXXI. WE HAVE ANDREW ON THE LINE. HELLO ANDREW.

ANDREW: HELLO AND HELLO RAY KURZWEIL. RAY, YOU SHOULD HAVE CALLED YOUR BOOK THE AGE OF SPIRITUAL FRAUD. BECAUSE WHAT RAY KURZWEIL IS PROMULGATING HERE IS A SPIRITUAL FRAUD. JESUS CHRIST USHERED IN THE HOLY SPIRIT INTO THE HUMAN RACE AND NOW RAY KURZWEIL SAYS THAT HE IS GOING TO PUT COMPUTERS, MINI COMPUTERS AND THEY'RE GOING TO HELP YOU THINK AND ALL THIS KIND OF STUFF. IT'S A COMPLETE SPIRITUAL FRAUD. ALL IT IS, AND BOB, YOU JUST HIT ON THIS WITH YOUR QUESTION ABOUT MALEVOLENT FORCES FOR, HOW DO YOU CONTROL THEM? ALL THIS IS IS A DOOR TO DEVIL SPIRIT POSSESSION. RAY KURZWEIL IS A SPIRITUAL FRAUD AND I NEVER WOULD HAVE FIGURED IT OUT BUT YOU NAMED YOUR BOOK THE AGE OF SPIRITUAL MACHINES.

SMITH: ANDREW, THANK YOU FOR OFFERING THAT, I GUESS WHETHER HE INTENDED TO OR NOT, HE'S GETTING TO THE QUESTION OF THE POTENTIAL OF WHETHER IT IS CONFLICT OR DIVIDE OR WHATEVER YOU WANT TO CALL IT, BETWEEN THE METAPHYSICAL REALM AND THE OBJECTIVE SCIENTIFIC REALM, KIND OF CONTINUING THAT WARFARE OF SCIENCE AND THEOLOGY THAT WE FIRST HEARD ABOUT FROM ANDREW DIXON WHITE 130 YEARS AGO. IS THIS BASICALLY THE LATEST CHAPTER OF THE STORY THAT ANDREW DIXON WHITE STARTED?

KURZWEIL: GENERALLY OUR RELIGIOUS TRADITIONS HAVE NOT OPPOSE PROGRESS AND MOST CHRISTIAN THEOLOGIES SUPPORT THE IDEA OF INCREASING SCIENTIFIC KNOWLEDGE ABOUT OURSELVES AND EXPANDING OUR CAPABILITIES THROUGH OUR TOOLS. SO UNLESS YOU'RE OPPOSED TO ALL OF TECHNOLOGY, THIS IS A CONTINUATION OF THE TREND THAT WE HAVE SEEN. WE ARE GETTING CLOSER TO OUR TECHNOLOGY AND A FEW PEOPLE WOULD OBJECT TO PUTTING A COMPUTER INSIDE THE BRAIN OF SOMEONE WITH PARKINSON'S DISEASE TO OVERCOME THE SUFFERING THAT COMES WITH THAT DISEASE FOR AND THAT'S REALLY WHAT WE'RE TALKING ABOUT IS OVERCOMING HUMAN SUFFERING THAT COMES AND EXPANDING OUR CREATIVE POTENTIAL, BUT NOT LOSING OUR SPIRITUAL QUALITIES.

SMITH: POPE JOHN PAUL THE SECOND MAY HAVE SAID IT BEST THAT THERE IS NOTHING INHERENTLY WRONG WITH SCIENTIFIC KNOWLEDGE, THERE'S NO CHALLENGE TO THE INFINITE IN IT IT'S ONLY THE QUESTION OF HOW WE USE IT.

KURZWEIL: IN FACT, TECHNOLOGY HAS ALWAYS BEEN A DOUBLE EDGED SWORD AND I'VE BEEN QUICK TO RECOGNIZE THAT. I'M WORKING NOW IN FACT WITH THE US GOVERNMENT ON PROTECTING OURSELVES FROM

POTENTIAL BIOTERRORISTS WHO WOULD MISAPPLY THESE NEW BIOLOGICAL TECHNOLOGIES, FOR EXAMPLE, TO CREATE A KILLER BIOLOGICAL VIRUS. SO WE DO NEED TO WORK ON ABUSE OF THESE TECHNOLOGIES WHILE WE TRY TO OVERCOME HUMAN SUFFERING WHILE APPLYING THEM IN CONSTRUCTIVE WAYS.

SMITH: I WANT TO TALK ABOUT SOME OF THE PLUSES AND ALSO SOME OF THE POTENTIAL CHALLENGES OF THIS KIND OF TECHNOLOGY IN JUST A MOMENT. I DO HAVE TO TAKE A SHORT BREAK, BUT WE'LL RETURN TO OUR CONVERSATION WITH RAY KURZWEIL IN JUST A MOMENT ON 1370 CONNECTION. I'M BOB SMITH, STAY WITH US, WE'LL BE RIGHT BACK ON WXXI AM AND FM HD 2.

THIS IS MEMBER SUPPORTED PUBLIC RADIO ON WXXI AM ROCHESTER AND NOW ON WXXI FM HD2 ROCHESTER.

SMITH: 1370 CONNECTION CONTINUES ON WXXI AM AND FM HD 2. I'M BOB SMITH. RAY KURZWEIL WITH US RIGHT NOW. HE OF COURSE THE WELL KNOWN FIGURE IN THE REALM OF TECHNOLOGY, OF SCIENCE AND OF THE FUTURE AND OF LITERATURE. HE'S WITH US RIGHT NOW IN ADVANCE OF HIS LECTURE THIS EVENING AT 7PM AT RIT AT THE GORDON FIELDHOUSE ON THE SUBJECT THE SINGULARITY IS NEAR: WHEN HUMANS TRANSCEND BIOLOGY. WE'LL GET BACK TO THE PHONES IN A MOMENT AT 263 WXXI AND ALSO READING FROM OUR INTERNET MAILBOX AT [ASKTALK@WXXI.ORG](mailto:ASKTALK@WXXI.ORG) . JUST BEFORE WE DO, WHEN YOU TALK OF TRANSCENDING BIOLOGY, I THINK OF EVERYTHING FROM ARTIFICIAL INTELLIGENCE TO SOME KIND OF HYBRIDIZATION OF HUMAN SPECIES THROUGH TECHNOLOGY TO HELP US APPROACH EITHER OMNIPOTENCE OR IMMORTALITY OR SOME OF EACH AND I'M REMINDED OF EVERYTHING FROM A STEPHEN SPIELBERG MOVIE TO A ROBERT SAWYER NOVEL LIKE ROBACH, AND TRYING TO IMAGINE IT AND GET MY ARMS AROUND IT, BUT WHEN WE LOOK AT THE POSSIBILITIES, WHAT DO THEY ACTUALLY INCLUDE FOR US?

KURZWEIL: WELL, THERE ARE TWO IDEAS HERE. ONE IS TO ACTUALLY FREE PROGRAM BIOLOGY FOR ITSELF. BIOLOGY IS A SET OF SOFTWARE PROCESSES FOR AND WE HAVE OUTDATED SOFTWARE FOR RUNNING IN OUR BODIES. I WILL GIVE YOU ONE EXAMPLE. THE FACT INSULIN RECEPTOR GENE BASICALLY SAYS HOLD ON TO EVERY CALORIE IN THE FAT CELLS BECAUSE THE NEXT HUNTING SEASON MIGHT NOT WORK OUT SO WELL FOR. AND THAT WAS A GREAT IDEA OF THOUSAND YEARS AGO. THAT'S NOT SUCH A GOOD IDEA TODAY; IT UNDERLIES DIABETES, HEART DISEASE. WE'D LIKE TO TELL THE FAT CELLS ONLY HOLD ONTO A LITTLE BIT OF FAT. WELL THAT WAS ACTUALLY TRIED BECAUSE WE HAVE TECHNIQUES THAT CAN ACTUALLY DO THAT NOW IN ANIMALS. THESE ANIMALS ATE RAVENOUSLY AND REMAINED SLIM AND THEY GOT THE

HEALTH BENEFITS OF BEING SLIM; THEY DIDN'T GET DIABETES, THEY DIDN'T GET HEART DISEASE, THEY LIVED 20% LONGER, THEY GOT THE BENEFITS OF CALORIC RESTRICTION WHILE DOING THE OPPOSITE AND THERE ARE SEVERAL PHARMACEUTICAL COMPANIES RUSHING TO BRING FAT INSULIN RECEPTOR GENE INHIBITORS TO THE HUMAN MARKET AND THAT'S JUST ONE OF THE 23,000 GENES WE WOULD LIKE TO MODIFY IN SOME WAY AND WE HAVE THE TECHNIQUES TO DO THAT NOW. THE OTHER IDEA IS ACTUALLY TO GO BEYOND BIOLOGY, NOT JUST TO REPROGRAM IT BY MERGING WITH A NONBIOLOGICAL SYSTEMS BUILT FROM NANO TECHNOLOGY AND ARTIFICIAL INTELLIGENCE. IN ONE SCENARIO FOR EXAMPLE IN THE TWENTY THIRTIES WILL BE SENDING MILLIONS OR BILLIONS OF NANO BOTS IN OUR BLOOD STREAM, BLOOD CELL SIZED DEVICES, THAT FOR ONE THING WILL KEEP US HEALTHY FROM INSIDE. IF THAT SOUNDS VERY FUTURISTIC, I'D POINT OUT THAT THERE ARE ALREADY DOZENS OF EXPERIMENTS OF DOING THAT IN ANIMALS WITH THE FIRST GENERATION OF THESE DEVICES. ONE SCIENTIST ACTUALLY CURED TYPE ONE DIABETES IN RATS WITH A BLOOD CELLS SIZE DEVICE. AT MIT THERE ARE BLOOD CELL SIZED DEVICES THAT CAN DETECT AND DESTROY CANCER CELLS, AND THESE NANO BOTS AS WE TALKED ABOUT EARLIER, WILL ALSO GO INSIDE THE BRAIN THROUGH THE CAPILLARIES, INTERACT WITH OUR BIOLOGICAL NEURONS AND EXPAND OUR INTELLIGENCE AND OUR EXPERIENCES THROUGH FULL IMMERSION VIRTUAL REALITY EXPERIENCES FROM WITHIN THE NERVOUS SYSTEM. SO THAT'S ONE OF THE SCENARIOS FOR HOW THIS WILL HAPPEN.

SMITH: NOW, WHEN I TALK ABOUT THAT, WHEN YOU TALK ABOUT ENHANCING EXPERIENCES, IT'S ALMOST LIKE WE'RE USING TECHNOLOGY TO FULFILL WHAT TIMOTHY LEARY SAID LSD PROMISED IN TERMS OF MIND EXPANSION. ARE WE TALKING ABOUT SOMETHING LIKE THAT OR SIMPLY RAISING THE ACUITY OF OUR PERCEPTION AND DOING WHAT WE NORMALLY DO WHILE KEEPING OUR HEADS ABOUT US?

KURZWEIL: FOR ONE THING, VIRTUAL REALITY IS A WAY OF HUMAN COMMUNICATION. THE TELEPHONE IS VIRTUAL REALITY: YOU'RE IN A VIRTUAL SPACE WITH SOMEONE ELSE EVEN IF YOU'RE HUNDREDS OF MILES APART. AT LEAST AS MUCH AS ONE HUMAN SENSE IS CONCERNED AND WE CAN ADD THE VISUAL SENSE TODAY WITH VIDEO CONFERENCING, WITHIN A FEW YEARS, RATHER THAN JUST BEING A TWO DIMENSIONAL IMAGE ON A SCREEN, THAT VISUAL SENSE WILL BE FULL IMMERSION, IT WILL BE HIGHLY DETAILED. YOU CAN GO INTO VIRTUAL WORLDS TODAY LIKE SECOND LIFE AND HAVE EXPERIENCES. RIGHT NOW IT'S CARTOON LIKE AND IT'S TWO DIMENSIONAL. IN THE FUTURE THEY WILL BE THREE DIMENSIONAL EXPERIENCES, FULL IMMERSION. WHEN WE CAN GO WITHIN THE NERVOUS SYSTEM, WE'LL ADD THE OTHER SENSES AND YOU WILL REALLY BE ABLE TO EXPERIENCE THESE VIRTUAL

REALITY ENVIRONMENTS, BUT IT WILL BE JUST LIKE A TELEPHONE CALL EXCEPT YOU'RE ADDING ALL OF THE SENSES AND IT'S FULL IMMERSION AND VERY HIGH RESOLUTION. SO FOR EXAMPLE, YOU WANT TO GO IN VIRTUAL REALITY, THE NANO BOTS IN YOUR BRAIN SHUT DOWN THE SIGNALS COMING FROM YOUR REAL SENSE, REPLACES THEM WITH THE SIGNALS YOUR BRAIN WOULD BE RECEIVING IF YOU WERE IN THE VIRTUAL ENVIRONMENT AND THEN IT FEELS LIKE YOU'RE IN THAT ENVIRONMENT. AND YOU'LL HAVE A BODY; COULD LOOK LIKE YOUR REAL BODY IN REAL REALITY OR IT COULD BE DIFFERENT THAN YOUR REAL BODY, YOU GO TO MOVE YOUR ARM IT DOESN'T MOVE YOUR REAL ARM IT MOVES YOUR VIRTUAL ARM AND YOU CAN INTERACT WITH OTHER REAL PEOPLE WHO ARE ALSO PROJECTING THEMSELVES IN THESE VIRTUAL ENVIRONMENTS AND SOME OF THE ENVIRONMENTS WILL BE RECREATIONS OF EARTHLY ENVIRONMENTS OR YOU CAN TAKE A WALK ON A VIRTUAL MEDITERRANEAN BEACH, OR SOME WILL BE FANTASTIC, IMAGINARY ENVIRONMENTS THAT DON'T EXIST ON EARTH, THAT ARE NEW EXPRESSIONS. THAT WILL BE A NEW ART FORM, CREATING NEW VIRTUAL REALITY ENVIRONMENTS AND THE BODIES TO GO WITH THEM. BUT IT WILL BE A SERIOUS WAY OF ACTUALLY HAVING INTERACTIONS. THE WORD VIRTUAL REALITY IMPLIES IT'S NOT REAL, BUT WE'LL BE HAVING REAL EXPERIENCES, JUST LIKE YOU HAVE REAL CONVERSATIONS ON THE TELEPHONE, WE'LL BE HAVING REAL INTERACTIONS WITH PEOPLE IN THESE VIRTUAL ENVIRONMENTS.

SMITH: WE COULD BE TALKING WITH EACH OTHER EVEN THOUGH WE'RE NOT IN THE SAME ROOM IN ROCHESTER, NEW YORK?

KURZWEIL: YOU DO THAT ON THE RADIO ALL THE TIME. HAVING TO INTERVIEW SUBJECTS WHO ARE ACROSS THE COUNTRY AND IT'S JUST LIKE YOU'RE TOGETHER SO THAT'S A CRUDE FORM OF VIRTUAL REALITY INVOLVING ONE HUMAN SENSE, THE AUDITORY SENSE. WE WILL BE ADDING THE OTHER SENSES AS WE CAN GO FORWARD.

SMITH: AND IT WILL CREATE THE REAL TRIP THAT TIMOTHY LEARY PROMISED, AND PRESUMABLY WE CAN AT LEAST CONTROL IT AND LINK IT TO SOMETHING THAT IS OBJECTIVE.

KURZWEIL: PART OF WHAT TIMOTHY LEARY TALKED ABOUT IS ACTUALLY CHANGING OUR PERCEPTIONS AND OUR MINDS AND WITH LSD WE DID THAT UNDER VERY UNCONTROLLED FASHION. WE WILL HAVE MUCH MORE CONTROL FOR THESE PROCESSES. FOR ONE THING, WE CAN INHABIT A VIRTUAL ENVIRONMENT THAT CAN BE VERY IMAGINARY, BUT OTHERWISE WE WILL HAVE OUR WITS ABOUT US, OR WE CAN MAKE SELECTIVE CHANGES IN OUR REACTIONS TO ENHANCE CERTAIN EMOTIONAL QUALITIES OF AN EXPERIENCE BECAUSE WE WILL HAVE CONTROL OVER THAT AS WELL.

SMITH: THE ONE THING THAT I WORRY ABOUT IS WILL WE HAVE A TENDENCY TO ISOLATE OURSELVES FROM AUTHENTIC, REAL, TACTILE EXPERIENCES AND LIVE WITHIN THIS ELECTRONIC VIRTUAL REALITY COCOON TO A GREATER DEGREE?

KURZWEIL: AS I SAID BEFORE, EVEN THOUGH WE HAVE THIS TERM VIRTUAL REALITY, WHICH IS A LITTLE UNFORTUNATE, THESE ARE REAL EXPERIENCES AND THEY ULTIMATELY WILL INCLUDE THE TACTILE SENSE. SO THIS WILL BE AS REAL AS REAL REALITY. ALL OF THESE TECHNOLOGIES START OUT CRUDE; VIDEO GAMES STARTED OUT WITH PONG AS A SIMULATION OF TENNIS BUT IT WAS VERY CRUDE AND SECOND LIFE TODAY IS A CRUDE, CARTOON LIKE RECREATION OF REAL REALITY BUT ULTIMATELY THESE WILL BE AS DETAILED, AS CONVINCING, AS TACTILE AS REAL REALITY AND WE'LL HAVE REAL EXPERIENCES AND IT WILL BE A WAY OF INTERACTING, COMMUNICATING, EVEN INTIMATELY WITH OTHER PEOPLE THAT GO BEYOND THE LIMITATIONS OF REAL REALITY.

SMITH: SO IN OTHER WORDS, ESSENTIALLY, GENE RODENBERRY WAS RIGHT! WELCOME TO THE HOLODECK, IN ANOTHER VEHICLE OF TECHNOLOGY THAN THE ONE HE HAD ENVISIONED, WHICH WAS PURELY HOLOGRAPHIC.

KURZWEIL: THAT'S RIGHT; WE'LL BE ABLE TO EXPERIENCE EACH OTHER IN NEW WAYS WITH THESE NEW COMMUNICATION TECHNOLOGIES.

SMITH: 263 WXXI. WE'RE TALKING WITH RAY KURZWEIL, WE'RE TALKING WITH YOU ON 1370 CONNECTION AND WE HAVE KEITH CALLING IN FROM ROCHESTER. HELLO KEITH, YOU'RE ON THE AIR.

KEITH: HI. I WAS CALLING ABOUT, YOU'RE TALKING ABOUT IN MOORE'S LAW, THE INCREASING, THE EXPONENTIAL GROWTH OF TECHNOLOGY OVER TIME, AND I WAS JUST WONDERING, IT SEEMS LIKE YOU GET A BIT ENAMORED WITH THE CURVE THERE INSTEAD OF WHAT IT'S MODELING, YOU KNOW, YOU COULD SAY THAT THAT WILL CONTINUE GIVEN THAT THE CURRENT DRIVING FORCES THAT MOVE US ALONG THAT CURVE CONTINUE TOO BUT THAT'S NOT NECESSARILY TRUE. BY THE SAME TOKEN YOU COULD ARGUE THAT IN THE 19<sup>TH</sup> CENTURY WE TRAVELED BY HORSE THEN WE TRAVELED BY CAR AND PLANES SO WE'RE ABLE TO GO FASTER AND FASTER AND BY EXTRAPOLATING ALONG THAT CURVE YOU COULD SAY HOW COME WE CAN'T TRAVEL FASTER THAN THE SPEED OF LIGHT NOW? I MEAN THERE ARE LIMITS EVENTUALLY. THERE ARE SPEED LIMITS AND THERE ARE SIZE LIMITS. I MEAN THERE IS GOING TO BE A POINT; I MEAN MAYBE IN PRACTICAL TERMS THAT'S WAY FAR DOWN THE ROAD, BUT TO IGNORE THAT I THINK IS A LITTLE DANGEROUS IN SOME

WAYS IF YOU'RE GOING TO TRY AND PREDICT WHAT'S GOING TO HAPPEN DOWN THE ROAD.

KURZWEIL: IT'S A GOOD POINT THAT EXPONENTIALS HAVE A LIMIT AND THIS IS NOT AN ISSUE THAT'S IGNORED. IN FACT, I DEAL WITH THIS QUITE EXTENSIVELY IN MY BOOK. FIRST OF ALL, MOORE'S LAW IS NOT THE SUM TOTAL OF EXPONENTIAL GROWTH. IT'S JUST ONE EXAMPLE OF A PARADIGM THAT HAS GROWN EXPONENTIALLY. IN COMPUTATION, WE'VE SEEN FIVE DIFFERENT PARADIGMS: MOORE'S LAW WAS NOT THE FIRST BUT THE FIFTH PARADIGM TO BRING EXPONENTIAL GROWTH TO COMPUTING. AND EVERY PARADIGM DOES RUN OUT OF STEAM AS YOU POINT OUT, BUT WHAT HAPPENS THEN IS IT CREATES RESEARCH PRESSURE FOR THE NEXT PARADIGM AND THE NEXT PARADIGM IS THERE IN TIME AND WHEN MOORE'S LAW RUNS OUT OF STEAM, PROBABLY IN THE TEEN YEARS OF THIS CENTURY, WE'LL GO TO THE SIXTH PARADIGM WHICH IS THREE DIMENSIONAL MOLECULAR COMPUTING AND THAT'S NOW VERY MUCH A MAINSTREAM VIEW. I PREDICTED THAT IN MY BOOK THE AGE OF SPIRITUAL MACHINES A DECADE AGO AND AT THAT TIME IT WAS A RADICAL NOTION BUT NOW IF YOU SPEAK TO THE INTEL CHIP DESIGNERS THEY'LL TELL YOU THEY HAVE THREE DIMENSIONAL MOLECULAR CIRCUITS WORKING AND THEY EXPECT TO CROSS OVER TO BE IN THE TEEN YEARS AND I HAVE A WHOLE ANALYSIS AS TO WHY INFORMATION TECHNOLOGY, AND NOT JUST COMPUTERS, IT'S TRUE OF GENETIC SEQUENCING, IT'S TRUE OF BRAIN SCANNING, IT'S TRUE OF MAGNETIC STORAGE, ANYTHING WHERE YOU CAN MEASURE THE INFORMATION CONTENT. THE INTERNET INHERENTLY GROWS AT THIS EXPONENTIAL RATE PARTLY BECAUSE WE ALWAYS USE THE LATEST TECHNOLOGY TO CREATE THE NEXT AND WE IMPROVE IT THEN IN MULTIPLICATIVE TERMS SO IT'S NOT JUST LIMITED TO ONE PARADIGM AND AS YOU POINT OUT, ONE PARADIGM LIKE MOORE'S LAW, WHICH IS THE SHRINKING OF COMPONENT SIZES ON AN INTEGRATED CIRCUIT WILL RUN OUT OF STEAM, BUT THERE WILL BE ANOTHER PARADIGM TO PICK UP THE PACE. THEN YOU POINT OUT WELL ISN'T THERE SOME OVERALL LIMIT TO THE ABILITY OF COMPUTERS TO LET'S SAY PROCESS INFORMATION BASED ON THE LAW OF PHYSICS? AND I DO TALK ABOUT THAT IN THE BOOK AND YES, THERE ARE LIMITS BUT THEY'RE NOT VERY LIMITING. IF YOU TALK ABOUT THE ULTIMATE SAY TWO POUND COMPUTER BASED ON WHAT WE KNOW ABOUT PHYSICS, IT WOULD BE TRILLIONS OF TIMES MORE POWERFUL THAN THE HUMAN BRAIN SO THE LIMITS ARE NOT GOING TO BE VERY LIMITING.

SMITH: THERE ARE SOME PEOPLE WHO THINK WE CAN TRANSCEND THE SPEED OF LIGHT AT SOME FUTURE DAY IF WE COULD FIGURE OUT HOW TO DRILL HOLES IN THE UNIVERSE BECAUSE THEY THINK THERE'S A WAY TO DO IT, IT'S JUST UP TO US TO GET THE T'S CROSSED AND THE I'S DOTTED.

KURZWEIL: I ACTUALLY TALK ABOUT THAT IN THE BOOK. WE'LL GET TO A POINT WHERE WE'VE SATURATED THE ABILITY OF MODERN ENERGY TO COMPUTE, AS THE CALLER SUGGESTS, LATE IN THIS CENTURY, AND WE'LL THEN BEGIN EXPANDING INTO THE REST OF THE UNIVERSE AND WHETHER WE CAN DO THAT AT THE SPEED OF LIGHT OR SUPERSEDE THE SPEED OF LIGHT OR MAYBE GET AROUND THE SPEED OF LIGHT BY FINDING SHORTCUTS THROUGH WORMHOLES, REMAINS TO BE SEEN.

SMITH: SOME PEOPLE SAY IF WE CAN THINK ABOUT IT, IF WE CAN IMAGINE IT, WE CAN DO IT.

KURZWEIL: IF THERE ARE EVEN SUBTLE WAYS OF DOING IT, AND I TALK ABOUT FIVE OR SIX APPROACHES IN THE BOOK, OUR INTELLIGENCE WILL BE SO GREAT WE'LL BE ABLE TO HARNESS THEM. CONSIDER FOR EXAMPLE BERNOULLI'S PRINCIPLE, A VERY SUBTLE SCIENTIFIC PRINCIPLE THAT IF YOU HAVE A CURVED SURFACE THERE'S SLIGHTLY LESS AIR PRESSURE ABOVE THE CURVED SURFACE THAN BELOW IT. BASED ON THAT SUBTLE SCIENTIFIC PRINCIPLE, BY AMPLIFYING IT THROUGH ENGINEERING WE CREATED THE WHOLE WORLD OF AVIATION. SO IF WE FIND SUBTLE WAYS OF GETTING AROUND THE SPEED OF LIGHT, OUR ENGINEERING WILL BE SO POWERFUL WE'LL BE ABLE TO AMPLIFY IT AND REALLY TAKE ADVANTAGE OF WORMHOLES, EITHER FINDING THEM OR ENGINEERING THEM, BUT YOU HAVE TO SAY THAT THAT'S SPECULATIVE. BUT EVEN WITHOUT THAT, JUST USING MATTER AND ENERGY HERE ON EARTH AND APPLYING WHAT WE KNOW ABOUT PHYSICS, WE'LL BE ABLE TO CREATE COMPUTERS THAT ARE VASTLY GREATER THAN HUMAN INTELLIGENCE.

SMITH: 263-WXXI 263-9994. LET'S GO TO JOHN IN THE CITY.

JOHN: I'VE GOT A QUESTION ABOUT SOME OF THE THINGS YOU WERE TALKING ABOUT EARLIER ABOUT, I'M ALL OR HELPING PEOPLE WITH PARKINSON'S DISEASE. THE ONLY THING I'M WORRIED ABOUT IN THE FUTURE IS IF YOU TALK ABOUT THESE THINGS BEING IMPLANTED INTO THE BRAIN AND WHAT WOULD HAPPEN IF THESE CHIPS OR WHATEVER THEY ARE WERE HOOKED UP TO A MAIN COMPUTER, WOULD IT BE POSSIBLE FOR SOMEBODY IF THEY GOT THEIR HANDS ON IT, TO BE ABLE TO CONTROL PEOPLE. DOWN THE LINE, AND THAT KIND OF THING, WHICH I HOPE DOESN'T HAPPEN. I THINK THAT'S WHAT A LOT OF CHRISTIANS ARE WORRIED ABOUT.

KURZWEIL: WELL, I THINK YOU BRING UP A VALID POINT. EVER SINCE WE'VE HAD TECHNOLOGY IT'S BEEN A DOUBLE EDGED SWORD, EVER SINCE FIRE AND STONE TOOLS, WE'VE USED THEM TO EXPAND OUR CREATIVITY AS WELL AS OUR DESTRUCTIVE ABILITY AND THAT WILL BE

TRUE OF THESE FUTURE TECHNOLOGIES AND YOU BRING UP ONE DANGER AND THERE ARE OTHERS THAT WE NEED TO BE CONCERNED ABOUT SO I THINK WE NEED TO TEST THESE TECHNOLOGIES CAREFULLY, WE NEED TO HAVE STRONG ETHICAL STANDARDS BY RESPONSIBLE PRACTITIONERS, WE NEED TO SET UP TECHNOLOGICAL IMMUNE SYSTEMS TO PROTECT OURSELVES AGAINST THOSE WHO WOULD TRY TO BE DESTRUCTIVE LIKE TERRORISTS. I'M WORKING ON THAT NOW WITH REGARD TO POTENTIAL ABUSE OF BIOLOGICAL TECHNOLOGIES, SO THESE ARE DANGERS. I CAN DESCRIBE TECHNICALLY HOW WE CAN PROTECT AGAINST THE KIND OF SCENARIO YOU DESCRIBE, BUT ONCE WE DO THAT, SOMEONE WILL THINK OF SOMEWAY OF GETTING AROUND THAT SO IT'S A CONSTANT BATTLE. BUT I THINK WE'VE BENEFITED MORE THAN WE'VE BEEN HURT BY TECHNOLOGY. IF YOU THINK ABOUT WHAT HUMAN LIFE WAS LIKE EVEN A COUPLE OF HUNDRED YEARS AGO, HUMAN LIFE EXPECTANCY WAS 37 AND THERE WAS NO SANITATION, NO ANTIBIOTICS AND HUMAN LIFE WAS EXTREMELY HARD, LABOR PRONE, DISASTER PRONE, DISEASE FILLED, SO WE'VE COME A LONG WAY, BUT THERE'S STILL A LOT OF SUFFERING IN THE WORLD AND WE NEED TO APPLY OUR TECHNOLOGY TO OVERCOME IT.

SMITH: 263-WXXI, 263-9994 – TECHNOLOGY MAKES THIS CONVERSATION POSSIBLE ON 1370 CONNECTION FROM WXXI AM AND FM HD 2. RAY KURZWEIL, A MAN WHO'S LEADING US INTO THE FUTURE. HE'S BEEN AT IT ACTUALLY OVER 40 YEARS NOW AND MADE MAJOR CONTRIBUTIONS IN MANY AREAS OF TECHNOLOGY AND OF OUR UNDERSTANDING OF SCIENCE AND THE UNIVERSE AND THE POSSIBILITIES. HE'S HERE WITH US RIGHT NOW IN ADVANCE OF AN EVENING LECTURE AT RIT AND WE HAVE THIS COMING IN FROM OUR INTERNET MAILBOX [ASKTALK@WXXI.ORG](mailto:ASKTALK@WXXI.ORG). FRED IN ROCHESTER ASKS WHAT SPECIFIC BENCHMARKS, I.E. COMPUTER ACCOMPLISHMENTS, SHOULD WE WATCH FOR TO CONFIRM, THAT SINGULARITY IS ON TIME?

KURZWEIL: WELL GOOD POINT, I'M ACTUALLY JUST WORKING ON AN ESSAY LOOKING AT SOME OF MY PREDICTIONS AND HOW THEY'RE FARING AND ALSO UPDATING THE GRAPHS AND THE SINGULARITIES TO CONFIRM THAT THESE EXPONENTIAL PROGRESSIONS ARE CONTINUING AND THEY ARE, VERY PRECISELY. SO ONE THING WE CAN LOOK AT IS THE HARDWARE PROGRESSION AND ALSO THE SOFTWARE PROGRESSION. IN HARDWARE IT'S EASY TO MEASURE IN TERMS OF COMPUTATION PER SECOND, PER DOLLAR, AND ONE OF MY FORECASTS IS BY 2019 \$1000 OF COMPUTATION WILL MATCH THE TEN MILLION, BILLION CALCULATION PER SECOND ESTIMATE AS NEEDED TO SIMULATE THE HUMAN BRAIN SO WE CAN CONTINUE TO MONITOR THAT, WHICH I HAVE, AND WE ARE VERY MUCH ON TARGET. SUPER COMPUTERS ARE APPROACHING THAT LEVEL WITHIN A YEAR OR TWO. THE OTHER MORE IMPORTANT ISSUE IS THE SOFTWARE SIDE AND THERE THE MOST IMPORTANT PROGRESSION IS

UNDERSTANDING THE HUMAN BRAIN, REVERSE ENGINEERING IT AND WE ARE SIMULATING AND MODELING AN INCREASING NUMBER OF REGIONS IN THE HUMAN BRAIN, EVEN THE CEREBRAL CORTEX, ARGUABLY THE MOST IMPORTANT REGION WHERE WE DO OUR ABSTRACT REASONING, IS BEGINNING TO BE MODELED AND SIMULATED AND TESTED ON COMPUTERS SO WE CAN CONTINUE TO MONITOR THAT PROGRESS AND THE PROGRESS HAS REALLY BEEN STUNNING IN THE TWO OR THREE YEARS SINCE MY BOOK CAME OUT.

SMITH: WHEN WE FINALLY GET THAT THREE DIMENSIONAL COMPUTATIONAL DEVICE THAT CAN EMULATE IN SOME WAY THE THREE DIMENSIONAL COMPUTATIONAL DEVICE INSIDE OUR SKULLS, WHAT WILL IT BE LIKE? WILL IT A TRULY INTELLIGENT BEING, ASSUMING WE HAVE A GOOD UNDERSTANDING OF WHAT INTELLIGENCE IS, AND WILL IT APPROACH, AT LEAST INTELLECTUALLY, AND MAYBE EVEN EMOTIONALLY WHAT WE ARE?

KURZWEIL: THE KEY WORD IS THAT WORD EMOTIONALLY BECAUSE IN TERMS OF ACCESS TO HUMAN KNOWLEDGE, DOING LOGICAL THINKING, SOLVING MATHEMATICAL THEOREMS, COMPUTERS ARE ALREADY VERY GOOD AND BETTER THAN MOST PEOPLE, IN FACT. OUR EMOTIONAL INTELLIGENCE IS IN FACT THE CUTTING EDGE OF HUMAN INTELLIGENCE AND THAT'S WHERE HUMANS STILL HAVE A SUBSTANTIAL EDGE. BEING FUNNY, GETTING THE JOKE, EXPRESSING A LOVING SENTIMENT – THESE ARE THE MOST COMPLEX THINGS THAT WE DO, BUT THEY ARE DONE BY OUR BRAINS AND WE'RE MAKING RAPID PROGRESS IN BEGINNING TO UNDERSTAND THAT, BUT FOR THAT WE'RE AT AN EARLY STAGE BUT THAT IS EXACTLY THE HEART OF MY PREDICTION: THAT THESE NON BIOLOGICAL ENTITIES INFUSED WITH SOFTWARE BASED ON REVERSE ENGINEERING OF THE HUMAN BRAIN INCLUDING ITS EMOTIONAL ASPECTS, WILL APPEAR INDISTINGUISHABLE FROM EMOTIONAL AND FUNNY HUMAN BEINGS. THAT'S THE KEY TO PASSING THE TURNING TEST, WHICH IS A TEST DETERMINING WHETHER OR NOT A COMPUTER IS OPERATING AT HUMAN LEVELS AND WAS VERY PRESCIENT I THINK IN BASING THAT ON HUMAN LANGUAGE AND ON THE ABILITY OF A MACHINE TO ACTUALLY APPEAR HUMAN LIKE AND THE REASON THAT PEOPLE SEEM HUMAN LIKE IS BECAUSE WE HAVE SUBTLE AND SUPPLE WAYS OF EXPRESSING OUR EMOTIONS AND UNDERSTANDING EMOTIONAL INTENT. SO THAT WILL BE THE KEY OF COMPUTERS EMULATING HUMAN INTELLIGENCE. AND I BELIEVE THEY WILL AND THE PRIMARY IMPLICATION OF THIS IS NOT SOME ALIEN INVASION OF INTELLIGENT MACHINES TO DISPLACE US, BUT REALLY TO ENHANCE OUR OWN INTELLIGENCE, JUST THE WAY THEY DO NOW. I MEAN, THE FACT THAT I CAN TAKE A DEVICE OUT OF MY POCKET AND ACCESS ALL HUMAN KNOWLEDGE IN A FEW KEYSTROKES, THAT EXPANDS MY EFFECTIVE

INTELLIGENCE. VERY FEW PEOPLE COULD DO THEIR WORK TODAY WITHOUT THE COMPUTERIZED TOOLS WE HAVE.

SMITH: SO IN A SENSE, ARE WE GOING TO BE TEMPTED TO OR EVEN FEEL THE NEED TO ENCASE THIS KIND OF COMPUTING POWER IN SOME KIND OF AUDIO, ANIMATRONIC DEVICE THAT EMULATES THE LOOK, THE FEEL, THE MOVEMENT OF A HUMAN BEING?

KURZWEIL: WE'RE GOING TO DO ALL OF THE ABOVE, BUT I THINK THE PRIMARY IMPLICATION IS TO EXPAND WHO WE ARE. WHEN I WAS A STUDENT AT MIT THE COMPUTER WAS ACROSS CAMPUS AND I HAD TO RIDE MY BICYCLE TO GET THERE. NOW IT'S IN MY POCKET AND IT'S A THOUSAND TIMES MORE POWERFUL AND THIS IS GOING TO CONTINUE, THIS SORT OF GROWING INTIMACY. WITHIN 20 YEARS IT WILL BE INSIDE MY BODY KEEPING MY HEALTHY AND THEN IT WILL MAKE ITS WAY INTO MY BRAIN. IT'S JUST A CONVENIENT PLACE TO PUT IT AND IT'S GOING TO EXPAND MY INTELLIGENCE AND I WILL BE A HYBRID OF BIOLOGICAL AND NON BIOLOGICAL INTELLIGENCE. THERE ARE A FEW PEOPLE TODAY WHO HAVE NEUROLOGICAL DISEASES BUT EVENTUALLY IT WILL BE A ROUTINE THING TO DO AND IT WILL BE A CONTINUATION OF THIS TREND OF EXPANDING HUMAN KNOWLEDGE, EXPANDING OUR ACCESS TO KNOWLEDGE, EXPANDING OUR INTELLIGENCE, EXPANDING OUR ABILITY TO COMMUNICATE WITH EACH OTHER IN FULL IMMERSION ENVIRONMENTS THROUGH THIS INCREASINGLY INTIMATE INFORMATION TECHNOLOGY.

SMITH: SO ARE WE THEN GOING TO BECOME AT ONE WITH OUR TECHNOLOGICAL CREATIONS?

KURZWEIL: THAT'S RIGHT, AND REALLY OUR TOOLS HAVE ALWAYS BEEN USED TO EXPAND WHO WE ARE. PEOPLE TALK ABOUT WHAT'S UNIQUE ABOUT HUMANS AND SCIENTISTS LIKE TO SAY, OH THERE'S NOTHING UNIQUE ABOUT HUMANS! WE'RE JUST LIKE ALL THE OTHER ANIMALS. BUT ACTUALLY THERE'S ONE WAY IN WHICH WE'RE UNIQUE. WE CREATE TOOLS AND USE OUR TOOLS TO CREATE MORE POWERFUL TOOLS TO EXPAND OUR REACH. THE VERY FIRST TOOLS EXPANDED OUR PHYSICAL REACH; WE COULD PICK UP A STICK AND MAKE OUR ARM LONGER THAN IT WAS, AND NOW WE EXPAND OUR MEMORIES TO OUR COMPUTERIZED TOOLS AND ULTIMATELY WE WILL LITERALLY EXPAND OUR INTELLIGENCE.

SMITH: 263-WXXI. WE GO NEXT TO JOHN IN SPRINGWATER.

JOHN: I'M GLAD I WROTE MY IDEA DOWN BECAUSE SINCE I CAME UP WITH IT 10 MINUTES AGO I'VE COME UP WITH 15 MORE IDEAS, BUT THE QUESTION IS THIS: WHAT HAPPENS TO THE NANO BOTS THAT YOU

REFERRED TO EARLIER AFTER THEY'VE DONE WHATEVER WORK IT IS. DO THEY GET INCORPORATED INTO OUR BODY OR DO THEY BECOME WASTE PRODUCTS AND GET EXCRETED AND START TO INTERACT WITH THE ENVIRONMENT THAT WE'RE A PART OF.

KURZWEIL: THAT'S A GOOD QUESTION IN TERMS OF THE ENGINEERING OF THESE DEVICES. WE PUT DEVICES IN THE HUMAN BODY AND BRAIN NOW AND WE NEED TO WORRY ABOUT WHAT HAPPENS WHEN THEY BREAK DOWN, SO THESE DEVICES WILL EITHER HAVE TO BREAK THEMSELVES DOWN ONCE THEY'RE NO LONGER WORKING; THEY'LL HAVE TO HAVE SELF DIAGNOSTICS AND IF THEY'RE NOT WORKING, MAKE THEIR WAY OUT OF THE BODY, IF THEY CAN'T DO THAT, SOME OTHER NANO BOT WOULD HAVE TO ESCORT THEM OUT OR BREAK THEM DOWN INTO PIECES WHICH COULD BE EASILY DISPOSED OF. BUT YOU KNOW, THE HUMAN BODY HAS A WAY OF DEALING WITH WASTE PRODUCTS AS WELL AND WE'LL HAVE TO DO THAT WITH ANY NANO TECHNOLOGY THAT WE INTRODUCE TO THE BODY.

SMITH: IN OTHER WORDS, WE DISPOSE OF IT THE SAME WAY WE DISPOSE OF OUR NOURISHMENT AFTER WE'VE GOTTEN WHAT WE NEEDED OUT OF IT.

KURZWEIL: EXACTLY, AND THAT'S GOING TO HAVE TO BE PART OF THE TECHNOLOGY; IT'S AN IMPORTANT PART. BUT THE FACT THAT THESE DEVICES CAN HELP US GET RID OF DEBRIS AND TOXINS THAT OUR BIOLOGICAL SYSTEMS ARE NOT ABLE TO DO, THAT'S ONE OF THE WAYS IN WHICH THESE NANO BOTS WILL BE ABLE TO KEEP US HEALTHY.

SMITH: IN A LOT THE SAME WAY THAT CHEMICAL MEDICINE DOES FOR US NOW.

KURZWEIL: THAT'S RIGHT. IF YOU TAKE MEDICATIONS, HOW THE BODY DISPOSES OF THEM, IS IT CAPABLE OF GETTING RID OF THEM OR DOES IT BUILD UP TOXIC LEVELS? THESE ARE ALL PART OF THE TESTING THAT NEEDS TO TAKE PLACE BEFORE WE CAN ACTUALLY INCORPORATE THESE SYSTEMS.

SMITH: WE HAVE ROB ON THE LINE FROM PITTSFORD.

ROB: THANK YOU. (INAUDIBLE) TECHNOLOGY SOMETIMES SOLVES PROBLEMS AND THEN IT CREATES PROBLEMS AND SOLVES THOSE PROBLEMS IN AN INTERESTING SPIRAL. IT SEEMS TO ME WE'VE CROSSED A THRESHOLD. A COUPLE OF HUNDRED YEARS AGO, A SMALL COMMUNITY COULD BE ESSENTIALLY SELF SUFFICIENT IN THE TECHNOLOGY THEY CREATED AND USED. AND THAT SEEMS TO BE AT THE POINT OF NO RETURN. WE'RE TOTALLY DEPENDENT NOW, MOST OF

US, ON TECHNOLOGY BUT IT'S FAR, FAR BEYOND OUR CAPABILITY TO CREATE OR EVEN UNDERSTAND. AND THAT CAN BE A LITTLE UNNERVING. I WAS WONDERING IF RAY WOULD COMMENT ON THAT AND WHERE IT CAN LEAD AND THE DANGERS.

KURZWEIL: WELL, IT'S A GOOD POINT, BUT IF WE WANT TO BE COMPLETELY SELF RELIANT, AS THE CAVEMAN AND WOMAN WERE, WE'D HAVE TO PUT UP WITH A LIFE EXPECTANCY OF 23, WHICH IS WHAT IT WAS BACK THEN. THAT'S WHAT'S NATURAL. SO IF WE WANT TO LIVE TO TODAY'S LIFE EXPECTANCY OF 80 AND TOMORROW'S LIFE EXPECTANCY WHICH WILL BE SUBSTANTIALLY GREATER THAN THAT, THEN WE NEED OUR WHOLE TECHNOLOGICAL INFRASTRUCTURE, WHICH DOES GET MORE AND MORE COMPLEX BUT IT'S REALLY SOME OF THESE OLDER, CRUDER TECHNOLOGIES LIKE THE 19<sup>TH</sup> CENTURY FOSSIL FUELS, WHICH WE'RE RELIANT ON TODAY, WHICH CAUSE A LOT OF THE PROBLEMS THAT PEOPLE ARE CONCERNED ABOUT. THESE NEW TECHNOLOGIES ARE MUCH MORE ENVIRONMENTALLY FRIENDLY AND ARE MUCH MORE REFINED AND I BELIEVE WILL BE ABLE TO OVERCOME THE DANGERS FROM THESE EARLIER INDUSTRIAL TECHNOLOGIES. BUT YOU'RE RIGHT: EACH NEW GENERATION OF TECHNOLOGY CREATES PROBLEMS WHICH WE THEN HAVE TO ADDRESS BUT WE'RE MAKING PROGRESS. LIFE EXPECTANCY HAS BEEN INCREASING AND WILL GO INTO HIGH GEAR VERY SOON.

SMITH: AND MY THANKS TO RAY KURZWEIL FOR TAKING US INTO THE FUTURE AND THE EXCITING POSSIBILITIES. AND OF COURSE A REMINDER AGAIN THAT YOU CAN HEAR HIM SPEAK ON THE SUBJECT OF "THE SINGULARITY IS NEAR: WHEN HUMANS TRANSCEND BIOLOGY." SEVEN O'CLOCK TONIGHT AT RIT'S GORDON FIELDHOUSE. AND THANK YOU VERY MUCH FOR BEING WITH US.