

REMARKS BY

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THE EXPANDING UNIVERSE OF COMPUTER-BASED EDUCATION

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IT IS A PLEASURE TO BE HERE TODAY FOR WHAT MIGHT BE CALLED A RETURN ENGAGEMENT TO TALK ABOUT COMPUTER-BASED EDUCATION. IN 1976, I SPOKE BEFORE A CONGRESS & EXPOSITION SPONSORED BY THE SOCIETY FOR APPLIED LEARNING TECHNOLOGY. THE TITLE OF MY PRESENTATION WAS "VIA TECHNOLOGY TO A NEW ERA IN EDUCATION."

THE SPEECH WAS SUBSEQUENTLY PUBLISHED BY PHI DELTA KAPPAN, WHICH SOLICITED COMMENTS ON IT FROM 19 LEADING EDUCATORS. THESE COMMENTS REFLECTED BOTH AGREEMENT AND SKEPTICISM -- WITH CONSIDERABLY MORE OF THE LATTER -- ABOUT THE MERITS OF COMPUTER-BASED EDUCATION. ONE RESPONSE ON THE SKEPTICAL SIDE WAS FROM A STANFORD UNIVERSITY PROFESSOR WHICH INCLUDED RATHER CATCHY DOGGEREL. QUOTE: "THERE HAS NEVER BEEN A SHORTAGE OF PEOPLE WITH TECHNOLOGICAL ANSWERS TO EDUCATIONAL PROBLEMS. MORE THAN 50 YEARS AGO, A WRY TEACHER WROTE A POEM ENTITLED "ANTIQUATED."

'MR EDISON SAYS
THAT THE RADIO WILL SUPPLANT THE TEACHER. ALREADY ONE MAY
LEARN LANGUAGES BY MEANS OF VICTROLA RECORDS. THE MOVING
PICTURE WILL VISUALIZE WHAT THE RADIO FAILS TO GET ACROSS.
TEACHERS WILL BE RELEGATED TO THE BACKWOODS, WITH
FIRE-HORSES AND LONG-HAIRED WOMEN;
OR, PERHAPS, SHOWN IN MUSEUMS.
EDUCATION WILL BECOME A MATTER OF PRESSING THE BUTTON.
PERHAPS I CAN GET A POSITION AT THE SWITCHBOARD.'

END OF QUOTE.

SINCE THERE IS LITTLE TO BE GAINED IN DWELLING FURTHER ON WHAT WAS THOUGHT TEN YEARS AGO ABOUT COMPUTER-BASED EDUCATION, I'LL MOVE ON TO WHERE WE ARE TODAY AND HOW TO STIMULATE FURTHER PROGRESS IN UTILIZING THIS SIGNIFICANT TECHNOLOGY AFTER I REVIEW THE URGENT AND HIGHLY RELEVANT MATTER OF FOREIGN COMPETITION.

DURING THE PAST DECADE, ESPECIALLY THE LAST HALF OF IT, WE HAVE WITNESSED AN UNPRECEDENTED SURGE IN GLOBAL COMPETITION. OVERSTATING ITS SERIOUSNESS IS DIFFICULT, CONSIDERING THAT OVER 70% OF THE U.S. DOMESTIC MARKET IS OPEN TO FOREIGN COMPETITION. THE PLAIN TRUTH IS THAT THE UNITED STATES IS IN A GLOBAL STRUGGLE, COMPETITION IS FIERCE, AND WE ARE LOSING IN MANY MARKETS.

OUR ONCE DOMINANT POSITION IN TECHNOLOGY HAS BEEN DETERIORATING FOR MANY YEARS AS OTHER COUNTRIES, ESPECIALLY JAPAN, HAVE TAKEN A NUMBER OF STEPS TO ACCELERATE THEIR DEVELOPMENT AND APPLICATION OF ADVANCED TECHNOLOGY. BROADLY SPEAKING, OUR FOREIGN COMPETITORS HAVE GREATLY ACCELERATED RESEARCH AND DEVELOPMENT, DRAMATICALLY INCREASED THE NUMBER OF TRAINED SCIENTIFIC AND TECHNICAL PERSONNEL, REDUCED NEEDLESS AND WASTEFUL DUPLICATION OF TECHNOLOGY DEVELOPMENT, FOSTERED GROWTH IN CAREFULLY TARGETED INDUSTRIES AND LOWERED THE COST OF CAPITAL IN THOSE AREAS.

THE 1985 REPORT OF THE PRESIDENT'S COMMISSION ON INDUSTRIAL COMPETITIVENESS PROVIDED A GOOD PERSPECTIVE OF THE FOREIGN COMPETITIVE CHALLENGE. IT WARNED THAT OUR ABILITY TO COMPETE WAS ERODING, AND THAT WE WERE LOSING WORLD MARKET SHARE IN INDUSTRY AFTER INDUSTRY, INCLUDING SEVEN OUT OF TEN HIGH TECHNOLOGY INDUSTRIES.

UNFORTUNATELY, THE TRENDS FLAGGED BY THE PRESIDENT'S COMMISSION HAVE CONTINUED. ACCORDING TO THE DEPARTMENT OF COMMERCE, THE U.S. RECORDED ITS FIRST WORLDWIDE TRADE DEFICIT IN ELECTRONICS IN 1986, GOING FROM A \$1.3 BILLION SURPLUS IN 1985 TO ALMOST A \$1.9 BILLION SURPLUS LAST YEAR. AT THE SAME TIME, A REPORT PREPARED FOR THE JOINT ECONOMIC COMMITTEE OF CONGRESS PREDICTED THAT WHEN ALL THE FIGURES ARE IN, 1986 WILL PRODUCE THE FIRST FULL-YEAR HIGH TECHNOLOGY TRADE DEFICIT SINCE THIS CATEGORY WAS FIRST IDENTIFIED.

ADVERSE EFFECTS OF THE LOSS OF MARKET LEADERSHIP IN HIGH TECH IS NOT RESTRICTED SOLELY TO REDUCED TRADE AND LOSS OF JOBS IN HIGH TECH COMPANIES. THEY ARE FELT MUCH MORE WIDELY BECAUSE HIGH TECH PRODUCTS, SUCH AS MICROCOMPUTERS, ARE USED TO IMPROVE THE PERFORMANCE, QUALITY AND LOWER COSTS OF PRODUCTS, PROCESSES AND SERVICES IN OTHER INDUSTRIES. HENCE, THESE INDUSTRIES, WHICH REPRESENT A LARGE SEGMENT OF THE ECONOMY, ARE PLACED AT A SEVERE COMPETITIVE DISADVANTAGE WHEN THEY DO NOT HAVE THE SAME ACCESS TO THE MOST ADVANCED HIGH TECH PRODUCTS AS THEIR FOREIGN COMPETITORS.

CLEARLY, U.S. INDUSTRIAL INNOVATION MUST BE EXPANDED ON AN UNPRECEDENTED SCALE TO MEET THIS SERIOUS CHALLENGE. LET US RECALL THAT INDUSTRIAL INNOVATION IS THE PROCESS OF CREATING AND UTILIZING TECHNOLOGY FOR MAKING NEW PRODUCTS, SERVICES AND PROCESSES OR TO MAKE IMPROVEMENTS IN EXISTING ONES AND BRING

THEM TO MARKET. THE INNOVATION PROCESS OFTEN STARTS WITH RESEARCH AND IS FOLLOWED BY DEVELOPMENT, MANUFACTURING AND MARKETING. OUR EDUCATION AND TRAINING INSTITUTIONS PROVIDE THE SKILLED PEOPLE REQUIRED FOR IMPLEMENTATION OF THE ENTIRE PROCESS.

TO AFFORD THE EXPANSION OF INNOVATION ON A MASSIVE SCALE WILL REQUIRE MANY CHANGES, INCLUDING A RESTRUCTURING OF ORGANIZATIONS IN VIRTUALLY ALL SECTORS OF SOCIETY. THIS IS NECESSARY TO REDUCE OPERATING COSTS, TO REALLOCATE RESOURCES TO THE MOST PRODUCTIVE USES AND TO USE NEW APPROACHES FOR IMPROVING PERFORMANCE.

C.B.E. TECHNOLOGY

ONE OF THE MOST SIGNIFICANT OF THE NEW APPROACHES AVAILABLE IS THE GREATLY EXPANDED USE OF COMPUTER-BASED EDUCATION. I WILL REVIEW THE STATUS OF THAT TECHNOLOGY BEFORE DISCUSSING OTHER ACTIONS THAT BOTH BUSINESS AND ACADEMIC EDUCATION MUST TAKE TO IMPROVE COMPETITIVENESS.

AT THIS POINT, I SHOULD GIVE YOU MY DEFINITION OF A COMPUTER-BASED EDUCATION SYSTEM. ESSENTIALLY, IT CONTAINS FOUR ELEMENTS:

1. COMPUTER-MANAGED INSTRUCTION
2. COMPUTER-ASSISTED INSTRUCTION
3. COMPUTER-ASSISTED TESTING
4. COMPUTER-GENERATED ADMINISTRATIVE REPORTS.

COMPUTER MANAGED INSTRUCTION (CMI) INCORPORATES THE CAPABILITIES TO MANAGE THE LEARNING PROCESS FOR EACH STUDENT. COMPUTER ASSISTED INSTRUCTION (CAI) IS PART OF WHAT IS MANAGED BY CMI AND IS THE DIRECT INTERACTIVE DELIVERY OF LESSONS TO INDIVIDUAL LEARNERS VIA THE COMPUTER. COMPUTER CONTROLLED INTERACTIVE VIDEO DISK, DIGITIZED AUDIO, AND SPEECH SYNTHESIS ARE NEW TECHNOLOGIES THAT ARE INCORPORATED IN C.B.E. THERE ARE VERY FEW TEACHER LECTURES IN SUCH A PLAN. WHAT DOES EXIST IS INFORMED DISCUSSION BETWEEN TEACHERS AND STUDENTS.

COMPUTER ASSISTED TESTING IS AN INTEGRATED SET OF SOFTWARE ROUTINES WHICH COLLECTS RESULTS FROM COMPUTER ASSISTED INSTRUCTION ACTIVITIES, BUT ALSO CONSTANTLY ASSESSES A STUDENT'S ACHIEVEMENT AGAINST LEARNING OBJECTIVES AND PROFILES THE STUDENT'S OVERALL ACADEMIC ACHIEVEMENTS FOR REPORTING TO THE TEACHER. IN NEWER TESTING SYSTEMS, ASSESSMENT OF LEARNING STRENGTHS AND WEAKNESSES PECULIAR TO A STUDENT'S STYLE OF LEARNING IS ALSO PERFORMED.

FINALLY, THE COMPUTER GENERATES ADMINISTRATIVE REPORTS, WHICH ARE NECESSARY FOR SCHOOL MANAGEMENT, INCLUDING ATTENDANCE REPORTS, CLASSROOM SCHEDULING, GRADE REPORTS, AND SO FORTH.

THE ESSENCE OF COMPUTER-BASED EDUCATION IS, OF COURSE, THE DIRECT INVOLVEMENT OF THE STUDENT AT THE CENTER OF THE LEARNING PROCESS AND THE ASSUMPTION OF RESPONSIBILITY FOR HIS OR HER OWN LEARNING PROGRESS. WE ALL KNOW THAT THE ACTIVE INVOLVEMENT OF A LEARNER GREATLY IMPROVES THE ODDS OF SUCCESSFUL ACHIEVEMENT OF OBJECTIVES. OUR TRADITIONAL INSTRUCTOR-CENTERED CLASSROOM PERMITS TOO MANY STUDENTS TO SETTLE INTO A PASSIVE ROLE -- IN A SENSE WAITING FOR LEARNING TO "HAPPEN TO THEM" RATHER THAN ACTIVELY SEEKING IT. EDUCATIONAL PSYCHOLOGISTS TELL US THAT MUCH OF THIS STYLE OF CLASSROOM INTERACTION, TYPIFIED BY TEACHERS TALKING AND STUDENTS LISTENING, IS DYSFUNCTIONAL. AS MUCH AS 85 PERCENT OF THE TEACHERS' TIME SPENT IN THIS KIND OF LECTURING TO CLASSES IN THE ELEMENTARY GRADES IS WASTED TIME, HAVING LITTLE EFFECT ON STUDENT LEARNING.

COMPUTER ASSISTED INSTRUCTION MATERIALS, ON THE OTHER HAND, ENGAGE THE STUDENT IN INTERACTION WITH AN EDUCATIONAL LESSON IN REAL TIME. THE CAI LESSON, CREATIVELY PACKAGED BY A TEACHER-AUTHOR, PROVIDES LEARNING EXPERIENCES IN MANY FORMS, SUCH AS DRILL-AND-PRACTICE -- TUTORIAL DIALOGUE -- INQUIRY -- SIMULATION -- GAMES -- PROBLEM SOLVING -- AND A WIDE RANGE OF HIGHER ORDER THINKING SKILL TASKS. COMPUTER ASSISTED INSTRUCTION IS USED IN CONJUNCTION WITH OTHER MEDIA SUCH AS FILMS, VIDEO TAPES, AUDIO TAPES, BOOKS, LECTURES, FIELD TRIPS AND ALMOST ANY OTHER LEARNING EXPERIENCE.

THE ROLE OF COMPUTER MANAGED INSTRUCTION (CMI) IS TO TIE ALL THIS TOGETHER. CMI CONNECTS THE STUDENT, THE TEACHER, THE COMPUTER, AND THE OTHER EDUCATIONAL RESOURCES. CMI GUIDES EACH STUDENT THROUGH A CURRICULUM, ALONG A LEARNING PATH DESIGNED BY THE INSTRUCTOR AND FOCUSED ON EACH STUDENT'S NEEDS, MAINTAINING RECORDS OF STUDENT ACHIEVEMENT FOR USE IN EVALUATING EACH STUDENT'S PROGRESS AND FOR USE IN MEASURING THE EFFECTIVENESS OF THE VARIOUS EDUCATIONAL RESOURCES.

IN SUMMARY, THE SALIENT FEATURES OF A COMPUTER-BASED EDUCATION SYSTEM INCLUDE:

1. USE OF AN EFFECTIVE EDUCATION METHODOLOGY
2. INTERACTIVE
3. INDIVIDUALIZED FOR EACH STUDENT
4. EASY TO USE
5. MOTIVATIONAL
6. PRIVATE LEARNING FOR EACH STUDENT
7. DEMANDS MASTERY OF COMPREHENSION BY THE STUDENT
8. MONITORS AND RECORDS STUDENT PROGRESS

9. REPORTS TO TEACHERS REGULARLY WITH MULTIPLE MEASURES OF STUDENT PROGRESS AND NEEDS.
10. MAINTAINS NECESSARY ADMINISTRATIVE RECORDS.

TEACHER: AT THIS POINT, IT SHOULD BE NOTED THAT WHAT I'VE SAID DOES NOT IMPLY ANY DIMINISHED ROLE FOR THE TEACHER -- QUITE THE CONTRARY, THE ROLE OF THE TEACHER IS ENHANCED, BEING RELIEVED OF THE NEED TO LECTURE AND PERFORM RECORDKEEPING FUNCTIONS. HENCE, THERE IS MORE TIME TO DEVOTE INDIVIDUAL ATTENTION TO NURTURE EACH STUDENT.

PERHAPS THE MOST SUCCINCT WAY TO FURTHER DESCRIBE THE STATUS OF C.B.E. TECHNOLOGY IS TO NOTE THAT NEITHER COST NOR PERFORMANCE ARE NO LONGER EITHER REAL OR PERCEIVED BARRIERS TO ITS USE. THERE HAVE BEEN DRAMATIC DECREASES IN THE COST OF HARDWARE, SOFTWARE AND COURSEWARE. AT THE SAME TIME, THERE HAVE BEEN SIGNIFICANT INCREASES IN THE PERFORMANCE OF HARDWARE AND SOFTWARE AND IN THE QUALITY OF COURSEWARE. NEW TECHNOLOGIES, SUCH AS INTERACTIVE VIDEO AND COMPACT DISC, READ ONLY MEMORY (CD-ROM), HAVE BECOME AVAILABLE AND INCORPORATED UNDER THE C.B.E. BANNER.

FURTHER, THERE IS A LARGE AMOUNT OF HIGH QUALITY COURSEWARE AVAILABLE. E.G., IN THE PLATO COURSEWARE LIBRARY ALONE, WHICH IS BY FAR THE LARGEST, THERE ARE OVER 15,000 HOURS OF HIGH QUALITY LESSON MATERIAL IN COMPUTER-BASED FORMAT IN OVER 200 SUBJECT AREAS. THIS COURSEWARE IS THE RESULT OF HUNDREDS OF COOPERATIVE PROJECTS BETWEEN CONTROL DATA AND MANY UNIVERSITIES, K-12 SCHOOLS, GOVERNMENT AGENCIES, FOUNDATIONS, LARGE COMPANIES, SMALL COMPANIES AND INDIVIDUALS.

ONE'S PERSPECTIVE ON THE RECENT ADVANCES IN TECHNOLOGY CAN BE ENLARGED BY VISITING THE EXHIBITS AT THIS CONFERENCE. I'M SURE YOU WILL PARDON ME IF I MENTION THE CONTROL DATA PLATO EXHIBIT, WHICH DEMONSTRATES, AMONG OTHER THINGS, LEVEL 3 INTERACTIVE VIDEO FUNCTIONS. CONTROL DATA HAS INTEGRATED ITS NEWEST AND MOST ADVANCED COMPUTER-BASED AUTHORING SYSTEM, PCD3, WITH INTERACTIVE VIDEO, TO GAIN THE POWER OF THE BLEND OF TECHNOLOGIES. THE DEMONSTRATION SHOWS HOW THE VARIOUS FEATURES OF INTERACTIVE VIDEO CAN BE USED IN AVIATION FLIGHT CREW COCKPIT TRAINING FOR A BOEING 767 AND HOW IT CAN BE USED FOR TRAINING IN THE USE OF COMPUTERIZED VERTICAL MILLING MACHINES.

RESPONSE BY BUSINESS & INDUSTRY

CBE USAGE: AS A CONSEQUENCE OF THE TECHNOLOGICAL ADVANCES IN COMPUTER-BASED EDUCATION AND UNPRECEDENTED COMPETITIVE PRESSURES, THERE IS A VIRTUAL EXPLOSION IN THE RATE OF ITS USAGE IN INDUSTRY. THIS IS OCCURRING ACROSS A SPECTRUM OF

APPLICATIONS IN MANY FIELDS, INCLUDING THE TEXTILE, TRANSPORTATION AND HEALTH CARE INDUSTRIES, MANY AREAS OF MANUFACTURING AND IN AGRICULTURE. ONE OF THE EARLIEST AND NOW MOST EXTENSIVE USE OF C.B.E. IS IN THE AIRLINE INDUSTRY FOR PILOT TRAINING AND MAINTENANCE. IN A FEW WORDS, COMPUTER-BASED EDUCATION IS ON CENTER STAGE AND PERFORMING BRILLIANTLY IN BUSINESS AND INDUSTRY TO HELP IMPROVE COMPETITIVENESS THROUGH BETTER AND LESS COSTLY EDUCATION AND TRAINING.

RAPIDLY GROWING INDUSTRIAL USAGE IS PROVIDING IMPETUS TO THE FURTHER DEVELOPMENT OF THE UNDERLYING TECHNOLOGY TO MAKE C.B.E. EVEN MORE COST EFFECTIVE AND TO EXTEND THE RANGE OF APPLICATIONS. DURING THE NEXT TEN YEARS, THERE WILL BE CONTINUING INCREASES IN COMPUTER POWER. THE COST OF HARDWARE WILL ALSO KEEP DECLINING. THERE WILL BE FURTHER IMPROVEMENT IN GRAPHICAL PRESENTATIONS. ADVANCES IN ARTIFICIAL INTELLIGENCE, AS REFLECTED IN EXPERT SYSTEMS SIMULATING HUMAN INTELLIGENCE, WILL WIDEN THE HORIZON OF COMPUTER-BASED EDUCATION. AND, OF COURSE, THERE WILL BE IMPORTANT DEVELOPMENTS WHICH WE ARE UNABLE TO EVEN PERCEIVE TODAY.

ALL INDUSTRIES WILL BENEFIT FROM THE DRAMATIC ADVANCES COMING IN C.B.E. WHICH WILL SIGNIFICANTLY IMPROVE U.S. COMPETITIVENESS; HOWEVER, NONE WILL BENEFIT MORE THAN MANUFACTURING AND AGRICULTURE, WHICH TRADITIONALLY HAVE BEEN THE GREATEST CREATORS OF WEALTH IN THE U.S., BOTH OF WHICH FACE UNPRECEDENTED PROBLEMS.

U.S. MANUFACTURERS HAVE BEEN FAR TOO SLOW IN UTILIZING ADVANCED MANUFACTURING TECHNOLOGY. ONE REASON IS LACK OF PEOPLE TRAINED IN THE OPERATION AND MAINTENANCE OF COMPUTER INTEGRATED MANUFACTURING SYSTEMS AND ROBOTIC EQUIPMENT FOR FABRICATION AND ASSEMBLY. THE ONLY WAY THIS HUMAN RESOURCE GAP CAN BE CLOSED FAST ENOUGH IS THROUGH C.B.E.

IN ORDER FOR U.S. FARMERS TO OPERATE AT A PROFIT WHEN THE WORLD MARKET IS GLUTTED WITH OVERPRODUCTION OF FARM COMMODITIES, IT IS NECESSARY TO DRAMATICALLY REDUCE COSTS. A CONSIDERABLE AMOUNT OF TECHNOLOGY EXISTS, AND MORE IS BEING DEVELOPED TO HELP CUT FARMING COSTS; HOWEVER, FARMERS MUST BE TAUGHT HOW TO USE IT IN THE SHORTEST POSSIBLE TIME. AGAIN, C.B.E. IS THE ANSWER.

OTHER ACTIONS: IN ADDITION TO THE EXPANSION OF THE USE OF COMPUTER-BASED EDUCATION TO IMPROVE THE QUALITY AND REDUCE THE COST OF TRAINING, MANY OTHER ACTIONS HAVE BEEN TAKEN BY BUSINESS TO IMPROVE COMPETITIVENESS BY RESTRUCTURING, REALLOCATING RESOURCES AND TAKING NEW APPROACHES. MORE EXPLICITLY, CORPORATIONS HAVE BEEN ELIMINATING LAYERS OF MANAGEMENT, CONSOLIDATING DIVISIONS, WRITING DOWN ASSETS, CLOSING DOWN OR SELLING LESS PROFITABLE OPERATIONS AND REDUCING THE WORKFORCE, WHILE SIMULTANEOUSLY REDUCING COSTS AND IMPROVING QUALITY.

RESTRUCTURING AND REALLOCATION ACTIONS, OFTEN INVOLVING DIFFICULT AND PAINFUL DECISIONS, ARE WIDESPREAD, OF MASSIVE PROPORTIONS AND BEING TAKEN ACROSS ALL INDUSTRIES, NOT JUST IN THOSE WITH THE WORST PROBLEMS. AT&T TOOK A \$3.2 BILLION PRE-TAX CHARGE FOR PLANT CONSOLIDATIONS, INVENTORY WRITE-DOWNS AND JOB REDUCTIONS TOTTALLING MORE THAN 27,000. GENERAL MOTORS ANNOUNCED THE CLOSING OF 11 U.S. AUTO MANUFACTURING PLANTS, 1/3 OF ITS DOMESTIC FACTORIES. SPERRY AND HONEYWELL HAVE MADE MASSIVE LAYOFFS AND TAKEN LARGE WRITE-OFFS, CONTROL DATA AND IBM HAVE MADE MAJOR WORKFORCE REDUCTIONS, AND THE LIST GOES ON.

IN FACT, I DON'T KNOW ANY U.S. COMPANY THAT ISN'T DOING EVERYTHING IMAGINABLE TO BECOME MORE COMPETITIVE, INCLUDING NEW APPROACHES SUCH AS GIVING PRODUCTION WORKERS MORE RESPONSIBILITY FOR PRODUCT COST AND QUALITY, INCREASING THE EFFICIENCY OF R&D THROUGH COOPERATION WITH OTHER ORGANIZATIONS AND, AS MENTIONED, IMPROVING AND EXPANDING EDUCATION AND TRAINING IN THE MOST COST EFFECTIVE WAY WITH COMPUTER-BASED EDUCATION.

RESPONSE BY ACADEMIC EDUCATION

UNFORTUNATELY, THE SAME CANNOT BE SAID ABOUT PRIMARY, SECONDARY AND UNDERGRADUATE EDUCATION. THERE HAS BEEN LITTLE RESTRUCTURING, OR REALLOCATION OR THE UTILIZATION OF NEW APPROACHES SUCH AS THE USE OF COMPUTER-BASED EDUCATION AS THE PRIMARY METHOD OF DELIVERY INSTEAD OF THE SUPPLEMENTARY ROLE IT PRESENTLY PLAYS. YET, IF GIVEN THE OPPORTUNITY, C.B.E. COULD PERFORM AS BRILLIANTLY FOR THOSE INSTITUTIONS AS IT HAS FOR BUSINESS. IN OTHER WORDS, BRING IT TO CENTER STAGE FROM THE BACKROOM WHERE IT WAS A DECADE AGO. THERE'S BEEN SOME MOVEMENT IN THAT DIRECTION, BUT NOT NEARLY ENOUGH. ONE COULD SAY IT IS NOW IN THE WINGS, AND READY FOR THE LEADING ROLE.

HOWEVER, IN ORDER TO ENERGIZE THE WILL TO MOVE C.B.E. TO CENTER STAGE AND CREATE AN ENVIRONMENT IN WHICH IT CAN REALIZE ITS ENORMOUS POTENTIAL FOR IMPROVING EDUCATION, SWEEPING ACTIONS WILL BE REQUIRED ON A SCALE EQUIVALENT TO THOSE BEING TAKEN BY CORPORATIONS. THEY WILL BE JUST AS DIFFICULT FOR THE ACADEMIC SYSTEM AND JUST AS GUT WRENCHING. BEFORE DESCRIBING THEM, I SHOULD COMMENT ON WHAT IS NEEDED FROM EDUCATION TO HELP MAKE AMERICA COMPETITIVE.

TECHNOLOGICAL ILLITERACY: IN THE SIMPLEST OF TERMS, WHAT IS NEEDED IS THE TRANSFORMATION OF A SOCIETY THAT IS LARGELY TECHNOLOGICALLY ILLITERATE INTO ONE WHICH IS TECHNOLOGICALLY LITERATE, PRODUCES MORE SCIENTISTS, ENGINEERS AND TECHNOLOGISTS AND EXPANDS THE CREATION OF KNOWLEDGE MORE EFFICIENTLY -- ALL AT AN AFFORDABLE COST. INCIDENTALLY, MY REFERENCE TO TECHNOLOGY IS TO BE CONSTRUED IN THE BROADEST SENSE. I PREFER TO DEFINE

TECHNOLOGY AS KNOW-HOW OR KNOWLEDGE CONCERNING THE SIMPLEST TO THE MOST COMPLEX AND ADVANCED PRODUCTS, SERVICES AND PROCESSES.

WE ARE SURROUNDED BY EVIDENCE ATTESTING TO THE Pervasiveness OF TECHNICAL INEPTNESS IN OUR SOCIETY. MOST PEOPLE BLINK IN PUZZLEMENT WHEN THE WORD INNOVATION IS MENTIONED. THERE IS LITTLE AWARENESS OF THE FACT THAT MOST NEW JOBS ORIGINATE FROM THE PROCESS OF INNOVATION NOR JUST HOW DIFFICULT IT IS TO CREATE JOBS. THAT LOW LEVEL OF UNDERSTANDING CAN EASILY ACCOMMODATE THE BELIEF THAT THE STORK BRINGS JOBS; ALTHOUGH THE BIRD HAS BEEN PREOCCUPIED WITH THE MORE TRADITIONALLY PRESCRIBED ROLE.

THE STEADY DECLINE IN THE ABILITY OF OUR WORKFORCE TO ROUTINELY APPLY BASIC NOTIONS OF SCIENCE AND TECHNOLOGY DIRECTLY DETRACTS FROM OUR ABILITY TO IMPROVE QUALITY AND PRODUCTIVITY, CRITICAL FACTORS IN OUR COMPETITIVE POSITION. OF COURSE, THIS IS A DERIVATIVE OF A LACK OF INTEREST BY YOUNG PEOPLE IN MATH AND SCIENCE - A PROBLEM WHICH IS COMPOUNDED BY A SERIOUS DEFICIENCY IN THE NUMBER OF QUALIFIED MATH AND SCIENCE TEACHERS AND THE GENERAL WEAKNESS OF MOST OTHER TEACHERS IN THESE SUBJECTS.

IN CONTRAST, THE JAPANESE SYSTEM FAR EXCEEDS OURS IN ITS ABILITY TO PREPARE EDUCATED WORKERS FOR A SIGNIFICANT ROLE IN BUSINESS. ONE REASON IS THAT YOUNGSTERS IN JAPAN SPEND MORE TIME DEMONSTRATING THEIR ABILITY TO HANDLE SCIENCE, MATH AND FOREIGN LANGUAGES. SPECIFICALLY, WITH RESPECT TO MATH AND SCIENCE, THE PERCENTAGE OF HIGH SCHOOL STUDENTS IN JAPAN TAKING THREE YEARS OF SCIENCE AND MATH IS MORE THAN TWICE THAT IN THE UNITED STATES. THIS SAME UNFAVORABLE COMPARISON FOR THE U.S. HOLDS WITH RESPECT TO WEST GERMANY AND THE SOVIET UNION.

OTHER FACTORS FAVORABLE TO JAPAN ARE THE HIGH PERCENTAGE OF STUDENTS GRADUATING FROM HIGH SCHOOL, ALMOST 90% COMPARED WITH 75% IN THIS COUNTRY, AND THE LONGER JAPANESE SCHOOL YEAR. BY THE TIME OF GRADUATION FROM HIGH SCHOOL, JAPANESE STUDENTS HAVE BEEN IN SCHOOL FOR AT LEAST THE EQUIVALENT OF ONE MORE YEAR THAN STUDENTS IN THE U.S. MOST OTHER INDUSTRIAL COUNTRIES REQUIRE STUDENTS TO SPEND MORE DAYS IN SCHOOL PER YEAR.

MORE TECHNICAL PERSONNEL: THESE UNFAVORABLE COMPARISONS OF THE U.S. WITH OTHER COUNTRIES HELP TO EXPLAIN WHY THE GROWTH IN THE SUPPLY OF SCIENTISTS AND ENGINEERS IN THE U.S. IS NOT KEEPING PACE WITH THAT OF OTHER INDUSTRIAL COUNTRIES. ALMOST THE SAME PROPORTION OF OUR POPULATION IS ENGAGED IN SCIENCE AND ENGINEERING TODAY AS TWENTY YEARS AGO. AS NOTED EARLIER, OUR COMPETITORS HAVE DRAMATICALLY INCREASED THE NUMBER OF SCIENTIFIC AND TECHNICAL PERSONNEL. JAPAN, WITH HALF THE POPULATION, IS GRADUATING MORE ENGINEERS THAN THE UNITED STATES.

MEETING K-12 EDUCATIONAL NEEDS: MEETING THE NATION'S EDUCATIONAL NEEDS SOON ENOUGH AT AN AFFORDABLE COST OBVIOUSLY REQUIRES MANY ACTIONS IN K-12 AND UNDERGRADUATE EDUCATION. I'LL FOCUS FIRST ON THOSE FOR K-12.

K-12: ACTIONS REQUIRED IN THE K-12 SYSTEM INCLUDE:

- ADOPTING CBE AS THE PRIMARY METHOD OF DELIVERY TO REPLACE THE PRESENT SUPPLEMENTARY MODE.
- REQUIRING NATIONWIDE TESTING OF TEACHER PERFORMANCE AND LEARNING OUTCOMES.
- DOUBLING OF TEACHERS SALARIES OVER A PERIOD OF TIME.
- MAKING AVAILABLE "CHOICE," I.E., STUDENTS CAN SELECT THE SCHOOL THEY WISH TO ATTEND.
- ADOPTING VOUCHERS
- ELIMINATING INDEPENDENT SCHOOL BOARDS
- DEVELOPING MORE RELEVANT CURRICULUM
- PRODUCING MORE MOTIVATED STUDENTS

EACH OF THESE AREAS MERITS MUCH DEEPER REVIEW THAN IS POSSIBLE IN THE TIME AVAILABLE TODAY. MANY INDIVIDUALS AND ORGANIZATIONS ARE ADVOCATING ONE OR MORE OF THESE ACTIONS. THEIR REPORTS PROVIDE ADDITIONAL SUPPORT FOR THE BLUEPRINT I'VE JUST OUTLINED FOR EDUCATION AND TRAINING IN A FIERCELY COMPETITIVE WORLD.

C.B.E.'s Primary Mode: FUNDAMENTAL TO THE PLAN IS THE UTILIZATION OF C.B.E. AS THE PRIMARY MODE OF INSTRUCTION UNDER THE PURVIEW OF TEACHERS CERTIFIED AS MEETING SPECIFIC PROFESSIONAL STANDARDS IN USE OF ADVANCED EDUCATIONAL TECHNOLOGIES IN ADDITION TO SUBJECT MATTER EXPERTISE.

Teacher's Pay: CERTIFIED TEACHERS' PAY LEVELS OVER TIME WOULD BE DOUBLED. IT IS RELEVANT TO NOTE THAT WHEN I GRADUATED FROM ENGINEERING SCHOOL IN 1932, THE SALARIES OF TEACHERS AND ENGINEERS WERE ABOUT EQUAL. TODAY ENGINEERS' SALARIES ARE AT LEAST TWICE THOSE OF TEACHERS. NO WONDER OUR EDUCATION SYSTEM DETERIORATED.

IN CONTRAST IS THE PAY SCALE FOR TEACHERS AND ENGINEERS IN JAPAN. THOSE EMPLOYED IN ENGINEERING AND ARCHITECTURAL SERVICES EARNED AN AVERAGE OF \$14,000 IN 1985, WHEREAS, AN UPPER SECONDARY SCHOOL TEACHER AVERAGED \$17,000.

THE HIGHER PAY LEVEL FOR U.S. TEACHERS WILL BE AFFORDABLE DUE TO INCREASED PRODUCTIVITY OF THE CERTIFIED TEACHER, USE OF PARAPROFESSIONALS TO ASSIST TEACHERS AND REDUCTIONS IN THE NUMBER OF ADMINISTRATIVE PERSONNEL.

Teacher Certification: CERTIFICATION OF TEACHERS HAS BEEN TALKED ABOUT FOR A NUMBER OF YEARS, AND THERE IS A GROWING CONSENSUS IN SUPPORT OF IT. TEACHER COMPETENCY TESTING IS GREATLY FACILITATED THROUGH THE USE OF COMPUTER-ASSISTED TESTING.

Student Testing: EQUALLY NECESSARY IS NATIONWIDE TESTING OF LEARNING OUTCOMES. TESTING IS ALREADY IN PLACE IN A NUMBER OF STATES AND THE NATIONAL GOVERNOR'S ASSOCIATION TASK FORCE ON EDUCATION FOR ECONOMIC GROWTH HAS RECOMMENDED ESTABLISHING PROGRAMS TO MONITOR STUDENT PROGRESS THROUGH PERIODIC TESTING OF GENERAL ACHIEVEMENT AND SPECIFIC SKILLS. AS NOTED EARLIER, MEASURING STUDENT PROFICIENCY IS FACILITATED WITH COMPUTER-ASSISTED TESTING.

Management of Schools: RELATIVE TO THE MANAGEMENT OF SCHOOLS, IT IS IMPORTANT TO NOTE THAT THEY ARE HANDICAPPED BY A LACK OF PERSONS AS SKILLED IN MODERN MANAGEMENT PRACTICES AS THEIR COUNTERPARTS IN BUSINESS. MANAGEMENT SKILLS ARE ACQUIRED TO AN EXTENT FROM FORMAL TRAINING; HOWEVER, THE MOST IMPORTANT TRAINING COMES FROM ON-THE-JOB EXPERIENCE AND ASSOCIATION WITH PEERS.

PERSONS IN MANAGEMENT IN EDUCATIONAL INSTITUTIONS NORMALLY LACK THE OPPORTUNITY TO OBTAIN THE BROAD EXPERIENCE MANAGERS IN INDUSTRY ARE ABLE TO ACQUIRE BY WORKING IN BUSINESSES WHICH EMBRACE MARKETING, PRODUCTION, ENGINEERING AND OTHER FUNCTIONS. NOR IS THERE AN OPPORTUNITY TO ACQUIRE THE DISCIPLINES OF QUALITY AND COST CONTROL. NOT SURPRISINGLY, THESE GAPS IN EXPERIENCE TRANSLATE INTO A MAJOR REASON FOR THE LAG IN THE ABILITY OF SCHOOLS TO EFFECTIVELY USE TECHNOLOGY IN THE TEACHING PROCESS.

CLOSING THE GAPS IN MANAGEMENT EXPERIENCE CAN BEST BE ACCOMPLISHED BY COMPANIES PROVIDING MANAGEMENT OF SCHOOLS UNDER CONTRACT. FEE SCHEDULES FOR THESE SERVICES WOULD BE KEYED TO LEARNING OUTCOMES. I.E., LARGER FEES WOULD BE EARNED BY HIGHER STUDENT PROFICIENCY TEST RESULTS.

Choice: A CALL FOR CHOICE HAS BEEN MADE BY THE NATIONAL GOVERNORS' ASSOCIATION, A CARNEGIE TASK FORCE COMMITTEE FOR ECONOMIC DEVELOPMENT, AND OTHER BIPARTISAN GROUPS. IN ADDITION, A GROWING NUMBER OF PLACES HAVE MADE IT POSSIBLE FOR STUDENTS TO SELECT SCHOOLS FROM AMONG A NUMBER OF OPTIONS. HENCE, THERE IS NO NEED TO ELABORATE ON THE MERITS OF BRINGING

SOME COMPETITION INTO THE EDUCATIONAL SYSTEM TO IMPROVE AND PROVIDE MORE DIVERSITY IN OFFERINGS.

Vouchers: TO FULLY IMPLEMENT CHOICE, VOUCHERS ARE REQUIRED, ESPECIALLY IF CHILDREN FROM POOR FAMILIES ARE TO BE SERVED ADEQUATELY. UNFORTUNATELY, SUPPORT FOR VOUCHERS IS LAGGING BECAUSE THEIR MERITS ARE USUALLY DEBATED IN TERMS OF PUBLIC VS. PRIVATE SCHOOLS -- THE IMPLICATION BEING THAT PUBLIC SCHOOLS WOULD NOT FARE WELL IN THE COMPETITION. HOWEVER, WITH CBE AND OTHER ACTIONS I AM ADVOCATING, PUBLIC SCHOOLS WOULD BE AS ATTRACTIVE AS PRIVATE SCHOOLS.

Student Motivation: ONE OF MY MAIN OBSERVATIONS ABOUT MEETING THE CHALLENGE OF MOTIVATING STUDENTS TO ACQUIRE A GOOD EDUCATION IS THAT A C.B.E. SYSTEM, MEETING THE NEEDS OF EACH INDIVIDUAL STUDENT IN A PRIVATE AND ENCOURAGING WAY, WILL CERTAINLY BE A SOURCE OF MOTIVATION -- LEARNING SUCCESS WILL GENERATE THIRST FOR MORE LEARNING. YET, THAT MAY NOT BE ENOUGH IN TODAY'S SOCIETY.

IN TIMES PAST, AN EDUCATION WAS EQUATED WITH GETTING A GOOD JOB. TODAY, THE TRADITIONAL VIEW OF EDUCATION AS A PROMISE TO A JOB HAS LOST CREDIBILITY TO MANY YOUNG PEOPLE WHO SEE THEIR OLDER BROTHERS AND SISTERS OR A DISPLACED PARENT UNABLE TO GET A JOB PROVIDING MORE THAN A SUBSTANDARD LEVEL OF LIVING.

EARLIER, I ALLUDED TO THE LOW LEVEL OF UNDERSTANDING OF TECHNOLOGY AND THE PROCESS OF INNOVATION -- AND THIS SURELY MUST CAUSE FRUSTRATION AMONG YOUNG PEOPLE. HOW CAN A YOUNG PERSON COPE EFFECTIVELY IN CHARTING AND FOLLOWING A CAREER PATH WITHOUT KNOWLEDGE OF THE PROCESS WHICH CREATES MOST OF THE NEW JOBS?

Relevant Curriculum: AN IMPORTANT PART OF THE ANSWER TO THAT QUESTION IS MORE RELEVANT CURRICULUM. CLEARLY, THE CENTRAL FOCUS MUST BE ON MATHEMATICS AND SCIENCE WHICH WILL REQUIRE A MORE COMPREHENSIVE CURRICULUM ON THOSE SUBJECTS. AT THE SAME TIME, THE IMPORTANT ROLE OF TECHNOLOGY, ALONG WITH THE TOTAL PROCESS OF INNOVATION, MUST BE CONTINUOUSLY TAUGHT, STARTING IN FOURTH OR FIFTH GRADES. REALISTICALLY, THE BEST AND ONLY PRACTICABLE WAY TO DO THIS IS WITH C.B.E. LEARNING ABOUT INNOVATION WILL CREATE A MUCH HIGHER INTEREST IN SCIENCE, MATHEMATICS AND LANGUAGES.

ADDITIONALLY, COURSES IN ENTREPRENEURISM, WHICH ARE PRESENTLY OFFERED IN A FEW PLACES, SHOULD BE TAUGHT IN ALL HIGH SCHOOLS. AGAIN, THEY CAN BE TAUGHT COMPLETELY, ECONOMICALLY AND EFFECTIVELY BY C.B.E.

Independent School Boards: WE COME NOW TO THE ELIMINATION OF ANACHRONISTIC INDEPENDENT SCHOOL BOARDS. DURING RECENT YEARS, MOST HAVE TAKEN FEW INITIATIVES FOR NEEDED CHANGE. FREQUENTLY, TURNOVER IS HIGH BECAUSE MEMBERS QUICKLY GET TIRED OF HASSLING WITH UNIONS OVER TEACHER PAY WITHOUT HAVING THE MEANS OF EVER REACHING A GOOD SOLUTION.

EVEN WORSE, THEY ARE USUALLY ISOLATED FROM LOCAL CITY AND COUNTY GOVERNMENTS. THUS, ECONOMIC DEVELOPMENT DECISIONS ARE MADE WITHOUT CONTROL OVER THE MOST IMPORTANT ELEMENT OF THE PROCESS. IT IS ANALAGOUS TO HAVING A KEY DIVISION IN A COMPANY SEPARATE AND AUTONOMOUS FROM THE REST OF THE ORGANIZATION.

CLEARLY, THERE NEEDS TO BE A RESTRUCTURING WHERE K-12 SCHOOL BOARDS ARE NOT SEPARATE FROM BUT PART OF COUNTY OR CITY GOVERNMENTS.

Undergraduate Education: BEFORE PROPOSING HOW RESTRUCTURING, REALLOCATING AND NEW APPROACHES CAN BEST BE CATALYZED TO OCCUR IN K-12 SCHOOLS, I WANT TO BRIEFLY REVIEW ACTIONS NEEDED FOR IMPROVEMENT AT THE UNDERGRADUATE LEVEL IN ACADEMIC EDUCATION.

EVEN THOUGH A RECENT CARNEGIE REPORT CHARACTERIZED UNDERGRADUATE EDUCATION AS A "TROUBLED INSTITUTION IN NEED OF REFORM ABOUT AS MUCH AS K-12 SCHOOLS," I AM GOING TO CONFINE MY RECOMMENDATIONS TO THREE ACTIONS WHICH WOULD BE THE MOST EFFECTIVE. THEY ARE:

- o ADOPTING COMPUTER-BASED EDUCATION AS THE PRIMARY METHOD OF INSTRUCTION FOR THE FIRST TWO YEARS OF THE CURRICULUM TO REPLACE ITS PRESENT SUPPLEMENTARY USE.
- o REMEDIATION FOR OTHER YEARS
- o SUBSTANTIALLY INCREASING FACULTY SALARIES

THESE ACTIONS WOULD HELP SUBSTANTIALLY TO INCREASE QUALITY OF INSTRUCTION, IMPROVE LEARNING OUTCOMES AND CONSTRAIN EVER RISING COSTS. ALSO, ENGINEERING SCHOOLS COULD BEGIN TO COPE BETTER WITH THE SERIOUS SHORTAGE OF FACULTY BY USING PLATO LOWER DIVISION ENGINEERING COURSEWARE. THUS, IT IS POSSIBLE TO IMMEDIATELY USE C.B.E. AS THE PRIMARY MODE OF INSTRUCTION FOR A SIGNIFICANT PART OF THE FIRST TWO YEARS OF THE ENGINEERING CURRICULUM.

USAGE OF C.B.E. IN COLLEGES OF EDUCATION IS ESSENTIAL FOR PROVIDING TEACHERS WITH TRAINING IN THE USE OF COMPUTER-BASED EDUCATION. THIS WILL HAVE TO OCCUR BEFORE THE FULL POTENTIAL OF C.B.E. IS REALIZED IN PRIMARY AND SECONDARY EDUCATION.

A FEW MONTHS AGO, DURING A VISIT TO A MAJOR MIDWEST UNIVERSITY, I MET WITH ALL OF THE DEANS TO EXCHANGE VIEWS ON THE USE OF COMPUTER-BASED EDUCATION. DURING THE DISCUSSION, I POSED THE QUESTION, "WOULD YOU FAVOR USING C.B.E. AS THE PRIMARY MODE OF INSTRUCTION WITH THE GOAL OF NOT INCREASING THE COST PER STUDENT, IMPROVING QUALITY AND SUBSTANTIALLY INCREASING FACULTY SALARIES." THE DEANS' RESPONSE NETTED DOWN TO "WE WOULD LIKE HIGHER PAY AND WE ARE IN FAVOR OF IMPROVING QUALITY, BUT TO USE TECHNOLOGY AS A PRIMARY MODE OF INSTRUCTION WOULD NECESSITATE A BASIC CHANGE REQUIRING A DECADE OR MORE TO IMPLEMENT, AND WE CAN'T DO THAT." THIS MEETING PROVIDED FURTHER EVIDENCE TO SUPPORT THE CONCLUSION I MADE TEN YEARS AGO -- COLLEGES WILL BE THE LAST PART OF OUR ACADEMIC SYSTEM TO REALIZE THE FULL POTENTIAL OF C.B.E. -- WHEN, OF COURSE, THEY SHOULD BE THE FIRST.

IMPLEMENTATION: IMPLEMENTING THE PLAN I'VE OUTLINED FOR IMPROVING UNDERGRADUATE, PRIMARY AND SECONDARY EDUCATION WILL BE VERY DIFFICULT. IN VIEW OF CURRENT ATTITUDE AND LACK OF PROGRESS IN TAKING THE NECESSARY ACTIONS TO MEET THE EDUCATIONAL NEEDS OF THE NATION, MUCH OF THE IMPETUS FOR IMPLEMENTATION WILL HAVE TO COME FROM OUTSIDE THESE INSTITUTIONS. THE BEST APPROACH, I BELIEVE, IS FOR THE GOVERNOR OF EACH STATE TO CONVENE A COMMISSION WHOSE MEMBERS INCLUDE TEACHERS AND ADMINISTRATORS FROM ACADEMIC EDUCATION, UNION REPRESENTATIVES, GOVERNMENT OFFICIALS AND REPRESENTATIVES FROM BUSINESS.

UNLIKE PREVIOUS COMMISSIONS ON EDUCATION WHICH FOCUSED MAINLY ON WHAT TO DO, THIS COMMISSION WOULD BE GIVEN THE GENERAL PLAN FOR WHAT TO DO BY THE GOVERNORS AND ASKED TO DEVISE THE BEST METHODS FOR PUTTING IT INTO PRACTICE.

CONSIDERING THE MOUNTAIN OF EVIDENCE BEFORE US OF THE SERIOUS OVERSEAS COMPETITIVE CHALLENGE, THE DRASTIC AND FAR-REACHING RESPONSE BY BUSINESS THROUGH RESTRUCTURING, REALLOCATING AND NEW APPROACHES, SURELY SUCH COMMISSIONS WOULD HAVE THE DEDICATION AND FORTITUDE TO FULFILL THEIR ASSIGNMENT.

DEVELOPING COUNTRIES

BEFORE CONCLUDING, I WOULD HAVE LIKED TO REVIEW THE PROGRESS WITH C.B.E. IN OTHER AREAS SUCH AS CONTINUING EDUCATION, EDUCATION AND TRAINING IN THE ARMED FORCES, FOR THE DISABLED AND IN CORRECTIONAL INSTITUTIONS; BUT TIME IS TOO SHORT. HOWEVER, I WILL SQUEEZE IN BRIEF REMARKS ON COMPUTER-BASED EDUCATION IN DEVELOPING COUNTRIES.

REALISTICALLY, THERE IS NO WAY THAT DEVELOPING COUNTRIES CAN MAKE ADEQUATE ECONOMIC AND SOCIAL PROGRESS WITHOUT IMPROVEMENT IN EDUCATION AND TRAINING ON A MASSIVE SCALE. PRIMARILY BECAUSE

OF THE CRITICAL SHORTAGE OF QUALIFIED TEACHERS, THE ONLY FEASIBLE WAY OF ACHIEVING THESE GOALS IS WITH COMPUTER-BASED EDUCATION. YET PAST RESISTANCE TO ITS ADAPTATION IN THOSE COUNTRIES HAS BEEN EVEN GREATER THAN BY ACADEMIC EDUCATION IN THE U.S. UNTIL QUITE RECENTLY, MOST TEACHERS AND GOVERNMENT AGENCIES IN DEVELOPING COUNTRIES, PRIVATE VOLUNTEER ORGANIZATIONS (PVO's); U.S. UNIVERSITIES WORKING WITH DEVELOPING COUNTRIES AND AGENCIES OF THE U.S. GOVERNMENT, WITH THE RESPONSIBILITY FOR IMPROVING ECONOMIC AND SOCIAL DEVELOPMENT ASSISTANCE IN THOSE COUNTRIES, HAVE BEEN UNWILLING TO ADOPT C.B.E. AS AN EDUCATIONAL TOOL.

LET ME REPEAT THAT I SAID "MOST" BECAUSE THERE WERE A FEW SUPPORTERS. REASONS FOR RESISTANCE INCLUDE FEAR OF JOB LOSS BY TEACHERS, LACK OF KNOWLEDGE OF THE MERITS OF C.B.E. AND BELIEF BY MANY PEOPLE IN THE U.S. GOVERNMENT AGENCIES "THAT THOSE PRIMITIVE PEOPLE COULDN'T HANDLE SUCH SOPHISTICATED TECHNOLOGY."

ALMOST TEN YEARS AGO, CONTROL DATA PLATO C.B.E. BASIC SKILLS INSTRUCTION WAS AVAILABLE ON A COST EFFECTIVE BASIS. YET THERE WAS LITTLE INTEREST IN MOST PLACES. BEING CONVINCED THAT THERE WAS NO OTHER WAY TO MEET THE MASSIVE EDUCATIONAL NEED OF DEVELOPING COUNTRIES AND THAT IT REPRESENTED A LONG TERM PROFITABLE BUSINESS OPPORTUNITY, CONTROL DATA DECIDED TO UNDERWRITE MOST OF THE COST OF INTRODUCING C.B.E. IN A NUMBER OF COUNTRIES. THREE OF THESE COUNTRIES WERE SOUTH AFRICA, GRENADA AND JAMAICA.

SOUTH AFRICA WAS SELECTED AS THE FIRST COUNTRY OF INTRODUCTION BECAUSE THE PARTICULARLY SEVERE AND SPECIAL PROBLEMS IN EDUCATION FOR BLACKS THERE PROVIDED AN ENVIRONMENT SIMILAR TO DEVELOPING COUNTRIES WHICH MADE THE ALTERNATIVE OF C.B.E. MUCH MORE ACCEPTABLE. THE FIRST SYSTEM WAS INSTALLED IN A PAROCHIAL SCHOOL ABOUT EIGHT YEARS AGO AND IS HIGHLY SUCCESSFUL. TODAY THERE ARE OVER 40 INSTITUTIONS UTILIZING PLATO C.B.E., AND THE RATE OF USAGE IS ACCELERATING.

ENCOURAGED BY SUCCESS IN SOUTH AFRICA, CONTROL DATA PROVIDED GRANTS TO ESTABLISH PLATO INSTALLATIONS IN A HIGH SCHOOL IN KINGSTON, JAMAICA AND A RURAL GRADE SCHOOL IN GRENADA. BOTH PROJECTS ARE SUCCESSFUL AND ARE KEY FACTORS IN GENERATING INTEREST IN UTILIZING C.B.E. BY U.S. GOVERNMENT AGENCIES, PVO's AND THE EDUCATIONAL ESTABLISHMENTS IN THOSE AS WELL AS OTHER DEVELOPING COUNTRIES.

C.B.E. WILL BE REACHING BEYOND ACADEMIC EDUCATION TO THE GENERAL POPULACE. ONE OF THE COMPREHENSIVE EFFORTS IN THIS RESPECT IS THE FAMILY SELF-RELIANCE PROGRAM WHICH IS BEING DEVELOPED IN A COOPERATIVE PROGRAM BETWEEN CONTROL DATA AND THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS.

BASICALLY, IT PROVIDES COURSES IN BASIC LITERACY AND EDUCATION, EMPLOYMENT PREPARATION, METHODS OF PROVIDING FOOD FOR A FAMILY OF SEVEN, PLUS CASH INCOME FROM ONE HECTARE OF LAND, AND PROCEDURES FOR VASTLY IMPROVING GENERAL HEALTH THROUGH TRAINING IN PERSONAL HYGIENE, SANITATION AND BASIC FIRST AID.

THE COURSE MATERIAL FOR HEALTH MAINTENANCE AND FARMING HAS BEEN PREPARED IN TEXT FORM AND USED SUCCESSFULLY. SINCE BASIC SKILLS, HIGH SCHOOL SKILLS AND EMPLOYMENT PREPARATION IS ALREADY BEING DELIVERED BY PLATO C.B.E., THE ONLY REMAINING WORK IS TO CONVERT THE AGRICULTURE AND HEALTH IMPROVEMENT MATERIALS FOR C.B.E. DELIVERY. ONCE THAT IS DONE, THE C.B.E. PROGRAM CAN BE IMPLEMENTED BY LOCAL GOVERNMENTS, CHURCHES AND COMMUNITY GROUPS IN DEVELOPING COUNTRIES. OBVIOUSLY, THE FAMILY SELF RELIANCE PROGRAM WILL BE PROFOUNDLY BENEFICIAL.

CONCLUSION

WITH THAT THOUGHT, I WILL CONCLUDE BY NOTING THAT C.B.E. TECHNOLOGY WILL KEEP ON ADVANCING AT A RAPID PACE.

EXPANDING USE IN BUSINESS AND INDUSTRY WILL FUEL CONTINUING RESEARCH AND DEVELOPMENT. ADVANCES IN THE TECHNOLOGY WILL HELP TO ACCELERATE THE ADOPTION OF C.B.E. IN DEVELOPING COUNTRIES, AND THERE IS REASON TO BELIEVE THAT THEY MAY PROGRESS FASTER IN UTILIZING C.B.E. AS THE PRIMARY MODE OF INSTRUCTION IN ACADEMIC EDUCATION THAN WILL THE U.S.

WITHOUT OUTSIDE INTERVENTION, USAGE OF C.B.E. IN ACADEMIC EDUCATION WILL CONTINUE TO INCREASE BUT IN A SUPPLEMENTARY MODE. TRANSITION TO C.B.E. AS THE PRIMARY MODE OF INSTRUCTION IN ORDER TO GET THE FULL BENEFIT OF ITS POTENTIAL THE SOONEST CAN BE ACHIEVED BY ADOPTING THE RECOMMENDED PROGRAM.

WITHOUT RESTRUCTURING, REALLOCATING AND NEW APPROACHES, ACADEMIC EDUCATION WILL BE THE ACHILLES HEEL WHICH WILL THWART THE U.S. DRIVE TO MEET THE FOREIGN COMPETITIVE CHALLENGE.