14/9/83

OPENING ADDRESS : THIRD SOUTH AFRICAN COMPUTER SYMPOSIUM ON RESEARCH IN THEORY, SOFTWARE AND HARDWARE

In 1975, shortly before I took up my present position as Vice-Chancellor of Rhodes University, an overseas computer expert, sponsored by one of the computer suppliers, was touring South Africa, assessing the state of computer development in this country. One of his conclusions, it was reported, was that Computer Science here needed a father figure, or elder statesman. He was kind enough to suggest that I was the nearest approach, but that unfortunately I was being lost to the field. Eight years later, after being put out to pasture in the bucolic fastness of the Eastern Cape, the organisers of this symposium have kindly called me back into circulation, at least for a brief appearance. I am duly grateful to them for the invitation.

Grahamstown, as you all know, is very English and very 19th Century. Our High Street runs from the Drostdy Arch, on the edge of the campus, past the Cathedral to the Railway Station about a kilometre away. Our local student newspaper once said that the Drostdy Arch was the gateway to the academic world, the Cathedral the gateway to the spiritual world and the station the gateway to the real world. On this occasion my gateway to the real world was the Port Elizabeth airport. Certain cynics of course will remark that Pretoria is no more part of the real world than Grahamstown. Be that as it may, the 19th Century steam trains that thread their way through Grahamstown's best suburbs several times a day serve to remind me that I must be one of the few present to-day with direct experience with "steam" (ie pre-transmitter or rather pre-semiconductor) computers.

THIS TRAIN OF THOUGHT SET ME REMINISCING BACK TO THE FIRST COMPUTER PROGRAM I EVER WROTE. IT WAS DURING MY FIRST TERM AT HARVARD, BACK IN 1957. AN EMINENT PROFESSOR OF APPLIED MATHEMATICS ASKED ME TO EVALUATE AN INTEGRAL FOR HIM. THE RESOURCE AVAILABLE WAS A UNIVAC I COMPUTER WITH THE UNHEARD OF QUANTITY OF 2 000 WORDS OF MERCURY DELAY LINE STORAGE, PERIOD. NO FORTRAN (AS YET UNINVENTED) COMPILER OR EVEN AN ASSEMBLER. I WROTE THAT PROGRAM IN ABSOLUTE MACHINE CODE. THE ONLY PERSON WHO KNEW HOW TO OPERATE THE MACHINE WAS A HIGH-SCHOOL DROPOUT NAMED KELLY. THE WHOLE INTELLECTUAL POWERHOUSE OF HARVARD UNIVERSITY WAS BEHOLDEN TO THIS RATHER UNPROMISING YOUNG MAN. I MUST HAVE PRODUCED THE RIGHT ANSWER BECAUSE THE PROFESSOR NEVER CAME BACK TO ME, NEITHER DID THE SPACE VEHICLE NOSECONE ON WHOSE DESIGN HE WAS WORKING BURN UP ON RE-ENTRY.

HOW WOULD THE PROFESSOR EVALUATE A DEFINITE INTEGRAL IN 1983 AS OPPOSED TO 1957? HE WOULD SIT DOWN BEFORE A VIDEO SCREEN AND CALL UP SOME COMPREHENSIVE NUMERICAL SOFTWARE PACKAGE. PROBABLY BY MEANS OF MENU SELECTIONS HE WOULD BE PRESENTED WITH THE NUMERICAL INTEGRATION COMPONENT, AND AFTER SUITABLE PROMPTING, SUPPLY IT WITH HIS FUNCTION, LIMITS OF INTEGRATION AND PRECISION REQUIRED. HE WOULD HAVE NO MORE NEED OF A KNOWLEDGE OF PROGRAMMING NOW THAN HE WOULD HAVE HAD THEN, BUT AT LEAST HE COULD ELIMINATE COMPLIANT GRADUATE STUDENTS AND HIGH-SCHOOL DROPOUTS.

IN ATTEMPTING TO ASSESS WHAT HAS CHANGED IN THE INTERVENING 26 YEARS BETWEEN 1957 AND 1983 I TRIED TO APPORTION HOW MUCH OF THE CHANGE WAS DUE TO ENGINEERING AND HOW MUCH TO SCIENCE. I CAME TO THE CONCLUSION THAT MOST OF IT WAS ENGINEERING. TO BE SURE THE HARDWARE

REPLACEMENTS, MAGNETIC CONES AND THEN SEMI-CONDUCTORS, ESPECIALLY THE LATTER, REQUIRED SOME FAIRLY SOPHISTICATED PHYSICS TO BRING THEM INTO BEING INITIALLY. SOME OF THE SOFTWARE PORTIONS OF THE OPERATING SYSTEMS AND THE COMPILERS IN PARTICULAR, UTILISE PRETTY ABSTRACT LANGUAGE, STRUCTURE AND CONCURRENT PROCESS THEORY THAT IS OBVIOUSLY CLASSIFIABLE AS SCIENCE. THE REST, PERHAPS 90% OF IT, IS ENGINEERING, OR IF YOU WISH TO CALL IT BY ANOTHER NAME, TECHNOLOGY.

AT SEVERAL KEY POINTS IN MY SUBSEQUENT CAREER I HAVE FELT A LITTLE UNEASY WITH THIS OBSERVATION. WHEN I RETURNED TO WITS, FRESH FROM THE HEADY CLIMATES OF HARVARD AND IBM POUGHKEEPSIE MY FIRST IMPORTANT OBJECTIVE WAS TO BEND THE RECALCITRANT SOFTWARE SUPPLIED BY OUR FRIENDLY COMPUTER MANUFACTURER TO THE NEEDS OF A CAMPUS ENVIRONMENT. THE RESULTS IN SOME CASES WERE SPECTACULAR, INCREASING THE THROUGHPUT

OF THE MACHINE FOR OUR PURPOSES A HUNDREDFOLD. IT WAS CHALLENGING, IT WAS EXCITING, IT WAS FUN, BUT IT WAS NOT SCIENCE: IT WAS ENGINEERING. IT WAS A NECESSARY PRELUDE TO COMPUTER SCIENCE, FOR WITHOUT THE PROPER RESOURCES THERE SEEMED NO POINT IN INAUGURATING COMPUTER SCIENCE COURSES.

LATER IN 1967, WHEN I WAS APPOINTED THE FIRST COMPUTER SCIENCE PROFESSOR ON THE CONTINENT, I HAD TO GIVE SERIOUS THOUGHT AS TO WHAT I WAS TO PROFESS. MY INSTINCTS WERE THAT COMPUTER STUDIES, TO GIVE THE SUBJECT A NON-QUESTION BEGGING NAME, BELONGED MORE APPROPRIATELY IN AN ENGINEERING FACULTY THAN IN SCIENCE. MY ENGINEERING COLLEAGUES AT THAT TIME INSISTED THAT ENGINEERING DEALT ONLY WITH TANGIBLE OBJECTS: STRUCTURES, MACHINES, CIRCUITS AND THE LIKE. HOW COULD ANYTHING AS ETHEREAL AS A PROGRAM POSSIBLY BE ENGINEERING? I REMAINED CONVINCED

THAT THE HABITS OF MIND OF THE ENGINEER - PRODUCE A WORKING PRODUCT WITH MAXIMUM EFFICIENCY USING THE KNOWN AND PROVEN TECHNOLOGY OF THE DAY - WERE THE APPROPRIATE ONES. THE DIE, HOWEVER, WAS CAST FOR ME. PROFESSOR BLEKSLEY RETIRED, AND I FOUND MYSELF IN 1970 THE HEAD OF A COMBINED DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTER SCIENCE IN THE FACULTY OF SCIENCE AND COMMITTED TO PRODUCING THE FIRST COMPUTER SCIENCE PROGRAMME IN THE COUNTRY. AT LEAST APPLIED MATHEMATICS WAS THE MOST ENGINEERING-LIKE DISCIPLINE IN THE SCIENCE FACULTY, BUT NONETHELESS I FELT COMMITTED IN CONSCIENCE TO DEVISING THE MOST SCIENCELIKE SYLLABUSES THAT I COULD. NEEDLESS TO SAY, I WAS FAIRLY ROUNDLY CONDEMNED IN CERTAIN QUARTERS FOR TAKING WHAT WAS REGARDED AS AN OVERLY ACADEMIC APPROACH.

FROM THOSE HUMBLE BEGINNINGS "COMPUTER SCIENCE" HAS EXPANDED TO THE POINT WHERE IT IS TAUGHT IN SOME FORM OR ANOTHER BY SOME 110 ACADEMICS IN AT LEAST 17 INSTITUTIONS, AND PRODUCES OF THE ORDER OF FOUR OR FIVE HUNDRED GRADUATES PER ANNUM. IT HAS REACHED A PLATEAU OF RELATIVE STABILITY TOO: AS ONE LOOKS AT SUCCESSIVE EDITIONS OF THE COMPUTER SCIENCE LECTURERS ASSOCIATION NEWS, MOST OF THE NAMES STAY THE SAME.

ONE BRANCH OF STUDY THAT HAS HIVED OFF FROM COMPUTER SCIENCE HAS COME GENERALLY TO BE KNOWN AS BUSINESS DATA PROCESSING OR BUSINESS INFORMATION SYSTEMS, AND IS USUALLY TO BE FOUND IN COMMERCE FACULTIES. I REGARD THIS AS A WHOLLY ADMIRABLE DEVELOPMENT, SERVING AN UNAMBIGUOUS AND GENERALLY USEFUL PURPOSE. ITS PRODUCTS WILL BECOME EITHER BUSINESSMEN AND ACCOUNTANTS WHO WILL BE ABLE TO PUT COMPUTER SYSTEMS TO GOOD USE BECAUSE THEY UNDERSTAND THEM, OR ELSE SYSTEMS

ANALYSTS AND THE LIKE WHO WILL TAILOR THE RIGHT SYSTEM TO THE APPLICATION IN HAND.

SOME COMPUTER SCIENCE DEPARTMENTS, ON THE OTHER HAND, SEEM TO BE TO BE SUFFERING FROM A CERTAIN AMOUNT OF THREE-WAY SCHIZOPHRENIA. THEY ARE ANXIOUS TO ATTRACT LARGE NUMBERS OF STUDENTS, AND THEY KNOW THAT 80% OF THE JOBS ARE BUSINESS ORIENTATED. THEY THEREFORE PAY LIP SERVICE TO THIS PHENOMENON BY TEACHING A SMATTERING OF COBOL AND SYSTEMS ANALYSIS. IN MY VIEW THEY MUST LEARN NOT TO SUCCUMB TO THIS TEMPTATION. RATHER LEAVE THE GENERATION OF LOW-LEVEL COMMERCIAL PROGRAMMING FODDER TO THE TECHNIKONS AND TO THE TRAINING HOUSES, SOME OF WHOM DO A VERY GOOD JOB. EMPLOYERS TOO MUST REALISE THAT THEIR RESPONSIBILITY FOR ON-THE-JOB TRAINING CANNOT BE ABDICATED.

EVEN IN THE COMPUTER SCIENCE PORTIONS OF THEIR SYLLABUS WE SEE SOLID EVIDENCE OF MY OLD DILEMMA OF SCIENCE VERSUS ENGINEERING. TOO MANY OF THE TOPICS ARE REALLY ENGINEERING. SOME DEPARTMENTS, TO THEIR CREDIT, HAVE RECOGNISED THIS EXPLICITLY AND LABELLED COURSE MODULES WITH TITLES SUCH AS "SOFTWARE ENGINEERING" AND "MANAGEMENT PROBLEMS WITH NEW PROGRAMMING METHODOLOGICS". FAR TOO LITTLE IN EVIDENCE ARE TOPICS SUCH AS FINITE AUTOMATA, REGULAR GRAMMARS, CONTEXT-FREE LANGUAGES, RECURSION, COMPUTATIONAL COMPLEXITY AND THE LIKE, WHICH ARE REALLY THE THEORETICAL KERNEL OF COMPUTER SCIENCE PROPERLY SO-CALLED. IF A DEPARTMENT WISHES TO GO THE SOFTWARE ENGINEERING ROUTE, BY ALL MEANS LET IT DO SO, BUT THEN IT MUST NOT LAY CLAIM TO THE TITLE SCIENCE. AT BEST IT COULD BE CONSIDERED APPLIED SCIENCE.

THIS DILEMMA IS BY NO MEANS A SOUTH AFRICAN ONE ALONE, AND ONE CAN SEE HOW IT AROSE. UNDER STRONG PRESSURE FROM INDUSTRY AND COMMERCE TO PRODUCE "USEFUL" PEOPLE QUICKLY THE MORE THEORETICAL ASPECTS OF THE SUBJECT HAVE BEEN DRASTICALLY UNDERPLAYED, BECAUSE THEY WERE FELT TO BE NOT VERY SALEABLE, AT LEAST IN THE SHORT TERM. THE REAL DANGER IS THAT SOME THEORETICAL BREAKTHROUGH SOMEWHERE COULD RENDER A GREAT MANY OF OUR PEOPLE OBSOLETE OVERNIGHT, WITHOUT ANY SOLID KNOWLEDGE BASE ON WHICH TO FALL BACK.

SOME OF THE OLDER SCIENCES, NOTABLY MATHEMATICS, PHYSICS AND CHEMISTRY, HAVE NOT SUCCUMBED TO THIS SIREN CALL. THEY HAVE OBSTINATELY STUCK TO BEING PURE <u>SCIENCES</u>, NO MATTER WHAT THE EMPLOYMENT FASHIONS OF THE DAY. THEY HAVE FALLEN ON HARD TIMES AND HAVE SEEN STUDENT NUMBERS DWINDLE, SOMETIMES DRASTICALLY. BY NOT

COMPROMISING, HOWEVER, THEY HAVE NOT SAPPED THEIR INTELLECTUAL VIGOUR. I OFFER ONE REPRESENTATIVE PIECE OF EVIDENCE. I AM A REGULAR READER OF A BI-MONTHLY JOURNAL, AMERICAN SCIENTIST, WHICH HAS A VERY FULL BOOK REVIEW SECTION. FROM THIS IT IS EVIDENT THAT TO-DAY'S PHYSICISTS ARE HAVING A VERY LIVELY TIME, ESPECIALLY IN THE FIELDS OF SUB-NUCLEAR PARTICLES AND COSMOLOGY. IN THE LATTER FIELD THEIR PHRASEOLOGY HAS BECOME ALMOST THEOLOGICAL : THEY TALK ABOUT FIRST THINGS (THE BIG BANG) AND LAST THINGS (PROTON DECAY). THE CHEMISTS ARE OF COURSE AS LOQUACIOUS AS EVER. I ONCE ASKED A STATISTICS COLLEAGUE WHY CHEMISTS TALKED SO MUCH AT MEETINGS. HE ADVANCED AN INTERESTING HYPOTHESIS : THEY ARE ALL SUFFERING FROM A MILD DOSE OF MERCURY POISONING (A POLITE WAY OF SAYING THAT THEY ARE ALL MAD HATTERS!)

ONE OF THE SUBDIVISIONS IN THE REVIEW SECTION OF THIS JOURNAL IS ENTITLED MATHEMATICS AND COMPUTER SCIENCE, AND IT IS ALWAYS WITH A SHOCK THAT I REACH THESE PAGES. BOOKS ON MANY BRANCHES OF MATHEMATICS - REPRESENTATION THEORY, TOPOLOGY, GROUPS, FUNCTION THEORY, DISCRIMINANT ANALYSIS AND SO ON- ARE FREELY REVIEWED, BUT ONLY IN ABOUT ONE ISSUE IN THREE DOES ONE COME ACROSS ANY COMPUTER TITLES AT ALL! THE LAST ONE REVIEWED WAS ESSENTIALLY A HANDBOOK ON NETWORK PRACTICE, HARDLY SCIENCE.

'ADIES AND GENTLEMEN, WHAT I AM PLEADING FOR, IN A NUTSHELL, IS A GREATER COMMITMENT TO INTELLECTUAL RIGOUR AND A RETURN TO BASICS IN COMPUTER SCIENCE. I AM NOT WISHING TO DENIGRATE THE WORK OF EITHER COMMERCE OR ENGINEERING. ON THE CONTRARY I HAVE THE GREATEST ADMIRATION FOR THESE ENDEAVOURS. HOWEVER INTRINSICALLY WORTHWHILE

THESE ACTIVITIES ARE THEIR PRACTITIONERS WOULD BE THE FIRST TO ADMIT THAT THEY ARE NOT SCIENCE. IF COMPUTER SCIENCE IS LEGITIMATELY TO LAY CLAIM TO RETAINING THE SECOND WORD IN ITS TITLE IT MUST RE-COMMIT ITSELF TO THEORETICAL FUNDAMENTALS AND RECOGNISE MORE EXPLICITLY ITS AFFINITY WITH COGNATE ABSTRACT DISCIPLINES SUCH AS MATHEMATICS AND LINGUISTICS. NOW THAT THE HELTER-SKELTER OF OUR PIONEERING DAYS ARE BEHIND US WE HAVE TIME TO THINK OF CONSOLIDATION AND TO REFLECT ON WHAT OUR SUBJECT IS, OR SHOULD BE, REALLY ALL ABOUT.

THE VERY HOLDING OF THIS THE THIRD SOUTH AFRICAN COMPUTER SYMPOSIUM ON RESEARCH IN THEORY, SOFTWARE AND HARDWARE IS HEARTWARMING EVIDENCE THAT THE PROCESS TO WHICH I HAVE ALLUDED IS ALREADY UNDER WAY. THE ORGANISERS ARE TO BE CONGRATULATED ON THEIR STRUCTURING OF THE PROGRAMME AND THE AUTHORS ON THEIR DILIGENCE AND INDUSTRY. THE TITLES

OF SOME OF THE PAPERS WOULD FIT INTO THE SCIENTIFIC CATEGORY. OTHERS DO NOT, BUT I AM SURE THAT ALL THE SPEAKERS WILL HAVE SOMETHING INTERESTING TO TELL US. I NOTICE THAT THE NEXT SPEAKER COMES DOWN FIRMLY ON THE SIDE OF PROGRAMMING BEING A SCIENCE, AND I AM SURE THAT YOU ARE ALL JUST ABOUT READY TO HEAR WHAT HE HAS TO SAY.

IF THESE SYMPOSIA ARE TO BECOME A REGULAR FEATURE OF OUR INTELLECTUAL LIFE I MAKE BOLD TO SUGGEST THAT THEY MIGRATE ABOUT THE COUNTRY. ALTHOUGH UNKIND PEOPLE SOMETIMES SAY THAT GRAHAMSTOWN IS THE END OF THE LINE, AND THAT WE LIVE IN A TIME WARP, WE NONETHELESS HAVE SOME INTERESTING DEVELOPMENTS IN BOTH COMPUTERS AND ELECTRONICS. WE CAN ASSURE SOME FUTURE EDITION OF THIS GATHERING A VERY WARM WELCOME.

IN ANY EVENT I WISH GUESTS, PARTICIPANTS AND SPEAKERS ALIKE A MOST SUCCESSFUL SYMPOSIUM. I AM GREATLY HONOURED TO HAVE BEEN INVITED TO GIVE THIS OPENING ADDRESS, AND I HAVE PLEASURE IN DECLARING THE SYMPOSIUM WELL AND TRULY LAUNCHED.

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