MAX PALEY TC-95
edited

#1.

S. Why don't we just start there at the beginning of your career. When did you start working for IBM?

P. February, 1949.

S. How did you come to work for IBM?

P. I'm a native of Poughkeepsie and a graduate of Penn State. The president of the bank in Poughkeepsie was a Penn State graduate and very close to the IBM executives including Mr. Watson and strongly suggested that I should look for work at IBM if I were interested. When I was in high school in Poughkeepsie, I was in Junior Achievement and IBM was my sponsor. I told him I would be interested but I was concerned that IBM was strictly mechanical and my background was more in electronics and servo-mechanisms. I then had an interview with Dawse Bibbey, who was General Manager of Poughkeepsie, and Frank Welch, who was head of the General Engineering Training Program, and I was hired in September, 1948 to join the Engineering Training Program which would begin in August, '49. Since I finished school after some graduate work in January, they asked if I wished to come and work in Engineering for six months prior to the beginning of school. During that time I started to work on the 604 in Product Engineering and Release to Manufacturing.

S. Were you an electrical engineer?

P. Yes an electrical engineer. But I did graduate work in control theory and knew nothing about computers. Initially at IBM I helped design a small relay storage unit that was to be used as an auxiliary storage, which turned out to be the first Card Program Calculator. It was called the 604 CPU at the time, not the 605, which came later.

S. Was the 604 a Card Program Calculator?

P. No the 604 was a plugboard controlled punch card calculator. It was an electronic tube computer that grew out of the 603, which was an electronic computer designed by Ralph Palmer and Jerry Haddad in Endicott.

S. Did you have something to do with the CPC?

P. Yes, I'll get to that later. During my Engineering Training Program the last three months was a design session and I decided that my design problem would be to design or invent a square root circuit for the 604. Based on that work, when I came back to Poughkeepsie in August of 1950, I returned to the Product Engineering area to work on the 604 with Ed Garvy. At that time we started working with Sales Engineering and Product Planning on the requirements to upgrade the old 604 CPC into what was later called the 605 Card Programmed Calculator. At the same time, there was another effort by a team called the Wooden Wheel, which was named after the inventors, Bill Woodbury, Truman Wheelock and Greg Tobin. Woodbury and Tobin had worked at Northrop Aircraft

and formed the initial team that requested the 604 Card Programmed Calculator, which in addition to having the computer programmed by cards and having the program change with the relay storage I referred to earlier, it also had a printer output which the 604 did not at that time. They started expanding this and replacing the vacuum tube storage with cathode ray storage.

S. At Northrop?

P. No at IBM. IBM hired Woodbury and Tobin and they joined with Wheelock at Poughkeepsie. This was about the same time that the 701 was being designed. The Wooden Wheel was actually delivered to Northrop on a contract basis. I proceeded to take the ideas out of that, one of the main features of which was to eliminate the plate followers which were more succeptible to noise and required additional circuitry to invert as you went from level to level and also had very limited driving power and replaced them with cathode followers which were used in the Wooden Wheel. The result of this technique was that we were able to eliminate enough tubes so that the 604 could be reduced to four panels which was two-thirds of the old 604 as a major cost reduction program. With two panels left in the 604 and pressures from Sales Engineering, we decided to put some more logic and program steps and called it the 607. With the 607, we also announced a companion box of electronic tube

storage so that the 607 could be purchased on either a single box basis with expanded electronic storage.

S. This is still plugboards then?

P. Still plugboards, yes. In June of 1954, Ralph Palmer asked if I would take a look at the application of transistors and cores to the 604 computer, and he indicated that he would like to have a model to dedicate the Research Laboratory in October. We put a team of engineers who had worked in transistor circuits and on the 604 and we built a transistorized 604.

S. Who were these guys?

P. They were .... I cannot remember all of their names but some of the key people who I do remember were Paul Eckelman, Dick Weiss, Ed di Cambio, Ray Emergy, George Bruce, Bob Ibeson, for example. Most had spent a great deal of time in the circuit area working on circuits. The machine was ready and was put on a road show as the first operational transistorized calculator.

S. And this was strictly a multiplying machine?

P. The 604, exactly. Once we had that going, then in December of 1954, I was made Manager of Electronic Accounting Machine Development. The first project in the computing field we took on was the upgrading of the

Wooden Wheel replacing the cathode ray storage with magnetic core storage and adding some logic to it.

S. The Wooden Wheel did what?

P. The Wooden Wheel was a large CPC and it had a thousand words of core storage.

S. And a plugboard.

P. A plugboard control, although you could wire it to operate almost like a stored program.

S. This was a very large program plugboard.

P. Yes it was a large program plugboard, similar to that which was used in the 407 accounting machine. The core version of the Wooden Wheel was a contract which we had and gave to the Daystom Corporation in Archibald, Pennsylvania. The people that worked directly on that were C. S. Rourk, T. Wheelock, H. Robson and Ed di Cambio from IBM. We delivered three of these systems. In the meantime while this program was going on, Palmer decided to take a look at trying to redo the entire product line replacing the electronic accounting machine or unit record and 700 series.

S. Let me ask you a question. In those early days you were involved

in EAM equipment, accounting machine equipment, you probably have a good insight into the motivations that were present for continuing this. Most of the people I have been talking to are people who originally dealt from their first days with the company, with computers or something electronic.

P. Who was that?

S. Ralph Palmer, to whom I had spoken. To most of the people of course computers eventually did replace all EAM equipment. I'd like to find out the reason for it and what was the environment that caused the continued development of thinking of EAM replacements, even though they were electronic replacements.

P. Well by far the majority of IBM's investment in the field was EAM. They had punched cards and tabulators, the medium of input was the card, the medium of output was the printed page or punched card and the calculating was done by either a mechanical calculator or a 604 electronic calculator. Yet as the businesses grew and demands were for more automation of data processing, the dem for higher speeds and more throughput became evident and the motivation to satisfy those people who were growing became very strong. They were familiar with this and we felt the stored program was too costly to enter into at that time.

S. In other words, there was a cost accounting made of what the 702 let's say, costs and what people were paying for the 407 compared to this?

P. Yes.

S. Do you remember the difference in price?

P. I think so. The average rental of the installation of EAM was something like five thousand and the average rental of the 702 was over twenty thousand. I think for example, we sold more than five thousand 604's and we sold maybe fifty 702's and that's quite a difference. Also in the field, the impact of software (languages hadn't really been accepted and most of the work was done in machine language or assembly programming). People didn't have qualified staffs to handle largescale data processing at the time and so our decision then was that we would use the basic concepts of unit record EAM, including the 604 and 607, and a development in Endicott which was an expanded 607 called the 608. We also were on the verge of a technology evolution to transistors and we had to go back and take a look at our strategy which at that time the 608 was a tube machine developed in Endicott, yet unannounced, and would have been obsolete in the United States. Then we developed the strategy which we called the Modular Accounting Calculator Program and this in turn triggered two events. One, Ralph Palmer and I met with Wally McDowell and persuaded him to persuade

Manufacturing that IBM should go into the transistor business.

We saw the day when integration of components was going to go on to the point where a greater piece of logic more and more was going to be done by a components area and felt IBM should have that capability. We then met with Bill Maier in Poughkeepsie and the decision was made to form a components effort in manufacturing transistors. That was the original alloy junction transistor program. With the new technology in hand, and the desire to expand the product line and replace electronic accounting machines, the second event took place and that is we began the MAC Program on Modular Accounting Calculators. Also at that same time, we hired a fellow named Rex Rice from Northrop who along with Woodbury, Wheelock and Tob n, was a pioneer in the Wooden Wheel. He was convinced that scientific calculating could grow into the 701 range very easily with a plugboard and persuaded us that we should base our line on a plugboard machine, since the infancy of the stored program would have been too traumatic to base the entire line on at that time. It turns out that we were wrong.

S. Northrop was a hotbed of.....

P. Of scientific computing, yes.

S. Yes and also of utilizing or pushing what they had as far as it could go without spending more money.

P. Yes that's true.

S. What was Northrop's impetus?

P. Well they felt that they could get the same performance and thruput a lot cheaper.

S. And so they turned down a 701.

P. Yes.

S. And kept the CPC?

P. Yes. As I said before, more than the CPC it was the Wooden Wheel.

S. Were they the main customer that pushed that idea or did you have indication that there were other customers equally receptive?

P. Well every CPC or 605 customer would have been receptive to this. On the other side of the coin, about the same time we announced the 650 calculator which was a drum machine and a stored program machine. That was developed in Endicott. Really the thing that changed the whole concept was not so much the stored program or the electronic calculator but the magnetic tape storage becoming acceptable as an input medium. We had larger data bases and the demand for taking over more and more accounting logic and editing for printing and very high speed input/output meant more memory in the CPU as the hard core. More memory meant that plugboards became extremely complex and the variety of jobs would require too many people to be employed just

plugging wires. The 701, 650 and 702 had been invented and data processing in a stored program concept was catching on. As it turned out, we in about the same time period hired a fellow named Jerry Blough to work on the 650 (750) which was part of the MAC Program. The first thing he did was to propose that we throw out the plugboard and go to a stored program. He didn't know how to bring the stored program concept into the very small machine and retain compatibility, because the complexities of a large machine are very costly and since we wanted to replace the entire product line with the world-wide effort, we had a dilemma. About that time also two engineers from IBM France, Gene Streems and Maurice Papo had come up with an idea of electronically controlling the print editing function that was done by the 407. Also there was a German proposal under Ted Eisle and Karl Ganzhorn which had another alternative and that in effect meant that there must be some merit to going this way. Anyway the people involved came from Endicott, World Trade and Poughkeepsie and we started to put together plans for a Modular Accounting Calculator line. We assigned the accounting machine to World Trade, a larger version to Endicott, and the very large machines to Poughkeepsie.

S. Was this all part of the MAC concept?

P. This was the MAC Program. I left my job as manager of EAM Development to head up this program. We transferred a number of key people

from Endicott to Poughkeepsie, for example, Charlie Allen, George Hawkins, Pete de George, Ted Lassiter and others. These were the people that were working on the tube 608. We formed a team. As I said before, Blough proposed a stored program and before long the Endicott people, since they had experience with stored programs on a 604, actually discovered a way to make a stored program into a small machine. Not that it was compatible, but it still was a stored program. Chuck Branscomb was a key member of that team. They designed the stored program feature that replaced the plugboard and the MAC Program as formerly known with plugboards, collapsed including the accounting machine in Europe and the net result was that the 1401 evolved. That however, did not satisfy the 700 series replacement and so Poughkeepsie started the development of a 750 which was a stored program version of the MAC Program that Blough had originally proposed. In the meantime, Endicott had been working on a 660 which was an upgraded 650, and Ralph Palmer made the judgment that Poughkeepsie who in addition to the 750 had just taken on the huge task of the STRETCH Program, felt that their resources to do both the 750 and STRETCH were not available and so he assigned the 750 to Endicott and the merger became eventually known as the 7070. STRETCH of course forced the SMS technology and this in turn permitted the 7090 and 7080 to appear.

S. What was the relationship between the WWAM, the World Wide Accounting Machine and the 1401?

P. Well the World Wide Accounting Machine was the original 140p in the plugboard concept. The key thing was that the normal controls which were on the 407 plugboard were put into electronic logic and the 1401, even though it was stored programmed, did retain all of these features.

S. What were some of the features that the 1401 had that were taken from the WWAM?

P. The print/edit function was the main invention in there.

S. Was that a major piece of machinery?

P. Well it was a major portion of the logic. You should understand that World Trade had an additional unique problem in that they were getting extreme pressure from the Bull Gama machine which was threatning the 604 installation in major utility and banking accounts in France and in Europe.

S. Was that Machine Bull?

P. Yes. Since the 1401 was redirected, it was on a much longer time schedule to satisfy the situation so I was asked to take an intermediate step and in order to meet the time requirements we took the Endicott 608 calculator out of mothballs and put it into production in France with locally produced components.

S. The transistorized..... was the 604 a transistori ed 604?

P. No, the 608 was a tube machine, the one at Endicott that was going to replace the 604 when the transistors and semi-conductor technology made it obsolete

domestically. As I stated, we took that machine and put a team of French engineers together and we demonstrated in 1957 and saved the key accounts and actually produced some 300 machines from an original forecast of 50. The machine was actually announced as the 628. In the meantime the U.S. was in a development cycle and the problem of course you understand was that it would take about five years to develop a machine with a new technology and about three years to develop one with an old technology. As I said before, since we couldn't wait the five years in Europe, we went directly with the 628. I think that brings us up to the 7000 series and the 1400 series.

S. Well which came first, the 1400?

P. Well the 700 series preceded the 7000 series and the 7090/7080/7070 are all upgrading of the 650, the MAC 750, the 702 and the 709. These were all developed concurrently with the 1401 which was the really completely new system without any predecessor. At that time it was apparent that in order to get a common technology, we required a common packaging program. While the STRETCH program which was also being done in IBM as a super computer entry forced the requirement to package with the density and performance that came out in SMS, in fact it was the volume requirements of the 1401 and the 7000 series that forced us into a standardization program. At that time Ralph Palmer assigned

Ed Garvy to come up with a solution and there were several alternatives. Palmer made the decision to go with Garvy's recommendation and the SMS technology was born.

S. Were you in on the beginning of the SMS?

P. Yes. If you really want to look at predecessors, the sms also came out of the MAC Program.

S. How did the concept start?

P. Well the started that in order to interconnect transistors, first of all transistor leads are small and it looked like they would be reliable so that it didn't make any sense to plug them in, that they should be inserted and soldered in automatically. So the necessary tooling for this was developed and then it further became clear that the interconnection by using a printed wiring technique was superior to using soldering and wiring on the small card, which was the SMS card.

S. Because of the small size of transistors?

P. Size, cost, reliability and the ability to automate.

S. Right.

P. So actually the first SMS card is right there in the MAC Manual (which I shoed Mr. Saphire at the time) and which looks very much like an SMS card.

S. What was that called, a printed card assembly?

P. It was called a MAC card. The whole object of course was the impact on manufacturing. Because machines being developed in the MAC Program indicated a large demand for cores and transistors that are peculiar to computers, IBM decided to manufacture its own transistors and cores. This would add a new facet and know how to manufacturing organization. It was only through the large demand for transistors generated by the common philosophy of these machines that we could justify the tooling to make transistors economically attractive. The following advantages also accrue in fabrication. Number one, automatic manufacture of pluggable circuit cards was practical due to the volume use of standard circuits, standard voltages and standard components. This includes the assembly of cards and panel wiring. Number two, that although this required complete tooling, ultimate tool costs were reduced with the use of standard assemblies and the ability to spread across the volume market. Also through this use of standard parts and assemblies, inventories were reduced. Improvement in testing quality control, etc. Pluggable cards were assembled, automatically soldered and automatically inspected and checked.

S. Who worked on the SMS?

P. In the MAC Program it was Warren Clittle who worked on it. In SMS per se, it was the Endicott team. It was under Ed Garvy.

S. Did it come out of the laboratory.

S. Did it come out of the laboratory?

P. Well there was no Components laboratory at the time. Components was a part of the Poughkeepsie laboratory and called Component Development and we had an interface called Component Circuit Development Packaging Development which during the MAC Program reported on a dotted line basis in and during the SMS Program was assigned to the Endicott laboratory for packaging and to the Poughkeepsie laboratory for devices and circuit development.

P. Let's see I think we're up to the 7000 series. You understand that when I came back from Europe again working for Ralph Palmer.

S. Let me ask you a few questions about Europe. What kind of influences were going on in Europe at the time you were there that you noticed in terms of American development, IBM development making an impact on Europe or vice versa?

P. Well there was quite a move to organize the European laboratories to make a direct contribution at that time. Ralph Morck was taken out of Endicott where he was Program Manager for the 1401. He was made Director of Engineering for World Trade. Ralph Morck was taken out of Endicott but I don't know what his position was. He was made Director of Engineering for World Trade and it was a

direct effort to tie the European laboratories in. The Netherlands lab was given the assignment of working then with the banking program, the British lab on small scientific computers and the French lab on the World Wide Accounting Machine. The British lab did their pioneer work for the read only store during this period.

S. In England?

P. Yes in England.

S. Did Charlie Bashe have any control over his programs?

P. Some.

S. I mean he contracted things to do to the Dutch laboratory there?

P. Not exactly. The laboratories, at least in that way, were somewhat autonomous in that they tried to serve the European market with a version of an American development hoping that while doing this they were also solving problems that might be applicable to America. In particular they were working on what was called a Post Gyro System which was the banking program which is handled by the post offices in Europe and they had to adapt the bank sorter/reader for the European market.

(Tape #4 and I don't recall what the last question was on #3 but I start off with a question on page #18 .....

S. To take care of European checks?

P. Right.

S. This was after the bank system was developed?

P. Well almost concurrently because the bank system hadn't been released or announced yet.

S. And what else?

P. Let's see, the French laboratory was given some assignments in core logic and they were working on paramatrons which was a concept that came out of the Japanese technology, a different type of logic which never panned out. The German laboratory was assigned the job of a line of small machines with a very small card which was called the 3000 series. As I stated, the French laboratory's main assignment was the World Wide Accounting Machine and the 628 and at that time advanced technology in the circuits area.

S. What was Ad Tech (advanced technology)?

P. Mostly circuit development in France. Research of course had a laboratory in Zurich which were working on hydraulics and films and magnetic logic. The Swedish laboratory which was established later, was working in the area of process control.

S. While we were talking about development of the 7000 series and the 1401, I think we were getting to what was in the WWAM that went into the 1401.

P. Well as I say most of the logic that controlled the input/output went into the 1401. But then there's really no magic in computing anyway. It's sort of straight forward. Both were decimal machines and .....

S. Was the logic of the 1401 totally different from anything you'd have to conceive for the WWAM?

P. Yes in a way. It was a differenr family of circuits. When you say logic, it was different. Of course using a stored program would make the logic

considerably different.

S. So actually then the correspondence between the WWAM and the 1401 is basically the WWAM I/O?

P. I don't know exactly. I do know French engineers and there were quite a few of them, did go to Endicott to participate in the design.

S. Do you remember who they were?

P. Beyond Streems and Papo I do not know. I did not have anything to do with the 1401.

S. What about the 7070?

P. Well when I came back from Europe, I worked for a while on SMS standardization and abou that time the RCA 604 was proposed for the Bell System data processing. The 7070 was under development and planned to go into that account but was not considered fast enough. In November, 1959, I was called into Learson's office and I had just been 24 hours before named IBM's Director of Standards. In that room there was Bob Evans, Ralph Palmer, T. V. Learson, Steve Dunwell, Charlie DeCarlo, Bill McWhirter, Ty Marcy, Jim Troy and Syd Lida. Evans was then Systems Manager in Endicott. He had re-organized the divisions. He was Systems Manager for the 1401 series and he was put on a special assignment with me because the 7070 got into severe

difficulties in manufacturing entry. We had some thirty machines on the floor and some dramatic changes were coming in that caused the production line to stop.

S. Your experience has been in manufacturing things, is that it?

P. Well release to manufacturing up to this point. Although I did develop the 607 machine from scratch and I did have the development of the whole MAC Program.

S. Let me backtrack for a second. The MAC Program stated as you describe, seems to have the seeds of the idea that we should have modular families. Was this the first appearance of that idea in IBM?

P. No. It was somewhat pre-dated by a card accounting machine family which was a proposal by Werner Buchholz to combine unit record type of processing. That is collating, punching and accounting, calculating all in one. It did not get out. It was impractical. There was too much mechanical integration but that was the first approach, to my knowledge, to integrate the accounting machine into one concept.

S. And what was the basic idea behind it?

P. The basic idea was two things and the advant of new technology we felt it made standardization absolutely necessary.

S. Was this solid state?

P. This was solid state technology. We're referring to the MAC Program now. The growing investment in the customer's office and the systems technology area as he went up in performance, meant that turn around time had to be seriously or significantly reduced and a family of machines which permitted this growth was the concept as is stated in the MAC manual which you have

read, the uniform systems, less customer training, standard procedures, compatible equipment, rearranging customer peaks, etc.

S. When you were in on the development, did you write this?

P. Yes I wrote that.

S. Did you conceive this or was it a group organization process?

P. I think Ralph Palmer, myself, Jerry Haddad were the key men behind it.

S. Well I've talked to them and they didn't mention it so maybe knowing this if you could give me some background on the motivation all three of you had, what kind of pushed you to think this was a good idea?

P. I remember very well Ralph Palmer called me one morning after I had been made Manager of EAM Development and asked what I thought about producing a standard line of machines. He was trying to combine everything, scientific accounting and the motivation came basically because the technology looked like we needed standardization and he predicted the growth concept. Ralph Palmer being the inventor of the 604, saw the way the product line was going, with electronic computers coming in, a combination of input/output and the advent of tape programs coming in. Based on this rationale he said that if we don't do something like this, we're going to have too many different product

and we're going to end up by having an impact on requirements of customer engineering, systems engineering and the customer. So in one respect, he succeeded in the end because we did standardize in the technology in the manufacturing area. We did not achieve our goal of standardization across the board in the machine organization area. There are some good reasons for that too. One reason is the scientific account had a different type of talent and different orientation and problem solution than the commercial accounts. These people were ready to take on more of a challenge in programming the systems and we did not have a standardized language. There was no such thing as an operating system. Everything was written and hand coded in assembly utilities and this made it difficult to standardize across the board. Anyway Ralph Palmer was the guy who was behind this.

S. This idea, was it a germ that eventually led to 360? What was the difference in time, five years or so?

P. Not specifically but generally.

S. The MAC Program.

P. I think first of all, the MAC Program was remembered by a lot of people. Everything has roots. STRETCH has had a lot to do with 360 if you dig in deep. There are some interesting historical developments on the way to 360, that is the 8000 series. Fred Brooks came in

from Research to Max Femmer's organization at the beginning and started to see if tapes were passe and if we were going to have a series of random access processors. Well what happened? The 8000 series was started right after STRETCH was in the laboratory and that was in development while the 7000 series was being released to Manufacturing. When the 7070 got into Manufac= turing trouble, we had the meeting I referred to. The assignment from Learson was twofold. A. Get the 7070 out of trouble with Evans in the engineering house and then engineer a replacement or a better machine. One of the opinions.... opti that we had at that time was to take one of the initial 8000 series machines called the 70AB being developed by Larry Kantor and a derivative, if you will, of the STRETCH Program, and use that as an answer for the growth. I was pushed very hard that way by DeCarlo and Dunwell. My assessment was however, that this would require an entirely dedicated software set and that incompatibility' was out of the question with the huge base of 7070's. Instead we took a team to the White Hart Inn in Connecticut, Phil Stouton, John de Veer, Claude Davis, some people from Endicott on the 7070, some people from Technology and gave them the charge to come up with at least a five times 7070 in performance. It turned out to be the 7074. So while I got into the 7070 program late, I had engineering control of that program which was being developed in Endicott for release to the Poughkeepsie plant and when Evans and I took over at the Endicott

engineering and Poughkeepsie it was in very serious trouble due to our exposure to engineering changes prior to a satisfactory product.

S. Where did the 7070 come from?

P. It came out of the 750 and 669. That's why you remember, Palmer made the decision he didn't have the resources in Poughkeepsie to keep both STRETCH and the 750. The 660 was to be a transistorized 650.

S. I see, but it never came off.

P. No but many common features were to be found there. For example, the drum from the 660 for program storage was also used for the 7070. The 7070 is quite an interesting machine.

S. But the 650 was the forebear of the 7070.

P. The 650 and the 750 were forebears because it used a lot of 750 techniques too.

S. The 750 came out of Endicott also?

P. No, the 750 was from the MAC Program in Poughkeepsie.

S. I see, the 750 was never built, right?

P. Right.

S. It was designed?

P. Yes.

S. Who designed the 750?

P. The 750 was Rex Rice's job. This was the one that started out as

as a plugboard and Jerry Blough came in and put the stored program in.

S. Since the 750?

P. Right.

S. What were some of the basics on it?

P. Decimal, fixed word, stored program. It had all the tape edit features and I/O features of the 1401 and it had electronic control with tape input/output.

S. It was aimed at what market?

P. It was aimed at the 702 commercial and 704 scientific. It was the first plan to go into the combination effort. You see, you had an intermediate calculator which was to cover the area really from the 604 to the 704 or 705 and then we had the 750 which was to cover the area from the 705 up to the 7090.

S. What was wrong with the 750?

P. We didn't have enough resources at Poughkeepsie to do both that and STRETCH.

S. And then it went to Endicott?

P. Well it don't take an engineering team to design the 650 and a 660 and get them to design a 750. It's just not going to work that way. It's like the Model 85 is now. The Model 85 looks more like a Model 65 than a Model 91. That's just the nature of engineering.

S. The engineers who are just familiar with it.

P. Sure.

S. In order in other words, because of the situation of no resources in Poughkeepsie and no inclination in Endicott, the 750 didn't get built. Was that the real reason?

P. Yes. Also the 750 design offered considerable scientific power also.

However, there were some features, notably alphabet, which were not needed. We were also thinking of an optional feature for high speed multiplier.

S. When the 750 was finally dropped, it was dropped for what reason and how was the decision made to do it?

P. The decision was made by Ralph Palmer. The 660 was going on in Endicott. We had the STRETCH contract. Ralph decided he did not have the resources to do both. We saw the 7090 and 7080 possibilities coming in later. So he decided to combine the 660 and 750 and do a 7070 in Endicott.

S. And where did the 7070 design start? In Endicott?

P. Yes.

S. Who was working on that?

P. Bob Avery. He is no longer with IBM. And Steve Blackford. He's in Endicott Manufacturing. These were the original people on it.

S. What was wrong?

P. Endicott had never developed a very large machine and they made some mistakes in miscalculating the impact of engineering changes on a large product introduction. They got themselves deeper and deeper in hot water and couldn't get out of it. They never handled a machine with this many circuits in it.

S. Was the 7070 patterned after the 650?

P. No, it was a combination of what we found on the 750 and the 660.

S. So it got to the point where the 7070 had been sold but there was difficulty in actually producing it.

P. We sold a lot of them. The first delivery was Texas Instruments and when I came into this it was supposed to have come out of B Test in December and as a matter of fact, my assessment as well as Bob Evans was that it wouldn't make it. We pulled it out of Product Test.

S. How did you rectify the situation?

P. We took a team of engineers and spread them over three machines assigning one for input/output, one for control and one for storage and we worked in parallel on engineering changes. The other major problem was what to do with the machines on the floor in Poughkeepsie and how to introduce them and put the changes in because there were different design recordkeeping systems, and so we had to wrestle that one also.

S. Where did you get the engineers to work on these three elements of the 7070?

P. Endicott and Poughkeepsie.

S. Was it a crash program?

P. Yes.

S. How long did you have to get it done?

P. I received the job in November. I was off by next June.

S. And everything ironed out?

P. Yes.

S. Was it strictly a matter of unscrewing the damage?

P. That was the main thing. We had some optimists in the program but never carried a machine into Manufacturing at all. These guys had to be pushed aside and more experienced people brought in. However, having gone through the 7070, these people became very valuable for the next go round. In the course of the next go round, this was to hold the line between the 7000 and 1400 series and force the 360 introduction. The hold the line effort of course was the 1410, 7010, the 7040, 7044 and the 7094 Model 1 and Model 2.

S. Did you have anything to do with the actual production of machines?

P. In manufacturing, no. I was always in engineering. On STRETCH I did have the manufacturing organization reporting to me on a temporary basis.

S. What about these other machines you just mentioned?

P. Well the 7074 came out of the 7070, as I said earlier.

S. What was the difference between the 7070 and 7074?

P. We used a higher speed arithmetic, higher speed circuit family and made some logical changes.

S. All these things being done in Endicott?

P. No, the 7074 was designed in Poughkeepsie.

S. Who designed it?

P. Phil Stouton and the key people in the program were Dan Duty, Dom Galage, John de Veer and Claude Davis.

S. You were in charge of moving all the big machines like the 7090?

P. Well while the 7070 and 74 were being worked on, the 7090 was being developed under George Monroe, the 7080 under Dick Tracy and I didn't have anything to do with that. When I finished the 7070 I went to Corporate Staff as Manager of Systems Components and four months later went back on another crash assignment because the STRETCH machine was enter in production and was having trouble. I was made czar on that program. STRETCH had a lot of problems because it didn't perform to specs. We did engineer an improvement program which improved the performance somewhat but still did not meet the anticipated performance.

S. What happened?

P. It's a long story. The main problem was that the architects walked off the job too soon and the engineers got hold of the machine and without a

knowledge of some of the basic rationale, they proceeded to take the most straight forward engineering approach and you have an analogy then of TV outlets in the bathroom, plumbing in the livingroom, stop lights where you should have clover leaves on superhighways, things like that that had to be ironed out. It was a monstrous undertaking.

S. And you came in after all the mistakes had been made.

P. Yes I came in very late in the program. As a matter of fact, I couldn't save the program from a marketing point of view. There was nothing I could do.

S. You could just lessen the damage a little bit.

P. Yes we eased the pain a little bit.

S. Did you release STRETCH for production?

P. Yes.

S. What was involved in releasing STRETCH for production?

P. Well once again, that went into the Kingston plant where they never put a commercial machine out before. So it was getting people trained to do that type of work. That's when I said I had manufacturing reporting directly to me.

S. And you had to get the Kingston plant ready to produce?

P. Yes and in addition to that, I had the marketing and customer contacts. STRETCH got into trouble because it started out with a goal to be ten times the 7090 and turned out to be five times. We had contracts for fourteen million dollars a system. Mr. Watson decided that if the evaluations came out that STRETCH were reall to miss this goal by a factor of 2, then we should cut the price by that amount and limit orders. We built seven of them I think. My relations with Bob Evans on the 7074 was very close. The 8000 series seemed to be floundering and at that point we also made a fundamental mistake of designing a new lines .... a new line of machines in the current technology when a new technology evolution was around the corner. When Bob Evans was asked by Learson to come in and reshape the new product line, one of the first things he did was to ask me to help him and he gave me the job of the interim machines which I referred to between the 1401, 7070, 7090, 7080 and the 360 machines and these were the 7040, 7044 which plugged a gap between the 704 and 7090, the 7010 and 1410 which plugged a gap between the 1401 and 7080 and 7070. The key theme of the hold the line machines was to design in a minimum cycle time and to retain as much compatibility or ease of programming without a traumatic change to the customer as possible. As an example, we started on the 7040 and 44 in May of 1961, and we shipped the first machine in March of 1963.

S. You were basically always on the line or very close to the market place?

P. Yes.

S. Your primary consideration wasn't necessary a new development, but a new development that would not be characterized by new technology.

P. I hadn't had a new development in technology since the MAC Program.

S. I'm kind of interested in this aspect of the business, where it is very practical aspect in that you were mentioning that you had to see that there was a growth for this machine and the 7010 would make the transition and so forth. But what you've been telling me all along, since the MAC Program, this seems to carry the sensitivity to actually what was being rented and sold and so forth. Were the decisions there always basically as you've been intimating, very closely tied to marketing needs and profits?

P. Yes, very sensitive to marketing needs at the time.

S. What's your idea of how this affected computer advances or what was the impact of this concept?

P. The impact of course was to dramatically change the number of large-scale systems that went into the field. We were now into the thousands and after the 1401, this was essentially a tape and file processing. That was a very interesting period, the hold the line period, because it became obvious to Evans that the

next generation, be it 8000 or what, should be based on a new technology. That was a wise decision, and then of course the Spread Committee which convened came out with the 360. I was involved in that because I was Manager of New Product Development, which was the hold the line, and as that job phased out in December of 1962, Evans asked me to take over engineering for System/360. I actually only held that job four months before I became Manager of System Planning and Development. I actually went to work for Fred Brooks as Engineering Manager and four months later he worked for me as Systems Manager and it worked out very well. During that time I took myself out of the mob for a while. In December of 1963 to tie together all of the preparations for announcement for 360 since this was a world-wide commitment and we had to be sure that input/output memories and technology were all geared to support the announcement.

S. Going back to the business about keeping the market going, you mentioned that thousands of machines were introduced into the field and many customers were made and kept busy with these systems.

P. There was a tremendous impact of software you see. The first operating system came with the 7090 and the 1410 turned out an operating system

S. Were you in the genesis of the concept of operating systems?

P. No.

S. Do you know who is?

P. I think Bob Ruthroff was. He was a key motivator, to my knowledge. However, it was becoming apparent that software was becoming so important out in the field too. The other thing was that the 1401 changed the concept of the market. There's a base of thousands of machines that needed growth, and as these grew, where are they going to go? They had to go essentially to a 7070 like atmosphere. That's where the 7010 came in.

S. That allowed the 1401 users to grow.

P. No, the 1410 permitted that and the 7010 was the growth for that. We did miss one machine. It was called the RAMAC 305 which was based on a non-tape system, random accessing processing from a disk file. It also had all the processing features, the logic of a processor in it but it didn't go over too well. It was a new concept and the area wasn't quite ready for software or for the idea of lack of archival storage. It did incorporate a good number of random accessing processing ideas into an improved 1401 which eventually became the 1410 and the 1410 in fact also offered both file processing and tape processing. And in addition of course, we put a 1401 compatibility feature in so that the 1401 programs would operate unchanged but also recognized that in order to really achieve the proper performance, reprogramming was necessary.

S. And a lot of these machines were bridging the gap between new generations of computers allowing the market to grow and stay with IBM?

P. That is correct.

S. And the market was willing to grow and stay with the IBM because of this?

P. I think the market was there if anybody wanted to try to get it. The key aspects of the IBM sales and service organization which responded with a tremendous understanding in systems concepts, working with the customer on its total problem. You know the IBM service and Systems and Procedures area was very important because this generally grew out of the old unit record area. As you grow into these machines, you find especially in commercial accounts, the investment in programming is pretty significant. One of the reasons why our strategy for the large systems entry on 360 included emulation. Although the scientific market is somewhat more receptive to change, the commercial market has to have a more gradual approach to it. They even have two different organizations -- one called SHARE and one called GUIDE. Basically these people in the scientific area or the SHARE groups are more mathematically inclined. They understand computers better. They seem to be more progressive. That's not to say that the commercial accounts haven't grown. They too have sharp people and the trend which is being proven is that these two areas are actually blending and in the future may see a complete disappearance of the break with the exception of a very small segment of the market.