SDD - Harrison
April 8, 1968

Memorandum to: Mr. L. M. Saphire

Subject: Oral History of Computer Technology Interview

Reference: Your memo to me dated April 2

I have noted areas where clarification is required.

                                        C. E. Branscomb

CEB:su

(Forwarded unsigned to avoid delay)

Date: April 2, 1968
From (location: CHQ Armonk
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SSD PRESIDENT
APR 4 10-06 AM '68

IBM

Subject: Oral History of Computer Technology Interview

Reference:

To: Mr. C. Branscomb

Here is the transcript of the interview we recorded. It
has not been edited for typist errors, etc. Would you
look it over and make any comments or additions you wish
and send it back to me. You will get a copy of the final
typing.

If any of your comments require extensive writing, it would
be better if we got together and taped what you have to say.
If you have any particular comments, please do not hesitiate
to call me.

Thanks for your cooperation.

L. M. Saphire
LMS:nd

Mr. Saphire
I have noted areas where
clarification is required.
C.B.

This is Interview TC-65 in the IBM Oral History of Computer Technology, Larry Saphire interviewing Mr. C. Branscomb on March 15, 1968.

S. Why don't you tell me a little bit about your background before you moved into the computer field. You were telling me that you were working in unit record equipment and that sort of thing.

B. Well I might very briefly just start at the beginning. I came with IBM in 1950 with a Master's Degree in Mechanical Engineering and went directly into the Endicott Laboratory in the Engineering Training Program and following the training program, was assigned to electro-mechanical development projects, the first one being a thing called Transcriber which was a 400 lines per minute electro-mechanical accounting machine. That particular project, after getting an engineering model developed, was subsequently terminated and was not carried to the market place. Following that I worked on various types of punched card or unit record type machines. I would say immediately prior to the 1401 days, I worked on what we called a basic card feed unit which was subsequently used on several card machines as the card feed unit -- the 1402, the 083 collator and others. Also worked on the development of the 084 2,000 cards a minute sorter and as a matter of fact, the latter stages of the development of the 084 sorter overlapped the beginnings of the development

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of the 1401. So in essence, a mechanical engineering and mechanical academic background but gradually began to get exposed to the electronic world in the Endicott lab and as a matter of fact, went through a so-called electronics training program some time around '56 or '57. Now moving on to the 1401,

. . . . .

S.   Could I just ask you a question?

B.   All right.

S.   About those years when you were in Endicott as a mechanical engineer, do you recall what your impressions were of the beginnings of the computer business in the company from the Endicott area point of view? Did it look at Endicott as if computers were going to do anything, even though the Mark I had been built at Endicott and the 650 of course was being built at Endicott.

B.   Well I would say a mixed outlook for this reason. The 650 of course was developed there and those of us in the lab gained adequate familiarity with the 650 to begin to understand the computing type of world as opposed to the unit record or punched card machine type of world and there was let's say, an attempt if you will, to move electronics development activity out of the Endicott lab. I don't recall the precise timing but I would estimate it to be in 1957, some time in that vicinity. I think this was simply the

recognition that we did not have unlimited resources in the electronics area
and there was a desire to consolidate that kind of capability in Poughkeepsie.
It did not work out in precisely that way, although several people did go to Poughkeepsie
as I recall. Quite a few remained in Endicott, both because of their desire
apparently to remain in Endicott and also I think because the laboratory manage-
ment in Endicott felt that electronics were going to be a part of the future in
various forms and that we should not transfer all of that kind of talent out of
the lab and into another location.

S. As a young engineer yourself at the time, working with the mechanical
end of it, did you feel that computers were the coming thing or not necessarily
you personally but the group as a whole. Or did it look there that unit record
machines were just going to go on as they had in the past?

B. Well no.

S. Just your impressions.

B. I would say that speaking of course as I do for myself, there was not
a very good grasp or visualization of the potential impact of computers certainly
as we know them today until the 1401 program came along. Indications of
that of course are the many attempts that were made to devise a new accounting
machine system. Almost all of them had electro-mechanical or semi-electro-
mechanical needs where the electronics was there to provide a little bit of

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storage capacity but did not provide the control a la stored programming nor the actual arithmetic operations. It only provided some electronic storage capability instead of providing storage by mechanical means. So in that I think I'm saying that it was with the early days of the 1401 that there began to evolve a picture of electronics technology moving into a cost range where you could afford to apply it to relatively small machines to do not only storage but also to do logic and arithmetic and control instead of utilizing a control panel. Now I think that the WWAM project in World Trade which of course used a fair amount of electronics, used it for storage and for logic but did not use it for control but continued to use a control panel for control and hence was conceptually primarily an accounting machine type design using a control panel but implementing as I indicated, the logic and arithmetic in electronics.

S. Was there any feeling about continuing on with the plugboard vs. stored program in Endicott at that time?

B. Well there are two key considerations that have to be approached. First is the question of cost. That is, can electronics be applied in the stored program mode at a cost level that will permit you to perform only fairly simple arithmetical and logical functions and justify the cost? Computers as we had known them prior to that time, had justified I believe much of their electronic cost by the fact that they were performing a considerable amount of computations

as opposed to the fairly simple, straight forward arithmetic and logical opera-
tions performed in an accounting machine. So cost was clearly a key factor.
The second key factor was of course the ability on the part of users to move
from a control panel type environment which they had known for years and of
course was being applied in considerable volume -- machines like the 407,
402 and 3 and collators and reproducers and so on. The ability of these people
to move from a control panel type machine to the stored programming concept
and program their machine and in really an entirely different way by putting
down on paper through utilization of certain prescribed procedures, etc. and
accomplishing as a minimum the same end result they did through a control
panel, and of course hopefully providing them considerably more flexibility,
with a stored program type machine. I would say those were the two key factors.
There was clearly a lot of discussion and debate as to whether or not the cost
level could be achieved and also whether or not unit record type customers
and by that I mean customer people, customer control panel wirers, applications
people, could adequately grasp stored programming and apply their problems
to this type of machine. Now let me just focus on the cost picture first.
Clearly the ability to meet the required cost levels was not reached until two
things happened I would say. First, the technology came along and it happened
to be SMS, but the technology came along that significantly reduced the cost

not only of electronics applied to logic and arithmetic operations but also significantly reduced the cost of electronics associated with building an electronic memory such as a ferrite memory. So the technology movement was certainly a key. Secondly, a machine design or a machine organization particularly created for minimizing the number of electronic components required to perform the fairly simple and straight forward logical and arithmetical operations associated with the extension of accounting machine type jobs as opposed to scientific computing type jobs. This meant that the total emphasis on the machine organization was cost and minimization of components rather than high computing type performance. It also meant I think another very significant item that should be related to the machine design and that is an ability to handle input/output had to be incorporated in the basic design. That ability had a requirement on it again to minimize the number of electronic components required and as a matter of fact, to share to the extent possible, the electronic components utilized in the arithmetic and logical portions of the machine because in fact the 1401 type machine is what you might call a high speed input/output type of machine, doing a nominal amount of manipulation of the data whereas the normal computer was looked upon as a system requiring a low level of input/output activity but a high level of internal computing and manipulation of the data. So let me move on to one

more item and then I'll come back and try to briefly summarize. This further item is that this machine organization and design would in fact establish the instruction set which the customer or user must work with at least until some higher level language could be devised and thus the further requirement on machine organization was to be very simple, very straight forward and to relate to the extent practical to accounting machine type operations. This implied handling variable length fields as accounting machines did and as computers did not do in those days. It implied a facility for easily handling editing of print ng, since as I indicated, there was a large amount of input/output and a large amount of printing, such things as float ng the full dollar sign, punctuation for amount fields, various kinds of format and print editing capability and other similar items relating to the input of informaton from cards, punching information out on cards or printing information out on report forms. Now briefly summarizing then, these key elements first, technology certainly was a key element because of the cost levels required to spread stored programming type capability across a large number of users, a large volume part of the market. That technology came through primarily SMS development and development of ferrite memories utilizing SMS capability to drive and to read and sense the memories. I might mention that the SMS generically of course applies to a broad technology area. The 1401 type machine required a specific type of circuitry in SI.

again for cost type reasons a thing we called CTDL type circuits, a diode type circuit as compared to the transistor type circuits that was initially used with SMS, the transistor circuit being much faster but much more expensive and hence again the trade-off of performance in terms of speed for the low cost of a diode type circuit. So that's the technology picture.

S. Were diode circuits in existence or just invented to reduce the cost?

B. It was developed in Endicott in relationship to the 7060... 7070 and the 1401 requirements at that time. So whether there is some comparable type of diode circuits in tube circuits or not, I suspect there was something that you might call comparable. However, there was a strong feeling by the early pushers of SMS that we should take advantage of the speed capability in transistor circuits, transistor technology, and as a matter of fact, there was a push to use a lot of transistors, the philosophy being that with quantity usage, cost reduction will occur. And both the 7070 and the 1401 could n t agree and live with that philosophy and hence the CTDL type of circuit was born in Endicott in those days.

S. Who were the people who were the main movers to develop the diode circuit?

B. I really don't know. I would say probably the machine technology people in Endicott at that time. I don't recall any specific individual.

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S.   How did these requirements for the 1401 in Endicott shape up?
What were the first tentative steps in deciding the technology you just described
as being necessary for the 1401?

B.   I was trying to summarize there about four points or so and then
come back and talk to you some more and we've gotten a little off the track
there I believe but maybe you would like me to pursue it on the technology.
I was going to hit the technology after the machine organization and design
aspects and the handling of input/output and the ease of use on the part of
the customer.

S.   Well we can do it then whichever way you feel more comfortable.

B.   We'll go better back to the technology thing.   What was the question
on technology?

S.   Well how did these requirements start shaping up in people's minds
and in your own mind?   Maybe you should tell me when you came to the 1401,
what was your particular responsibility.

B.   Well as I recall, I was something called Area Manager of Accounting
Machines at that time.   That was probably the summer of '57.   The WWAM
Program was in existence at the time, being developed primarily in the European
laboratories and in Germany and France.   There was a liaison function in
the Endicott lab to the WWAM Program.   This function was primarily to assist

the WWAM Program in getting accomplished those activities that had to occur
in the domestic labs to support the WWAM Program. In the fall of '57. . . .
well before I go into that let me just say that there was certainly a recognition
on the part of many people at that time that there was a broad volume vast market
for accounting machines and extensions of accounting machines to include
what we might generally call calculating ability at that time and the ability to
handle faster input/output, and the Market Planning people and the Engineering
people and Technical Planning people who drew up the specifications for the
World Wide Accounting Machine, WWAM, of course recognized that. The
Calculating Accounting Machine as I recall had been proposed in Poughkeepsie.
I can't remember the gentleman's name right now. Endicott had pursued
the machine called TAM as I recall, the Transistorized Accounting Machine.
That was not a full-fledged development project but primarily an exploratory
effort on this to understand what could be done with electronic technology moving
in the direction of accounting machine type functions. But the major activity
was the WWAM Project. Now in the fall of '57 there was a review of the WWAM
Project from a broad standpoint -- the cost of electronics, the technical approach
on the printer, which was a stick printer, and the general conclusion reached
later that year that while the WWAM approach had several interesting and
attractive features, that the cost levels that would come out of that project

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would not be satisfactory for the so-called expanded accounting machine market and also there was a conclusion I believe that the electronic technology was continuing to move forward at a rapid enough rate such that the control panel approach for controls would soon be obsoleted for an advanced accounting machine. Thus late in 1957, or possibly early in 1958, the WWAM Project as a development project moving toward the market place was stopped and in March of '58, the 1401 project was formally recognized and accepted as the approach we were going to pursue for an advanced accounting machine and for a broad market.

S.   Let me ask you this question. By that time, this was before the 1401 program was adopted, did the cost of the WWAM .... did it appear that the cost of the making of the 1401 machine, a stored program at that time would be worth the extra capability that you could get out of a stored program vs. the cost of the WWAM. Was there a competitive or market consideration in there?

B.   I don't recall the specifics in terms of the cost of WWAM and whether or not there was any significant changes in the projected cost of the WWAM machine during that period. Certainly Fran Underwood and Jim Ingraham and as I recall, Val Adams were working on a stored program approach, did

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find a way through machine design and machine organization concepts to apply

electronic technology and electronic memory a la ferrite memory in a way

that would permit a more attractive cost picture in a stored program machine than

had been previously visualized and there was clear agreement I think on the fact

that if one could solve the applications problem, that is, the transition of users

from unit record type programming to stored programming, that the stored

program design was much more desirable and much more flexible and certainly

had considerably more value in the market place and in the eyes of the customers.

Now I'm not sure if I answered your question or not.

S. Yes.

B. So another thing is that the movement in technology in the machine

design and organization work done combined to demonstrate the stored program

approach that looked very attractive. Now there were certain features that were

in the WWAM machine that were, certainly modifications of those features and

approaches were used in some areas of the 1401. This does not include

what I consider to be the key development or contribution that the 1401 machine

organization people made, namely how to get stored programming at the right

cost level. But it does include as I recall, certain features about how variable

field lengths will be handled and certain features about how input/output, particu-

larly card input/output would be gotten into the electronic area in a way that

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was relatively inexpensive from the standpoint of the number of electronic components used. And so there were certain features incorporated or expanded on or modified from the WWAM Program. But again I don't consider those features to be the key to the 1401 machine organization. As a matter of fact, there are features in the 701 that were incorporated into the 1401 design, the 701 and 705 as I recall, and I suspect not very many features from the 704 scientific oriented machine or the 650, which was the fixed word concept machine. But as I recall.... not the 701.... I probably should have said the 702 and the 705 which were commercially oriented machines and I believe were a single character at a time-oriented machines as was the 1401. I look at the 1401 machine organization and design which was evolved primarily under Fran Underwood's command, I would say, certainly with a lot of participation from Jim Ingraham and Val Adams and I believe Rus Rowley, they drawe upon a considerable amount of history in various areas but did come up with a unique design, particularly directed toward low cost, trading off in essence performance for cost and adapting stored programming type capability in a way that would not look completely new and completely different to the unit record programmer from what he had seen in control panel programming.

S. Well as the 1401 project got started in Endicott, were there any big hurdles or big problems that came up in the development or did it go smoothly?

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B. A development program never goes smoothly, particularly a signifi-
cant one. I don't recall the precise timing but there was a considerable amount
of emphasis during the development put on expanding the machine and making
it larger and more powerful with larger capacity in memory and so on and hence
more costly. We had laid out a set of objectives for the program at its incep-
tion, certainly by the time it was accepted as a full-blown program in March
of '58 which we felt were inviolate type objectives. They related to the cost
and the performance level in an accounting machine-like environment as opposed
to the computer-type environment. Now as I recall, there was a program
proposed and so on at San Jose, an extension of the 305 kind of program, called
a 305, which was for a while sort of a competitor to the 1401 and there was
as I mentioned a sort of continuing push for more power, more capacity even
at higher cost. Of course one of the key elements of the 1401 system is the
chain printer, he 1403 printer. Joanie Dayger had that under development
at the time we started the 1401 and it was being developed at that time
for a tape to printer type operation and we decided to incorporate it into the
1401. The chain printer had very, very difficult technical problems through the
first quarter and into the second quarter of 1959. But Mr. Dayger and his people
through dedicated efforts and I really mean that because they had some problems

brought it through and brought it through of course in fine style. And one of the key elements of its success of the 1401 system. The 1401 itself of course *feed path* during the early days of SMS and *the* 7070 program was passing through a lot of problems and SMS technology, packaging, card layout, design automation, powering, just many, many problems that were faced and fortunately in some respects had to be faced initially on the 7070 and hence the 1401 was able to follow that 7070 by *a short* time. We had trouble in the memory development area. We were late on getting the *memory humming* compared to what we had scheduled. This was due primarily to again the design approach taken on the memory for the 1401 that focused on on minimum cost, minimum number of electronic components and utilizing what I believe we called a core matrix type drive for the ferrite memory, which provided the low cost. Also as I indicated, by the technical problems that had to be solved and were solved but we were late getting into Product Test with the machine for several reasons including the SMS problems that I've talked about, the memory problems and one more that I'll mention with respect to change in the configuration of the system. Okay now, with respect to configuration I mentioned that the chain printer was being developed for a tape to printer type application. This was to support off-line or peripheral type operations to large systems such as the 7030 and the 7070. We concluded with the large systems people in early *1959*,

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(1250) that magnetic tape should be offered with the 1401 at initial announcement. This was based upon the analysis and conclusion that the 1401 with magnetic tape and of course also having the reader, punch and printer that was a part of the 1401 system anyway, was a much better solution to the peripheral requirements of the large system than a separate tape to print system and the card I/O and printers directly on the large system. Thus in March of '59, we made a decision to incorporate magnetic tape attached to the system in the initial announcement and that was planned for September, '59 and we changed our program to include attachment of magnetic tape and our first engineering model which of course was the model going to Product Test. That was one of the key reasons that we were late getting into Product Test. We got into Product Test on August 15 as I recall, instead of early July, and we did not make our September target announcement, but we did make early October announcement of four configurations of the system as I recall, the basic card system, an expanded card system, a tape system and well two versions of the tape system really, the tape system that also had all of the other I/O punched cards in and out and the printer and a configuration of the tape system that only had tape to print for those customers that had adequate tape to print operations such that they wanted a stand alone system for that function only. Now what was your other question Larry?

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S.   What was the reason for putting more power into the system and also

for making these other options available and also for integrating..........

B.   Well let's take them one at a time.   The more power thing of course we

did not include more power into the basic design during development although

as I indicated, we had a considerable amount of interest in various places

in seeing that done.   The interest and pressure came primarily from people

who I would say were computer background-oriented as opposed to accounting

machine or expanded accounting machine-oriented.   They felt of course that

the basic machine, being a stored program machine, even though it was directed

toward advanced accounting machine markets, did in fact have computing type

capabilities and hence we should expand upon that capability both in terms of

performance and also in terms of capacity, primarily memory capacity.

We laid out designwise, approaches to expand the capacity aspects of the machine

at a later time, memory being the key one and attachment of random access

disk files being another one.   We defined designwise how this could be done

so that we knew we were not operating on a dead end but we in essence refused

to incorporate those capabilities into the basic machine design because it would

increase the cost of the basic machine and we felt that the large volume market

for the 1401 type machine must be achieved and we felt that achieving this

large volume market was very much related to the cost level and price level

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of the basic configuration of the machine for both card and tape.

S. For the option, was there a push on or was there a competitive situation that people foresaw that meant it better have more power to it or was it just a market that was foreseen for these other options?

B. Well as I recall, there was not a significant competitive situation underlying the push at that time. Solid State 80 and 80 was a computer out by Sperry-Rand but we had made our own announcement of the 1401 compared to those machines and were satisfied even with the really relatively small memory we planned that the 1401 would take on a considerable amount of the market area that the Solid State 80 and 90 had been directed toward because they were really commercial expanded accounting machine-oriented rather than computers. There was of course interest in just expanding the market standpoint with a larger, more powerful machine of the 1401 type. Now later after announcement, as a matter of fact it was in late March, as actually I recall, 1960, competitive action by RCA on the 301 did occur, and did bring in larger memory and as planned and possibly with some expediting. I'm sure there was some expediting, we proceeded with the expanded memory features as options of the 1401 and of course through time all of the features that we had considered in the basic design with respect to how they could be attached, were subsequently added, including such things as disk files, attachment of the MICR type reader

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as I recall, paper tape equipment, probably several others that I
don't recall right now. That's the brief story. We might have a breaking point
right now if that is satisfactory to you.