25. RCA. Radio Corporation of America, with 1952 revenues of nearly $694 million, was another large, technically sophisticated company well situated to enter the computer business during the early 1950s.* McCollister testified he believed that throughout the 1950s, RCA's revenues exceeded those of IBM. (Tr. 9553.)

a. RCA's Early Computer-Related Activities. Before and during the early 1950s, RCA gained experience in computer-related activities in three areas: Computing devices, vacuum tubes and transistors, and core memories.

Scientists at RCA Laboratories "began a study of electronic computing devices as far back as 1935" (PX 344A, p. 1) and in the early 1940s, RCA "'pioneer[ed] in electronic data processing'" with its "'systems for anti-aircraft fire control'". (PX 343, p. 3.) RCA produced its first computer in 1947 at the request of the U.S. Navy. (PX 344A, p. 1.) This computer, the Typhoon, "was a very large analog computer, one of the most sophisticated for its time, and it was used primarily for simulation studies". (Beard, Tr. 8652.)

---

* At that time RCA operated in five divisions. Nearly three quarters of its total revenue, or $507 million, came from the manufacture and distribution of RCA Victor products --phonographs, records, radios, televisions, etc.--and from RCA Laboratories; the National Broadcasting Company had revenues of $162.5 million; RCA Communications had revenues of $17.5 million, and RCA's Radiomarine Corporation had revenues of $11.9 million. (DX 658, p. 6.)

By 1950 RCA had undertaken an "exploratory investigation of a digital computer for commercial applications". (Beard, Tr. 8651.)

By 1952 RCA reported that a "substantial part of [its] Laboratories Division activity . . . was devoted to research on classified Government projects in such fields as electronic computers". (DX 658, p. 17.) MIT selected RCA as one of the finalists in the competition to produce SAGE computer systems. (Crago, Tr. 85962; Hurd, Tr. 86463.)*

By the early 1950s, as a result of its involvement in the manufacture of radios and televisions, RCA was one of the nation's major manufacturers of vacuum tubes. (DX 658, pp. 19-23.) The designers of the ENIAC consulted RCA's engineers in an effort to develop "ultra reliable" tubes for the ENIAC computer. (Eckert, Tr. 768.) Following the invention of the transistor, RCA began research on possible transistor applications, recognizing as early as 1952 that "substitution of transistors" for vacuum tubes would permit the construction of computers "of greater versatility and utility, as well as reducing their size and power consumption." (DX 658, p. 13.)

RCA also pursued the development of core memory during the early 1950s. In 1953 RCA employees wrote: "[r]ecently ferrite materials have been developed which are suitable for use

---

* RCA continued to work on classified military projects to develop electronic computers during the 1950s. (E.g., DX 659, p. 20; DX 661, pp. 34-35.)

as memory elements for large-scale electronic computers. A memory unit capable of storing ten thousand bits of information has been developed by RCA." (DX 659, p. 16.)*

Against that background it is plain, as Mr. Beard acknowledged, that "in the early 1950's . . . RCA had the financial and technical capabilities successfully to develop, manufacture and market computers for commercial application". (Beard, Tr. 8652.)

b. RCA Computer Developments 1956-1959. RCA did not deliver a digital computer until 1956. (PX 344A, pp. 1-2.) In that year, it delivered the BIZMAC, which was "a data-processing giant" (PX 343, p. 3) with a purchase price of $4 million. (DX 661, p. 21.) It had a small amount of core memory: approximately 28,000 cores. (Hurd, Tr. 88213.)

RCA developed BIZMAC for the Army and intended it to be used for business-type applications: "stock control of replacement parts for military combat and transport vehicles". (DX 661, p. 21.) It was intended to "provide speedy and accurate information on inventories, to determine in minutes the current supply of any item at any Ordnance depot in the nation, and to compute forecasts of future requirements." (Id.; see Beard, Tr. 8449-50.)

---

* In 1953 Dr. Rajchman of RCA realized that, having made a 10,000 core memory, the next important step would be a core memory comprising "millions" of cores. To accomplish that goal would "require great innovations in construction techniques and still further improvements in magnetic switching." (PX 6091, p. 16.)

The BIZMAC took RCA "a lot of time and money to develop." (McCollister, Tr. 9254-55.)

RCA shipped approximately six BIZMACs during the 1950s.* (Beard, Tr. 8710-11.) Withington testified that the BIZMAC worked "relatively poorly" and classified the product as a "failure". (Tr. 56507-08.)

Because of its size, the BIZMAC program kept RCA "pretty well occupied up through the middle fifties and maybe 1956, 1957". (McCollister, Tr. 9255.) In 1958 RCA began work on the 501. (Id.)

The 501 was, according to RCA's management, "the first completely transistorized, general purpose electronic data processing system". (PX 343, p. 1.) It was announced in December 1958** (id.), and first delivered in mid- to late 1959.⁄ (PX 114, p. 18.) It was Mr. Beard's understanding that only three 501s were delivered to customers outside of RCA during the 1950s.

---

* Customers included: Travelers' Insurance, New York Life, Higbee Department Stores and The Army Tank and Automotive Command. (Beard, Tr. 8658; McCollister, Tr. 9254; DX 662, p. 20; DX 664, p. 18.)

** "The 501 is the fifth of six new products which Mr. Burns [RCA's President] said last May would be announced by RCA in 1958. The first four were a tape cartridge to provide stereophonic music in the home, a line of stereo tape and record players, the 'Wireless Wizard' remote control for black-and-white and color television receivers, and a two-way belt radio which transforms the wearer into a 'walking radio station.'" (PX 343, p. 2.)

⁄RCA received orders for the 501 prior to its announcement. (PX 343, p. 2.)

(Tr. 8711.)

While McCollister believed the 501 was a "competitive system" and that it was "well designed by the standards of the time" (Tr. 9542), RCA experienced difficulties with some peripherals. The card reader and card punch equipment were "slow" and "unreliable", and the line printer "required a lot of maintenance"; its "print quality wasn't particularly good". (McCollister, Tr. 9542-43.)*

As of December 1959 RCA reported "commitments for 41" of its 501 systems. (PX 114, p. 5.) Nevertheless, because the computer division had "optimistically scheduled production in excess of what they were able to sell", more 501s were built than were marketed. (McCollister, Tr. 9541-42.)

In the late 1950s, RCA was chosen as program manager for the BMEWS project, a computer system commissioned by the North American Air Defense Command to provide early warning of any ballistic missile attack. (Beard, Tr. 8450-51, 8676.) Among RCA's BMEWS subcontractors were IBM (which provided the main CPUs--IBM 7090s), General Electric and Sylvania. (Beard, Tr. 8676.) RCA also developed computers of its own for the BMEWS system, and RCA's subsequent commercial products made use of the

---

* The Social Security Administration was not satisifed with the 501, and transferred its workload to an IBM 7080. (DX 5793, p. 9; DX 7539, pp. 31-32.)

advances introduced in the BMEWS.*

During the late 1950s, RCA announced its third computer, the 110 Industrial Control Computer. (Beard, Tr. 8660; PX 114, p. 37.) RCA's Electronic Data Processing Division performed the development work on the 110. (Beard, Tr. 9027-28.) According to Beard the 110 differed from RCA's other computers in that it was supplied with less software and was designed to operate in a "more severe environment". (Tr. 8565-66.) The 110 was offered as a "standard unit" that could be "modified readily" to accomplish different functions and could be "supplied with a wide variety of optional functions". (PX 114, p. 37.)**

Despite its substantial technological capabilities at the beginning of the 1950s, RCA, by the end of the 1950s, had not succeeded in establishing a substantial presence in the computer industry. As late as December 1959, in a business review of RCA's Electronic Data Processing Division, the company stated that it was just "beginning to overcome the major obstacle which

---

* For example, the RCA 3301 computers used an improved version of the electronic circuitry developed and designed for BMEWS; it used some of the electrical packaging features of the BMEWS computers. Also, the RCA 4100 used similar packaging and a somewhat improved circuitry over that which had been used in BMEWS; the 4100 was used by United Airlines to provide communications functions as part of an airlines reservations system. (Beard, Tr. 8684-86, 8983-84.)

** Modified RCA 110s (called 110As) were used by NASA as part of the Saturn Missile Launch Computer Complex at the Kennedy Space Center. (DX 5255, pp. 11-12.)

plagued us previously; namely, doubts as to RCA's seriousness in the EDP business". (PX 114, p. 5.)

About this time RCA's management was "faced with a decision as to what they should do about being in the computer business". (McCollister, Tr. 9255.) Expressing one point of view was RCA President John Burns, who felt that "in view of RCA's technical capabilities and what appeared to be great growth opportunities in the computer field, . . . this was a business . . . RCA should be in". (Id.) Pushing in the other direction was RCA's desire to develop and commercialize color television. The resulting battle for investment money within RCA began during the 1950s and continued through the 1960s, to the detriment of RCA's computer related activities. As Beard testified concerning the allocation of RCA's total corporate resources throughout the 1950s, there was a "greater total effort in television from the engineering point of view than there was in the computer". (Tr. 8717.)

Production of peripheral products was limited in this time frame. Thus, RCA's computer division decided to curtail the development of peripherals in the late 1950s or early 1960s in order

> "[t]o concentrate RCA's investments in areas where they felt they would get the most return and where it would be possible to procure such things as printers, card readers,

and punchers from other manufacturers who were making them available directly to other manufacturers". (Beard, Tr. 8998-99.)

c. RCA's Computer Developments 1960-1963. On April 13, 1960, RCA announced two new computer systems, the 601 and the 301. (PX 344A, p. 1.) RCA described the 601 as "an ultra-high speed, general purpose EDP system . . . equally efficient for massive business data processing and complex scientific computation" (DX 562, p. 2; see Beard, Tr. 8958); the 301 was a "small to medium size" computer. (Beard, Tr. 8454.)

McCollister described the 601 as a "disaster" (Tr. 9622):

(1) The manufacturing cost for the 601 turned out to be "very, very substantially higher than the original cost estimates upon which the pricing had been predicated". If RCA had raised the price of the 601 to cover its costs, the product would have been "uncompetitive". (McCollister, Tr. 9543; Beard, Tr. 8458.)

(2) RCA had difficulty in providing "some of the functional capabilities that had been originally announced and specified in that system". For example, RCA intended the 601 to be an "on line" and "multiprogramming type of system". RCA's attempt to make the system operate that way was "economically just a totally impractical thing to do" and also "there was a big slowdown in being able to accomplish these functions in a technical sense". (McCollister,

Tr. 9544.)

(3) RCA used coaxial cable to improve the performance of the CPU. However, so many cables were used that:

> "it was virtually a physical impossibility to interconnect all of the points on the back side of the machine that had to be interconnected". (McCollister, Tr. 9544.)

John L. Jones, then employed at the Air Force Logistics Command, observed the same problem:

> "it required a large amount of special wiring and the wiring got so thick on the back board, the back plane of the machine, that they could no longer get down to the pins to attach more wires through this layer of wiring and there was still a large number of wire connections that needed to be placed, and at that point they gave up on delivering the RCA 601 on its original schedule and, of course, that impacted the decision as far as the [Air Force] Logistics Command was concerned. And, in fact, what they had to do was to go back and redesign a new type of very thin coaxial cable in order to again come forward with the RCA 601." (Tr. 79347-48.)

Thus, after marketing the 601 for a short time, RCA realized that:

> "there were severe technical problems, both in a functional and in a manufacturing sense, and there were also severe financial problems, so much so that the company began to look for a way out of the program." (McCollister, Tr. 9544.)

In 1962, RCA stopped marketing the 601. At that time it decided to honor the "present commitments that were made to customers but not to sell any more". (Beard, Tr. 8457-58.) McCollister believes that RCA manufactured only five 601s and delivered only four. (McCollister, Tr. 9545.)

The aborted 601 program hurt RCA's computer business in several respects. McCollister testified:

"[The 601] cost [RCA] money, from which we received no worthwhile return, both from the manufacture and the development expense, which was quite substantial, and it also lost us time of engineering people because, while they were working on that product, trying to salvage it within the limits that had been established, they were unable to put their efforts into the design of products that might have had a more important business future." (Tr. 9624.)

The failure of the 601 "embarrassed" RCA. (Beard, Tr. 8723-24.)

"[I]t hurt [RCA's] reputation very badly, because we had placed great public emphasis upon the 601 as a product and its capabilities, and it hurt us with several important customers." (McCollister, Tr. 9623.)

The failure of the 601 hurt RCA's ability to market its other products because RCA "had counted on the 601 to fill the upper end of the computer systems market." (Beard, Tr. 8724.) The absence of the 601 "left a void for the 301 customers who were looking to move into larger systems." (Beard, Tr. 8983.)*

The failure of the 601 cost RCA about "three or four years" in development of its computer business. (McCollister, Tr. 9362-63.)

RCA intended the 301 for "regular data processing type work loads". (Beard, Tr. 8955.) It offered an enhancement to the 301 processor, for about a 10% extra charge, that was intended to assist the system in performing scientific applications. Beard considered this "a plus factor" because:

---

* In September 1963 RCA announced an interim product, the 3301, which was a relatively large computer designed to substitute for the withdrawn 601. (Beard, Tr. 8455, 8983; McCollister, Tr. 9629.)

"the machine as used by the customers at that time had to be looked at for both their data processing needs, which generally were the primary needs, and the secondary needs of engineering and scientific calculations". (Beard, Tr. 8955.)

RCA experienced some success with the 301. According to McCollister:

"[T]he 301 system was a successful product program and . . . a strong product program, as the sales results of the following years indicated." (Tr. 9622.)

The 301 System had some problems, particularly with some of the peripheral products purchased from other companies.* For example, RCA used a Bryant disk file on the 301. When it failed, "it took a long time to get the necessary parts in to get the equipment back on the air, as much as six hours or twelve hours". (Beard, Tr. 9009-10.) Withington regarded the RCA 361 disk, used on the 301, as a "major product failure" because of reliability problems. (Tr. 56508-09.) Another example is the printer RCA obtained from Anelex, which, "for certain applications . . . had insufficient . . . print quality". (Beard, Tr. 10323.)

RCA "effectively stopped selling" the 301 "somewhere in 1964, '65." (Beard, Tr. 8457.)

By the end of 1961, RCA's EDP division "was in considerable trouble. It had grown rapidly and it was incurring

---

* The peripheral products RCA purchased from other suppliers included IBM card readers and punches, Anelex printers, Farrington optical scanners and Bryant disk files. (McCollister, Tr. 9599-600.)

a substantial operating loss and, worst of all, it was in severe technical difficulties." (McCollister, Tr. 9245-46.)

In 1962 RCA decided to resume developing and manufacturing its own peripherals. According to Beard this was done for two reasons:

> "The first was that our experience with some of our suppliers had not been entirely satisfactory. Secondly, it was felt that resources were available to expand the product development to include more work in the peripheral area and that as a consequence of this we would have control over the product characteristics, such things as reliability, and certainly would be able to enjoy a greater contributed value in the product, and our manufacturing costs we expected to be less than the purchase price we were paying to other people". (Tr. 9003-04; see Tr. 8451.)

Stopping and then restarting its development of peripheral products hurt RCA's product line:

> "It certainly had an effect on how far forward RCA was able to move in the development of peripheral products. . . .
>
> "But when RCA decided to redevelop its products, it had lost the continuity of the engineering effort that had been going on in such things as printers and essentially had to reestablish its engineering skills and manufacturing skills in those areas. So in that sense time was lost by the early decision to abandon these peripheral developments". (Beard, Tr. 9004.)

By the end of 1963 RCA's computer business had not made up for its slow development in the late 1950s. As McCollister testified, IBM made "greater strides" than RCA during the 1950s "in the sense of a wider range of products and a larger quantity of products delivered to customers". (Tr. 9552-53.)