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Note

# On the original copies of “First Draft of a Report on the EDVAC” by John von Neumann

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## §1 Introduction

“First Draft of a Report on the EDVAC” written by John von Neumann in 1945 is a report on the logical structure of EDVAC, which was planned as a successor of ENIAC, and it is well-known as the earliest report on the concept of the stored-program computer. In early 1945, J. Presper Eckert, John Mauchly, Herman H. Goldstine, Arthur Burks, John von Neumann and S. Reid Warren, who was the director of the EDVAC project, discussed the EDVAC plan at the Moore School of Electrical Engineering, University of Pennsylvania.<sup>1</sup> It is said that von Neumann wrote the draft by hand in spring of 1945 based on this discussion and Goldstine typed it. This “First Draft” was duplicated and distributed to Eckert, Mauchly, Burks and Warren in May 1945 and to others including the staff at the Moore School and government sponsors in June 1945, and it was also passed to other scholars and engineers in the US and Britain such as Max Newman and Alan Turing.<sup>2</sup> Although this draft was never published in a completed form, it had a great impact on the logical design of many early computing machines. For this reason, the “First Draft” became one of the most famous reports in the history of computing. And it also became an important piece of evidence at the ENIAC trials, which challenged the validity of the ENIAC patent which Eckert and Mauchly, and later Sperry Rand Corporation, owned: the Sperry Rand vs. Bell Labs lawsuit in 1962 and the Sperry Rand vs. Honeywell lawsuit in the 1970s.

In regard to manuscripts of this “First Draft” distributed in 1945, however, several unsolved questions remain: How many copies were printed at the time? To whom were

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<sup>1</sup> Burks 1988, p. 201.

<sup>2</sup> Aspray 1992, p. 41; Burks 1988, p. 201.

these copies distributed, other than Eckert, Mauchly, von Neumann, Goldstine, Burks and Warren? How many of these copies have survived?<sup>3</sup> Where are they preserved? In this paper, I will briefly summarize information on several original copies of the “First Draft” which have survived. I will also describe “another version” of the “First Draft,” which is preserved in the American Philosophical Society Library.

## §2 Distributed ‘‘First Draft’’s

The most well-known reprint of the “First Draft” is the one edited by Michael. D. Godfrey in 1993.<sup>4</sup> This reprint is based on the original typescript copy which was preserved in the University of Pennsylvania Moore School Library, on the title page of which “Moore School of Elec. Eng. Library” was stamped.

Most photocopies of the “First Draft,” which were distributed widely among scholars after the 1950s were made from this “Moore School copy.” For example, the collection of George Stibitz Papers in the Dartmouth College Library has a set of photocopies of “Moore School copy,”<sup>5</sup> and I. Barnard Cohen Papers in the Charles Babbage Institute<sup>6</sup> has another set.<sup>7</sup> The Moore School Library, however, no longer has the original copy. This can be found neither in the Moore School Record nor the list of ENIAC Trial Exhibits Collection at the University of Pennsylvania.<sup>8</sup>

Besides the “Moore School copy,” there are two existing original typescript copies, in the Smithsonian Institution Libraries and in the Princeton University Library. The Dibner Library of the History of Science and Technology, which is part of the Smithsonian Institution Library has a mimeographed copy of the “First Draft.” This copy is printed in

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<sup>3</sup> Paul Ceruzzi, email to SIGCIS mailing list, May 30, 2009.

<sup>4</sup> von Neumann [1945a] 1993. Godfrey opened the new corrected version of reprint on his website. See von Neumann [1945b] 2011.

<sup>5</sup> von Neumann 1945c. This set of photocopy seems to have been collected for the lawsuit between Sperry Rand and Bell Labs in 1962.

<sup>6</sup> von Neumann 1945d.

<sup>7</sup> Professor Emeritus David Hemmendinger, Union College, also has a set of photocopies from Moore School, although this set lacks a couple of pages (David Hemmendinger, email message to author, May 30, 2009). This set seems to have been printed after spring of 1982 according to its circulation record stamped on the last page. The circulation record shows that the original copy which was in Moore School Library had circulated over 30 times since 1962 for 20 years.

<sup>8</sup> Nancy R. Miller, University of Pennsylvania Archives, email message to author, June 11, 2009. According to Miller, University of Pennsylvania Van Pelt Library has a microfilm of the original copy.

pale purple ink on dark paper<sup>9</sup> and it has the stamped name of Samuel N. Alexander, who belonged to National Bureau of Standard and developed the SEAC (Standards Eastern Automatic Computer).<sup>10</sup> The Princeton University Library has another mimeographed copy with gray double-spaced type. On page 1, the name of “S Reid Warren, Jr.” is hand printed in the same gray color as the text.<sup>11</sup>

Although it is not an original typescript, the Herman H. Goldstine Papers collection in The American Philosophical Society Library has a set of photocopies of an original copy of the “First Draft” with the signature of Adele K. Goldstine, who was the wife of Herman Goldstine and contributed to the programming of ENIAC.<sup>12</sup> It appears that in the original of these photocopies there were a number of alternations handwritten in pencil such as typo corrections.

A photostat of the mimeographed typescript with the signature of Arthur Burks appears in *The Origins of Cyberspace*.<sup>13</sup> This photostat was sent by Herman Goldstine to Lawrence Stark, professor at the University of California, Berkeley, before being added to the collection of “The Origins of Cyberspace, A Library on the History of Computing, Networking, and Telecommunications” by Jeremy M. Norman.<sup>14</sup> This whole collection of “The Origins of Cyberspace” was offered for sale at Christie’s in New York City on February 23rd, 2005<sup>15</sup> and the photostat was sold for \$2880 (Sale 1484, Lot 203). At the same auction, a xerographic copy of the “First Draft” with handwritten pencil notes related to the EANIC trial by J. Presper Eckert was also sold at Christie’s for \$3360 (Sale 1484, Lot 236).

It seems that these copies in the Dibner Library of the History of Science and Technology, the Princeton University Library and the American Philosophical Society Library and the copy with the signature of Arthur Burks are the same as the “Moore School copy” in terms of pagination and typeface; they would be printed at the same time.

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<sup>9</sup> Kirsten van der Veen, Special Collections, Smithsonian Institution Libraries, The Dibner Library of the History of Science and Technology, email message to author, December 10, 2009.

<sup>10</sup> Paul Ceruzzi, email message to author, October 20, 2009.

<sup>11</sup> Julie Arnhem, Princeton University Library, email message to author, January 14, 2010.

<sup>12</sup> von Neumann 1945e.

<sup>13</sup> Hook, Norman and Williams, 2002.

<sup>14</sup> Christie’s, accessed 2011.

<sup>15</sup> Weiss 2005.

### §3 Another version of the ‘‘First Draft’’

In the American Philosophical Society Library, in addition to the photocopies of the ‘‘First Draft’’ with Adele Goldstine’s signature, the Herman H. Goldstine Papers collection includes ‘‘another version’’ of the typescript of the ‘‘First Draft.’’<sup>16</sup> This typescript is printed in gray ink with different pagination from the ‘‘Moore School copy.’’ All of the figures are handwritten and it has some handwritten alternations in typed sentences. And also, it does not have a title page or a date. It is plausible to suppose that this is a revised version of the original ‘‘First Draft,’’ because some of the handwritten corrections are the same as the ones found in the photocopies with Adele Goldstine’s signature in the American Philosophical Society Library. Besides minor typo corrections, there are big differences between the ‘‘Moore school copy’’ and this version; this version has two *unknown* sections and six additional figures, Section 6 and 7 of Chapter 13 (13.6 and 13.7), Figure 23, 24, 25, 26, 27 and 28, which are not in the ‘‘Moore School copy’’ version; that is, in a sense, chapters and figures are completed in this version.<sup>17</sup>

A rough description of 13.6 and 13.7 is as follows. 13.6 is located just after 13.5 and it includes approximately 1200 words, Figure 23, 24, 25 and 26. 13.7 includes approximately 550 words, Figure 27 and 28. The titles of these figures are found in the contents of figures on a page after the table of contents; ‘‘Figure 23. Function matrix switch, central part: First arrangement,’’ ‘‘Figure 24. q-line terminal,’’ ‘‘Figure 25. Function matrix switch, central part: Second arrangement,’’ ‘‘Figure 27. Final form of dl and its associated circuits’’<sup>18</sup> and ‘‘Figure 28. M and its connections with CC.’’ The title of Figure 26 is not on the list, but according to the description of Figure 26, we could name it ‘‘Completed SG together with its q-line.’’

The topic of 13.6 is a solution to ‘‘the problem of switching the 256 SG’s’’ in terms of economy of the number of E-elements, that is, ‘‘the function matrix switch’’ which consists of a central part. It corresponds to the discussion on SG announced in 13.4 that is ‘‘Actually SG will have to be redrawn later (cf. [sic]), we now give its preliminary

<sup>16</sup> von Neumann? 1945?.

<sup>17</sup> *ibid.*, pp. 68–74.

<sup>18</sup> This ‘‘dl’’ is squared just as found in the text.

form: SG’ in Figure 21”<sup>19</sup>; namely, “13.6” is supposed to be inserted in the blank. In fact, Figure 26 is a completed version of the preliminary sketch of SG given in Figure 21 of 13.4. This section also includes a detailed discussion on a sequence of stimuli of “the order to turn on a certain SG ? say No. K” announced in 13.5.<sup>20</sup> One of the missing references in 13.5, “The stimulus expressing the order as such must appear on the first line (cf. above) in some definite time relation to these stimuli on the second line — as will be seen in [sic], it comes immediately after the last digit,”<sup>21</sup> should also be completed with “13.6.” A noteworthy fact is that this section contains the name of J. Presper Eckert and his suggestion about p-lines which connect CC and SG,<sup>22</sup> although his name cannot be found in the other sections of the “First Draft.”

13.7 consists of some comments on Figure 27 and remarks on Figure 28. Figure 27 depicts the connection of dl, A and SG given in Figure 18 and Figure 20 of 12.6 more precisely. Figure 28 is the entire description of “M and its connections with CC,”<sup>23</sup> which is a combination of Figure 22, 25 and 27. This section presents questions about several decisions on implementation; for example, whether changes to some or all of the connections between DLA organs should “be made by manual plugging, or by relays which maybe controlled by manual switches or by punched cards or tape, or electronically.”<sup>24</sup>

Although the date when this manuscript was typed cannot be found on any pages, it would be reasonable to think that this is a retyped version of the original handwritten draft by von Neumann.<sup>25</sup> For these two sections closely correspond to the other sections in the same chapter, and obviously some of the empty references can be completed with these two sections, 13.6 and 13.7, as mentioned above. Why the “First Draft” that was printed in 1945 lacked these two sections, however, remains an unanswered question.<sup>26</sup>

<sup>19</sup> *ibid.*, p. 66.

<sup>20</sup> *ibid.*, p. 67.

<sup>21</sup> *ibid.*, pp. 67–68.

<sup>22</sup> *ibid.*, p. 71.

<sup>23</sup> *ibid.*, p. 73.

<sup>24</sup> *ibid.*, pp. 73–74.

<sup>25</sup> Neither John von Neumann papers in the Library of Congress nor Herman Goldstine papers in the American Philosophical Society Library has the very original handwritten drafts.

<sup>26</sup> I deeply appreciate the information offered by The SHOT Special Interest Group for Computers, Information, and Society members. I specially thank David Hemmendinger for sharing his copies of the “First Draft.” I hope the information in this research note will help further study on “the First Draft.”

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