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Ada Lovelace

Introduction / Einführung:
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Introduction

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There Never Was a Note G

In his letter to Ada Augusta Lovelace of July 2, 1843, Charles Babbage writes: "I like much the improved form of the Bernoulli Note but can judge of it better when I have the Diagram and Notation."[1] He is referring to the last in a set of notes written by Lovelace that interpreted the Analytical Engine, the first fully automatic and universal computer, invented by Babbage in 1834, although never actually completed during his lifetime. She appended these notes to her translation of an article written by Luigi Federico Menabrea after he had heard Babbage present a paper on the Engine. Her translation, together with her extensive notes (three times the length of the original article), were published in 1843 and signed A.A.L.[2]

In the same letter, Babbage recounts the order of the notes in preparation for submitting them to the publisher:

A Sent to Lady L.
B With C.B.
C Ditto
D Sent to Lady L.
E With C.B.
F Retained by Lady L.
G Where is it gone?
H With C.B.

In response to his question about the missing Note G, Lovelace writes: "There never was a Note G. I do not know why I chose H instead of G, & thus insulted the latter worthy letter."[3] In the final published version of the work, Note H becomes Note G and subsequently, along with Babbage's machine and the rest of Lovelace's notes, a key reference point in the history of modern computing.[4]

1 | Letter from Charles Babbage to Ada Augusta Lovelace, July 2, 1843, typed copy, British Library, Additional ADD 54089.

2 | Luigi Federico Menabrea, "Notions sur la machine analytique de Charles Babbage," *Bibliothèque Universelle de Genève* 82 (October 1842). The translated article with Lovelace's notes was published as "Sketch of the Analytical Engine Invented by Charles Babbage, Esq. By L. F. Menabrea, of Turin, Officer of the Military Engineers. With Notes by the Translator," *Scientific Memoirs* 3 (1843), pp. 666–731.

3 | Letter from Ada Augusta Lovelace to Charles Babbage, July 2, 1843, handwritten, British Library, Additional ADD 37192.

4 | This came almost one hundred years in advance of the work of Konrad Zuse, Alan Turing, Howard Aiken, and Grace Hopper and the invention of the machines that came to symbolize the age of modern computing (Z1, Baby Manchester Computer, Harvard Mark I, and ENIAC).

The significance of Note G is that it provides a description of method and a diagram of an algorithm for setting up the engine to compute the Bernoulli numbers.[5] The diagram is widely referred to as the first computer program, and the notes the first expression of computer theory. Together, they can be considered what we would describe in contemporary terms as the software required to operate the hardware of Babbage's machine, which did not yet exist.

However, at the time there remained uncertainty over the significance of Babbage's invention, and the future potential of computation per se. Note G, reproduced in full in this notebook from its first published version of 1843, contains Lovelace's reservations in this respect:

> It is desirable to guard against the possibility of exaggerated ideas that might arise as to the powers of the Analytical Engine. . . . The Analytical Engine has no pretensions whatever to *originate* anything. It can do whatever we *know how to order it* to perform. It can *follow* analysis; but it has no power of *anticipating* any analytical relations or truths. Its province is to assist us in making *available* what we are already acquainted with.[6]

While Note G advises caution as to the potential of the Engine, and computational machines more generally, to demonstrate independent thinking (artificial intelligence), Lovelace recognizes the particular significance of the Engine in marking a transition from calculation to general-purpose computing—from a machine merely able to tabulate numbers to a programmable universal machine capable of manipulating symbols according to rules and of generating anything at all, whether music, poetry, or images.[7] In Note A she writes:

> The Analytical Engine, on the contrary, is not merely adapted for *tabulating* the results of one particular function and of no other, but *for developing and tabulating* any function whatever. In fact the engine may be described as being the material expression of any indefinite function of any degree of generality and complexity. . . . The operating mechanism can even be thrown into action independently of any object to operate upon.[8]

The distinctive feature of the machine is its use of punch cards for programming the Engine, adopted by Babbage after they were first introduced by Joseph Jacquard to instruct the loom to automate and regulate weaving patterns in 1804. Lovelace remarks that the Engine "*weaves algebraic patterns* just as the Jacquard-loom weaves flowers and leaves."[9] Furthermore, in expressive terms that combine poetry and mathematics (as befits the daughter of the poet Lord Byron), she imagines that the Engine might "compose elaborate and scientific pieces of music of any degree of complexity or extent,"[10] preempting Donald Knuth's comments in 1968 that computer programming need not be considered to be merely functional, but "an esthetic experience much like composing poetry or music."[11] Lovelace points to the poetic and metaphysical dimensions of technological invention, something to which Geoffrey Batchen draws attention in his article describing the parallel history of the Analytical Engine and lace in connection with William Henry Fox Talbot's lace contact print of 1845.[12]

In keeping with Babbage's description of Lovelace as the "Enchantress of Numbers," it is the speculative nature of her work that continues to intrigue, such as her childhood dreams of writing a book about "Flyology" that would set out a method of flying (predating William Henson's design for an aerial steam carriage of 1842):

5 | In Note G, Lovelace explains that her choice of Bernoulli numbers—a sequence of rational numbers—to demonstrate the computing powers of the Engine is "a rather complicated example" ("Sketch of the Analytical Engine Invented by Charles Babbage" [see note 2], Note G, p. 724), but useful in that it allows one to highlight the contrast between Babbage's earlier machine, the Difference Engine, as a mere *calculating* machine, and his more advanced Analytical Engine as a universal *computing* machine.

6 | Ibid., p. 722.

7 | In time, this also became contestable. In 1950, Alan Turing, mathematician and computer scientist, wrote his seminal paper on "Computing Machinery and Intelligence" to question the perceived limitations of machines for independent thinking (artificial intelligence), against the reservations expressed by Lovelace some hundred years earlier. He famously asked: "Can machines think?"

8 | "Sketch of the Analytical Engine Invented by Charles Babbage" [see note 2], Note A, pp. 691, 694.

9 | Ibid., p. 696.

10 | Ibid., pp. 696, 694.

11 | Donald E. Knuth, *The Art of Computer Programming* (Reading, Mass.: Addison-Wesley Publishing Company, 1981 [orig. 1968]). It is also interesting to note that there is an object-oriented programming language named Ada in recognition of Lovelace's contribution to programming.

12 | Geoffrey Batchen, "Electricity Made Visible," in *New Media Art: Context and Practice in the UK 1994–2004*, ed. Lucy Kimbell (London and Manchester: Arts Council England and Cornerhouse Publications, 2004), pp. 27–44. In 1999 Hüseyin Alptekin made an embroidered canvas that connects many of these threads and named it *Lovelace*. He explained: "Lace, which denotes a completion of love, which is remembered along with love, purveys meaning both in the sense of being a sucker as well as in terms of embroidery. Besides this, lovelace is once again a borrowing from disparate references and is a send off to different contexts. Like the famous porno star Linda Lovelace, it is also a borrowing of the famous mathematician Ada Byron Lovelace whose name was given to an infobiogen server. Tulle, curtaining, veiling, removing, stitching. . . . Fantasy deals with postponing the jouissance,

> As soon as I have brought flying to perfection, I have got a scheme about a . . . steamengine which, if ever I effect it, will be more wonderful than either steampackets or steamcarriages, it is to make a thing in the form of a horse with the steamengine in the inside so contrived as to move an immense pair of wings, fixed on the outside of the horse, in such a manner as to carry it up into the air while a person sits on its back.[13]

In her work, as well as in her life, Lovelace managed to combine scientific rationalism with subjective imagination, influenced by her experience of the Industrial Revolution and the many technological innovations at that time.[14] However, in a departure from the discipline-based systems of thinking and acquiring knowledge reinforced by the industrial period, she strongly believed in the need for connecting *all* disciplines. This attempt to go beyond the separation of fields of knowledge has since become a common thread in contemporary thinking, as for instance in the work of cybernetician Heinz von Foerster, who argued that in an increasingly complex world, it is no longer possible to maintain traditional science as the dominant structure of thinking. Consequently, there is a shift toward what he described as "systemics," an approach that sees *things together* in complex connections and interrelations.[15] Lovelace's term for this was "Poetical Science," and her Note G anticipates the indefinite potential of machines to express complexity.[16]

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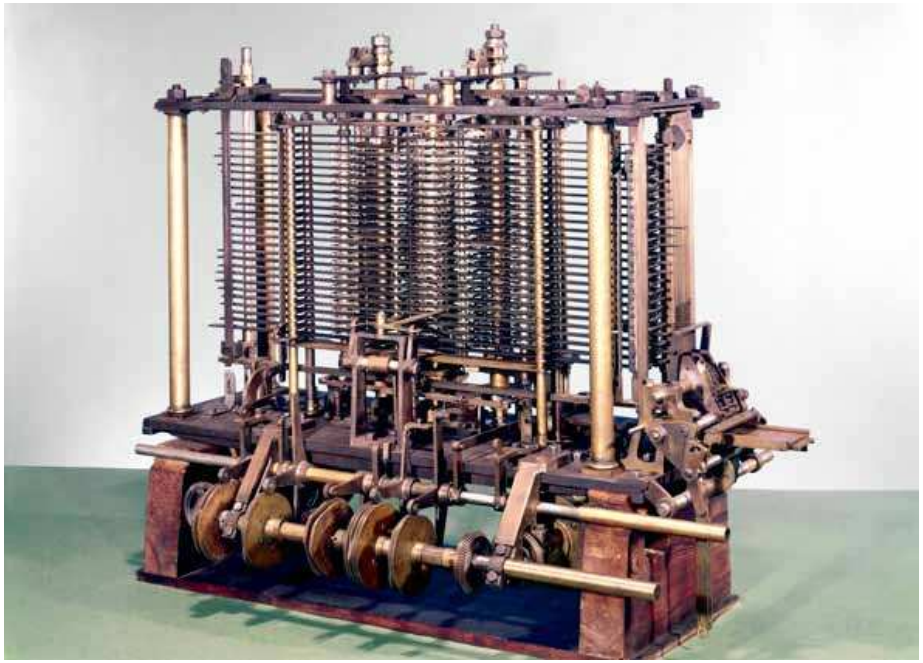
inasmuch as the truth is embroidered in the dance of seven veils." Quoted from: www.clubmedia.de/clubmedia99/hba_html/hba_set_12.html (accessed October 2011).

13 | Quoted from a letter from Ada Lovelace to her mother Lady Byron dated Monday, April 7, 1828, in Betty A. Toole, *Ada, The Enchantress of Numbers* (Mill Valley, Cal.: Strawberry Press, 1992), p. 34.

14 | Most importantly Charles Wheatstone's telegraph, Joseph Jacquard's loom and punch cards, Sir David Brewster's kaleidoscope, Michael Faraday's first induction of electric current, and Mary Somerville's scientific writings *On the Connexion of the Physical Sciences* (1934).

15 | Interview with Heinz von Foerster in Lutz Dammbeck's documentary film *Das Netz* (2003).

16 | The author would like to thank those who assisted in various ways with research in preparation of the material for this notebook: Colin Harris, Mary Clapinson and Alan Brown at the Bodleian Library, University of Oxford; Adrian Shindler and Justin Clegg at the British Library, London; Matthew Connell and Paul Wilson at Powerhouse Museum, Sydney; Nicola Thwaite at the National Trust, London; Jo Francis and John Fuegi; and Lucia Pietroiusti.



Charles Babbage,
Analytical Engine, 1871