Ada Lovelace's *Notes* and *The Ladies Diary*

Ada Lovelace's "Notes" on her translation of Menebrea's paper on Babbage's Analytical Engine were published in *Taylor's Scientific Memoirs*, which was more of a serious scientific publication. *The Ladies Diary* was a popular publication, which she may or may not have read. Baum cites:

- Perl, Teri. *The Ladies Diary* or *Woman's Almanac*, 1704-1841, **Historica Mathematica 6** (1979): 36-53
- Wallis, Ruth and Peter. *Female Philomaths*, **Historica Mathematica 7** , (1980), 57-64.

"There were indeed women in mid-century England who signed their names to mathematical articles in popular journals, and there were influential periodicals, such as the *Edinburgh Review*, that lent intellectual women psychological support.... Although the *Ladies Diary* ... , the most popular of the mathematical periodicals, encouraged women to join wit with beauty, it attracted serious amateurs of both sexes... [it] was a respectable place to pose mathematical problems and sustain debate... since there were few science periodicals in England until the 1830s, technical articles often appeared in general periodicals like the *Ladies Diary*. It may have been something similar that originally sparked Mrs. Somerville's interest in mathematics. At a tea party one afternoon, she recalled years later, young Mary Fairfax had been given a ladies' fashion magazine that contained a puzzle, the answer to which was given in strange symbols. These symbols turned out to be algebra. And that magazine became her introduction to the world of Euclidean geometry and number."

Baum, p. 35
Submitted by Linda Talisman

A Selection and Adaptation From Ada's Notes found in ``Ada, The Enchantress of Numbers,'' by Betty Alexandra Toole Ed.D. (Strawberry Press, Mill Valley, CA)

Pages 240-261

Notes annotated in collaboration with Colonel Rick Gross, USAF. ``Ada, The Enchantress of Numbers'' can be purchased from Strawberry Press P.O. Box 452 Sausalito, CA 94966 for $29.95.

All quotations and page numbers refer to the original Memoir which was printed in *Scientific Memoirs, Selections from The Transactions of Foreign Academies and Learned Societies and from Foreign Journals*, edited by Richard Taylor, F.S.A.,Vol III London: 1843, Article XXIX. Sketch of the Analytical Engine invented by Charles Babbage Esq. By L. F. Menabrea, of Turin, Officer of the Military Engineers. [From the Bibliothque Universelle de Gnve, No. 82 October 1842].

Submitted by Betty Alexandra Toole Ed.D.

Introduction

What captured my attention about Ada Byron, Lady Lovelace, in 1976 when I was getting my doctorate at the University of California at Berkeley, was how strange it was that the daughter of the famous poet Lord Byron was connected with the birth of the computer revolution. What expanded my sense of strangeness was when I was at Oxford working with Ada's letters from 1984-1987, I would take a break at Blackwell's Bookstore and be overwhelmed by the tens of books on the shelves about "Ada" the programming language. In 1991 I wrote an article for "Ada's Letters" entitled " Ada Byron, Lady Lovelace, Analyst and Metaphysician" and had the good fortune to have Colonel Gross review the article. It was Ada's mind-set, her creative critical skills that not only laid the groundwork for her ability to write the first computer program but correctly predict the future of computing. It does take imagination, a leap of faith, to go from the structure of language, lines of code, to creative thinking, context and creativity, skills that Ada exhibited and I try to promote and had the expert help of Colonel Gross. As Ada programmers you might see other relationships between Ada's mind-set and the nature and execution of Ada, the programming language.

The first step is to see how Ada went about her task and what follows is a few pages from my book ``Ada, The Enchantress of Numbers.''

To start with, Ada added a footnote to her translation of Menabrea's article. She emphasized the difference between

Pascal's machine, which can be compared to a calculator, and Babbage's Analytical Engine, which can be compared to a modern day computer. Ada translated what Menabrea wrote: RFor instance, the much-admired machine of Pascal is now simply an object of curiosity, which, whilst it displays the powerful intellect of its inventor, is yet of little utility in itself. Its power extended no further than the execution of the first four operations . . .S Ada augments Menabrea's statement and clearly defines the boundaries of Babbage's Analytical Engine.

Ada emphasized the fundamentally different capability of the Analytical Engine, that is, to be able to store a program (a sequence of operations or instructions) as well as data (informational values themselves). At this point, she began to recognize and to amplify the increased responsibility this new capability placed upon the machine's user, to specify the stored program both precisely and in complete accordance with the user's interest. Her recognition of this increased responsibility is a remarkable insight, in that the magnitude of this specification task (a task we refer to today as software development) is only now being appreciated.

It is accordingly most fitting, and most honouring to her insight, that the programming language Ada, developed in the early 1980's by the U.S. Department of Defense, provides the most precise facilities for this software development (specification) task of any general-purpose software language for large-scale problems existing today. In the following passage, Ada explained the difficulty of the software development task, that is, the difficulty of communicating to the machine what it is we expect it to do. But note that in so doing, she also, in effect, extolled the power of mathematical language when it is precise. Thus, a software language capable of great precision in specification (like the Ada language) also provides great power.

Ada exhibited the principle that power comes from disciplined creativity.

From Note A, p. 693:

The confusion, the difficulties, the contradictions which, in consequence of want of accurate distinctions in this particular, have up to even a recent period encumbered mathematics . . . It may be desirable to explain, that by the word operation, we mean any process which alters the mutual relation of two or more things, be this relation of what kind it may. This is the most general definition, and would include all subjects in the universe . . . They will also be aware that one main reason why the separate nature of the science of operations has been little felt, and in general little dwelt on, is the shifting meaning of many of the symbols used in mathematical notation. First, the symbols of operation are frequently also the symbols of the results of operations . . . Secondly, figures, the symbols of numerical magnitude, are frequently also the symbols of operations, as when they are the indices of powers [e.g., 2 and 32] . . . [In] the Analytical Engine . . . whenever numbers meaning operations and not quantities (such as indices of powers), are inscribed on any column or set of columns, those columns immediately act in a wholly separate and independent manner . . .

One of Ada's most famous quotes is from Note A, p. 694:

Again, it [the Analytical Engine] might act upon other things besides number, were objects found whose mutual fundamental relations could be expressed by those of the abstract science of operations, and which should be also susceptible of adaptations to the action of the operating notation and mechanism of the engine . . . Supposing, for instance, that the fundamental relations of pitched sounds in the science of harmony and of musical composition were susceptible of such expression and adaptations, the engine might compose elaborate and scientific pieces of music of any degree of complexity or extent.

Once Ada had made the distinction between numbers and the operations to be performed, it was not difficult for her to project further how the Analytical Engine would then be capable of giving two types of results; numerical and symbolic, (eg algebraic). In effect, an Analytical Engine could generate new programs as well as numbers. As a result the Analytical Engine opened up a vast new territory for the analysis of information. Here again, the Ada software language contains somewhat unique facilities corresponding in a sense to Ada's insight. One such Ada facility is the generic subprogram, a template for future software generation. Having defined a generic subprogram for data of one type, the Ada software developer can create new copies automatically tailored to data of other types.

Another often quoted selection from Note A, p. 696

The distinctive characteristic of the Analytical Engine, and that which has rendered it possible to endow mechanism with such extensive faculties as bid fair to make this engine the executive right-hand of abstract algebra, is the introduction into it of the principle which Jacquard devised for regulating, by means of punched cards, the most complicated patterns in the fabrication of brocaded stuffs. It is in this that the distinction between the two engines lies. Nothing of the sort exists in the Difference Engine. We may say most aptly that the Analytical Engine weaves algebraical patterns just as the

Jacquard-loom weaves flowers and leaves.

In addition to Ada's prescient comments linking the Analytical Engine to its potential use for sound and graphics she provided what might be justly called "the first computer program", a plan for the Analytical Engine to calculate Bernoulli numbers, a very complicated chore. This table is also found in this chapter.

However, of all the material in the translation, the following Note has probably engendered the most controversy today in light of its denial of the possibility of creating original knowledge through so-called ``Artificial Intelligence."

From Note G, p. 722

It is desirable to guard against the possibility of exaggerated ideas that might arise as to the powers of the Analytical Engine. In considering any new subject, there is frequently a tendency, first, to overrate what we find to be already interesting or remarkable; and, secondly, by a sort of natural reaction, to undervalue the true state of the case, when we do discover that our notions have surpassed those that were really tenable. The Analytical Engine has no pretensions whatever to originate any thing. 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. This it is calculated to effect primarily and chiefly of course, through its executive faculties; but it is likely to exert an indirect and reciprocal influence on science itself in another manner. For, in so distributing and combining the truths and the formula of analysis, that they may become most easily and rapidly amenable to the mechanical combinations of the engine, the relations and the nature of many subjects in that science are necessarily thrown into new lights, and more profoundly investigated.