Fredericka Moxon '67

Miss Asprey outside the Computer Center.

Vassar's Newest Jewel: the 360

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On January 11, 1967, Vassar became the proud, though awed, owner of an IBM Systems/360, Model 30E, a high-speed electronic computer. We are pioneering. So far as I know, Vassar is the first women's college to have a 360, and the second college in the nation to have one! Do you remember the old laundry building behind Main? The Computer Center now occupies the superbly renovated ground floor, with the Comptroller's Office about to move from its cramped location in Main to the floor above.

Last spring when President Simpson announced that a Computer Center would be established on the Vassar campus, mixed reactions, ranging from rejoicing to indifference and head-shaking apprehension, were expressed. The rejoicers consisted largely, but not exclusively, of faculty and students in the "environmental sciences," the new catch-all phrase which includes the physical, the biological and the social sciences. To them, the computer is an indispensable research tool without which today's scientist is increasingly handicapped. Most of the members of the indifferent set came from those whose interests centered in the humanities and who could see no beneficial relation of a computer to their disciplines. The head-shaking group had many members in common with each of the other categories. They were the people to whom the word *computer* connoted *automation* with consequent loss of individualization. They were concerned, and rightly so, with the impact of the computer on the character of the College. Were we to seek your opinions, you, too, would be divided into much the same categories. Let me try to speak to all of you: the believers and the non-believers.

For better or for worse, we are living in a computerized world. The initial revolution, begun only a dozen years ago, is over. Computers steadily grow more sophisticated, smaller and cheaper. They are here to stay and here to enter into almost every phase of our lives. They are the tool of a new and unpredictable field. They have proved their worth in the practical business world and in scientific research. They are just now beginning to have a cultural impact that will cut straight across the curriculum. One can predict with certainty that an awareness of the kinds of things computers do—perhaps even direct contact with computers—will soon be regarded as an essential part of a liberal arts education. Familiarity with a computer will be as commonplace a demand as familiarity with a foreign language presently is.

The basic operation of a computer is easy to understand. I shall try to explain it non-technically. The heart of a modern computer is its *arithmetic-logic* unit and its *memory* or *storage*. To picture it, think of the mail boxes in the Vassar post-office, each with its own number or address, the numbers running in sequential order. Some boxes are empty (yours always was, if you remember); others not. Clearly, the contents of a box and its address are not related. So it is with the computer's memory. Each addressable cell may have one piece of information stored in it or it may be empty. This piece of information may be a coded command, such as *add, read, multiply,* or it may be a number. To enter an item into memory, one must tell the computer two things: *the item itself* and *the address where you want it stored.* "Input," as this process is known, can be done by punched cards, by magnetic tapes or by various other devices. The operator presses the *start* button which sends the computer to the starting address of the program, say address 1967. The internal hardware of the machine goes to address 1967 and the information stored there is pulled out for processing. Suppose the information at address 1967 is a coded command which translates into *Read 22.* The computer then reads the information stored in cell 22. Having accomplished this, it goes automatically to the next sequential address, 1968 in this example, to find out what to do next. It will perform commands sequentially unless it is programmed to change the natural order. When finished with its business of computing, it "outputs" whatever information you asked for. (To *input, output, de-bug* are acceptable verbs in computer language.) Output, like input, can be accomplished by several means. Primarily, we use the printer. Our model is slow—only 240 lines of 120 characters each per minute! As computer usage grows, the printer will soon be changed for a faster model.

There are several types of memory: drums, tapes, disks. Our computer has disk storage with more than 32,000 addressable locations. A disk looks like a thin long-playing record. It is made of metal with a magnetic coating on each side. Data are recorded on it in the form of magnetized spots. Imagine six of these long-playing records piled one above the other with a bit of space between each pair. Each of the six records contains grooves, but instead of spiraling in toward the center as do musical records, the grooves or tracks are concentric circular bands. Stationed at the side of this pile of records is a read-write arm which resembles a person's hand with fingers extended and slightly spread. As the disks rotate past the arm at a tremendously fast rate, these fingers dart in toward the center and out, "reading" the information written in the separate tracks on the disks. Access time, the time required by the computer to locate and transfer a unit of data in memory, varies from computer to computer. It takes two-millionths of one second on our model.

The questions I am most often asked are: "Do I have to understand all about computers to use one?" and "How do I actually put a problem on a computer?" Just as you drive a car without knowing what takes place under the hood, so you can use a computer without understanding its internal mechanism. For solving a problem, the computer must be given step-by-step directions written in a code which the computer can "understand." It is this series of directions or instructions, called a "program," that is stored in the computer's memory. All instructions are available whenever needed, and they can be combined in varying orders to perform extremely complicated operations. Academic users of our 360 usually choose to write their programs in FORTRAN (*For*mula *Trans*lation), a language which makes use of words and symbols already familiar to them. For example, the FORTRAN instruction C = A + B would tell the computer to add the values in cells A and B and store their sum in cell C. Though the computer cannot directly understand FORTRAN, it is capable of transforming your FORTRAN instructions into a "machine-language" program which can be run on the computer.

The first step for a user, then, is to program his problem in FORTRAN. Next, he key-punches these instructions, one by one, onto IBM cards. This process is done by means of a key-punch which closely resembles a standard typewriter. When you type C = A + B, the result appears in the form of punched holes on a card. These cards constitute the source deck. They are loaded into the card reader and from here on, the computer takes over. Your FORTRAN program is translated into machine-language in which all calculations take place and eventually the results are punched or printed out in whatever form you specified in your program. Of course, it is rare to have a program work on its first run! Careful as the programmer may be, errors creep in. It is quite humbling to have the computer itself write you messages about your careless errors: you forgot a left parenthesis, you used a period when you meant a comma, you misspelled or mistyped a command. Harder to find are the logical errors in your reasoning, errors which the computer cannot recognize. The process of finding and correcting both types of errors is known as "debugging," a colorful and descriptive term. Once it is

The control panel of the 360.

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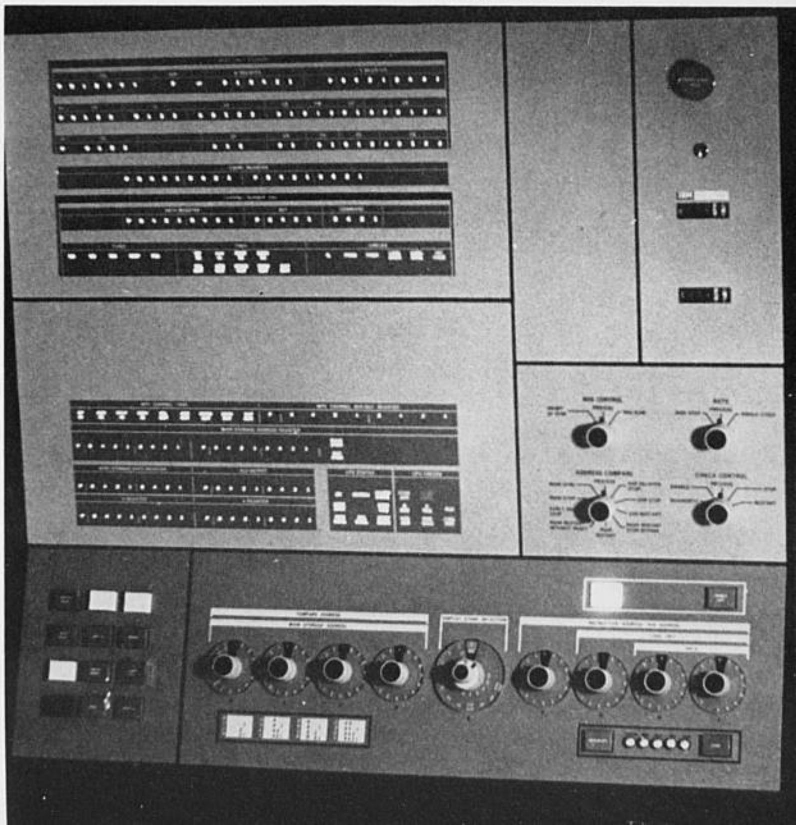

completed, you are ready for production runs, i.e., the use of your program to solve problem after problem of the same type.

ALTHOUGH it is too early to assess the impact that the 360 will have on the Vassar campus, widespread curiosity already exists. This fall, non-scientific faculty and administration members were invited to enroll in a computer-appreciation course (shades of Art 105 and Music 140). The seminars, each limited to twenty members, were offered and over-subscribed. The diversity of disciplines represented arts, classics, English, foreign languages, history, library, music, philosophy, the Recorder's office. Mrs. Leila de Campo, professional assistant to the Director of the Computer Center, organized and taught these groups. Each consisted of four sessions of two hours' duration, meeting one night a week. Included were a trip to a nearby IBM installation to see computers in action and hear a guest lecturer. On one such trip, seminar participants watched a computer calculate and print out monthly and cumulative costs at varying rates of interest over periods of 10, 15, 20, 25 years on home loans, a subject of deep concern to members of the Vassar faculty even before the announcement of a possible move to New Haven!

Dr. Herbert Bohnert of IBM, one of the seminar speakers, lectured on *Natural Languages*. He pointed out the difficulties encountered in machine analysis of English with examples such as : 1) *Tom and Joe are teachers;* 2) *Tom and Joe are brothers.* On surface analysis, these sentences are identical: compound subject, plural verb, predicate noun. Now individualize each: *Tom is a teacher* and *Joe is a teacher* versus *Tom is a brother* and *Joe is a brother*. Consider two more sentences: 1) *Parallel lines don't meet* and 2) *Barking dogs don't bite*. Again surface structure is identical, but individualizing leads to *A barking dog doesn't bite,* which makes sense, whereas *A parallel line doesn't meet* is nonsense. He characterized such problems as "deep structure," and asked to what extent it will ever be possible to program a computer to recognize such subtleties of language.

Another guest from IBM and a representative of the national organization of the Association for Computing Machinery (ACM), Dr. George Heller, presented a single computerized program which could be immediately adapted to choosing diverse items such as wedding trousseaux, menus, even football teams. Through Dr. Heller's sponsorship, the national chapter of ACM approved Vassar's application to found a student chapter, the first such club to be organized at a women's college. There are twenty-one charter members, and Anne Lounsbury '67 (mother: Mary Laird '41) is president. The Vassar chapter has joined with the Poughkeepsie chapter in several meetings and has an active program planned.

A senior mathematics major who intends to specialize in computer science taught a comparable seminar in computer appreciation, open to seniors. Present plans call for more seminars of this type for all undergraduates. In addition, we are arranging non-credit seminars in FORTRAN programming for faculty and students who need to learn how to use a computer in connection with their own research problems. IBM has been very generous in granting us permission to reproduce substantial parts of one of their manuals so long as its use is restricted to the campus.

To a very select group of Vassar students, computer experience is not new. A decade ago, the Department of Mathematics introduced a course at the advanced level on digital computers with prerequisite or corequisite of advanced calculus. This year 36 students are registered in the course. IBM donated time on their 7040 so that students might have direct contact with a high-speed computer before our 360 was available. Some of the pictures in this issue of the magazine show students at the console of the 7040 at the nearby IBM Education Building. More and more, students are also gaining experience with computers through summer jobs. Twenty thousand 360's are on order in the United States right now—sufficient to ensure jobs to all who are interested. These jobs command lofty beginning salaries—as high as $8,000 on graduation from Vassar.

THE heart of any computer installation is its machine room. Ours is located at the far end of the Computer Center, toward the Service Building. Along with the computer-console, which is the part of the computer usually pictured because it has the impressive looking buttons and twinkling lights, the machine room houses the "on-line" equipment, mechanical devices like the printer and the card reader which link directly with the computer. Its sides are glass-enclosed to permit visitors to see, but not interfere with, computer operations. The opposite sides of the two corridors flanking the machine room contain offices and study carrels. The north side, toward the Circle, is reserved for academic use and includes the library, two classrooms which can be used separately or jointly, study cubicles, the director's office and the lobby. On the south side, space is reserved for data-processing operations such as the college payroll, student billing, etc., as well as for the off-line equipment room with its key-punches, sorter and verifier.

With the mention of data-processing, let me pause to calm the fears of those of you who are apprehensive that students and alumnae will henceforth only be known as Miss 084-26-8400. Even if Vassar had not made the decision to acquire a computer, students would have been asked for their social security numbers, and this information would have been put on modern office machines; namely, unit record equipment. This is simply a trend of the times. I have fought hours of battles with the computerized data-processing operations of *Time* magazine, and only my sweet nature keeps me from bending, folding or mutilating. Such operations will play a subservient role at Vassar. Last year Vassar applied to the National Science Foundation (NSF) for help in establishing its Computer Center. Under the Undergraduate Scientific Equipment Program of NSF, we received a

Nancy Timbers '68

Mathematics students by a printer in the IBM Education Building.

grant of $50,000, the maximum amount given to only three institutions in the country (Brown University for biological sciences, University of California at Los Angeles for chemistry and Vassar College for computers). In accepting this grant, we guaranteed that business and administrative usage of the computer will consume much less than one-fifth of available computer time. Academic needs (faculty-student instruction and research) will have clear priority.

The case for the computer as a tool in scientific investigations has long since been made. Here at Vassar, research projects already in progress in the natural sciences and mathematics are making heavy demands on computer time. I predict, however, that Vassar will become nationally known in the computer field, not through scientific innovations but as a result of its contributions to computer research in the humanities. Exploration in this direction is embryonic, while major advances in scientific lines will be almost exclusively products of high-level group research at centers such as MIT, Cal Tech and major universities.

A fascinating recent experiment, which could well be reproduced and amplified by our students, concerns decision theory. A rather complex problem is formulated; relevant and redundant facts relating to its solution are listed, analyzed and rated on a numerical scale. The proposers decide on an optimum solution based on the weights of essential factors, and all this information is fed into the computer. An intelligent subject is presented with the problem via the console typewriter, and told that he may query the computer for whatever information he needs to make his decision. He may ask for certain facts, may repeat his questions and may take his time. His final decision is scored and compared with the optimum score. Preliminary findings show that the person's score is usually less than one-fifth of the optimum score. Think of the implications that similar experiments could have on the values of present teaching practices, for the computer keeps in its memory a complete record of the individual's actions, and can easily be programmed to carry out comparative analyses on responses for all members of a group. Could experiments be devised to throw light on the age-old argument of the efficacy of discussion versus lecture methods? Is the customary teacher-student confrontal in the classroom the best way to learn?

JAMES COOVER, Music Librarian at Vassar, organized an exhibit which was recently on view in Skinner Hall, designed to show the use of the computer in the field of music. In introducing it, Professor Homer Pearson, Chairman of the Department of Music, wrote the following statement:

"For a considerable time we have followed the use of computers in the field of music, both analytic and creative. We are by now familiar with processes and initial results. The Music Library has gradually collected, from numerous sources that are rapidly expanding with possibility, a collection of materials on the subject.

"This exhibit, then, is intended to call your attention to the subject. It may still be debatable to some observers, but it is no longer novel. Do not prejudge it—either its technical assumptions concerning the possibilities of some aspects of composition or its special uses in historical and theoretical research. View it without prejudice as you make up your minds."

Prominently displayed in the exhibit is a quotation from a speech by Dr. Edmund Bowles, an IBM expert who knows a great deal about computer music:

"The main point to remember is that the computer does not and cannot solve aesthetic or stylistic problems on the the basis of figures, but it does provide facts and figures with fantastic economy of time and effort, thus freeing the scholar for questions of greater probity and significance. . . ."

I SPENT last summer at Pomona College in Claremont, California, where Professor Donald McIntyre of the Department of Geology was experimenting with the 360. In addition to exciting scientific experiments, he decided to program a concordance. For this, he chose a short poem by Gerard Manly Hopkins. An operator at the console of the computer could not believe his eyes one day when he was checking the machine and read forth: "God, the Horror and the Havoc." Recently, a concordance to the Revised Standard Version of the Bible was produced on a high-speed computer in a little over two years as compared with the King James concordance which took 54 scholars ten years to accomplish. Concordances are now routine jobs for a computer. The newest research in this line is stylistic analysis.

Vassar students, like 100,000 others, flock to fill out forms for computer dates. London experts have organized a company known as PACT: Psychological Assessment of Compatible Traits, to be registered, its founders hope, as a charity! "Falling in love" says its director, "is a highly human business and one with which the computer has nothing to do. What we say is that personality has a good deal to do with the relationship between man and woman. Therefore let us try to assess personality." To accomplish this, prospective clients will fill out answers to 207 questions—routine ones of income, religious belief, health, as well as: do you often long for excitement? does your mood often go up and down? were you allowed all your own way as a child? Honest answers are expected since clients appear only as code numbers and the 1500 pieces of information extracted from each will be a secret known to the computer alone. For a modest fee of $30 one name is supplied every two months for a year. It is estimated that 2000 to 3000 applicants will be served each month.

Interesting pioneering in art-forms is in progress. Many of you saw the article in the December issue of the *Vassar Alumnae Magazine* by Peggy Kepner '67 on "Mathematical Art." Her procedure borders on computer art. Patterns formed by uniting solutions of equations with colored ink are another example of this field. Should it be taken seriously? Is it art? Does it communicate and does it possess aesthetic values? Are we ready, perhaps eager, for computer art to succeed pop and op art?

ONE area of research which presently is of interest to me is that of Computer Assisted Instruction, commonly called CAI. Read the statistics. Increased enrollments in our schools and colleges are the result of the baby boom of the late forties and early fifties. Competent teachers at all levels are scarce. Programmed instruction of the Skinner variety has proved to be a disappointment. The Crowder technique, while an improvement, is clearly not the answer. Perhaps you have never heard of either method. Briefly, a text programmed in Skinner style leads you from frame to frame in straight progression, the correct answer following each question. You read the question while keeping the answer covered, give your answer, then instantly check your response by uncovering the author's answer. The Crowder technique allows for branching: that is, if you demonstrate by responding correctly to a frame, or to a series of frames, that you have mastered a certain technique, then you are directed to by-pass a certain number of frames. Current practice in both methods is to lead the reader along in *very* gentle steps; they are programmed so that your responses are 99% correct.

CAI (Computer Assisted Instruction), on the other hand, seats you at a typewriter linked to a computer. The computer may be physically far distant (which explains the term *remote terminal* commonly used for such a linkage). You and the computer engage in a two-way conversation consisting of text-like explanations, questions and answers. You may question the computer, or it may question you. You are given a vocabulary, perhaps 200 words, that the computer will recognize and respond to. Furthermore, 40 to 50 students may be connected with a given computer at the same time, yet each will receive individual attention. I have seen demonstrations of such programs: one here in Poughkeepsie, where a class in a Florida college was studying statistics via remote terminals; a second, in San Jose, California, where a student was analyzing an unknown in a chemistry exercise. The latter had a television-like screen as well as a typewriter, and the litmus paper test came out in color! Can CAI add the versatility needed to make mechanized instruction a boon to the educational world? This is one area in which Vassar could have not only regional influence but also national impact. The field is wide open for research and for imaginative plans. In addition, we are fortunate in having available IBM friends ready and eager to cooperate in *educational* experiments, a fact which has convinced many of the indifferent at Vassar that there may be computer potentialities well worth exploring.

As I write this article, Vassar's Computer Center is just beginning. Its academic staff is composed of four people: myself, Mrs. Leila de Campo, Assistant to the Director; Mrs. Betty Ware, IBM expert assigned to the Computer Center; Mrs. Charlotte Aagenas, Secretary, Librarian and Receptionist.

Alumnae are always welcome visitors, whether they come with a computer problem or just out of curiosity to see Vassar's newest jewel.