1983

An Introductory Course on Computers for ESL Students

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An Introductory Course on Computers for ESL Students

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Submitted in partial fulfillment of the requirements for the Master of Arts in Teaching degree at the School for International Training, Brattleboro, Vermont.

May, 1983

This project by Anne Christenson Rice is accepted in its present form.

Date July 7, 1983 Principal Adviser [illegible]

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Title: An Introductory Course on Computers for ESL Students

Degree awarded: Master of Arts in Teaching

Institution: School for International Training

Year degree was granted: 1983

Thesis adviser: Alex Silverman

Program: Master of Arts in Teaching

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Abstract: This paper details the process of creation and an evaluation of a computer course for non-native English speakers.

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Background Information:

I designed and taught a computer elective course for non-native English-speaking students in February, 1983. The class was designed for English Language Services, Inc. (ELS), but it could be used by any ESL/EFL school whether or not the school had access to computers. And it can be taught by anyone, regardless of previous training in the computer field. The course is really an English language course focused around the subject and vocabulary of computers. As shown in the sections on activities and in the general course description, all areas of English are, or could be, focused on. In my course, listening comprehension, discussion, reading, and vocabulary development are primary elements, but writing could be easily incorporated. The materials are easily accessible or available in this paper, and supplementary materials could be added.

The course was for four weeks, with one fifty-minute class per day. In our system that meant 16-18 class periods. The course is designed in modules for students of varying interests and backgrounds. I used a preliminary questionnaire (See Appendix 11.) to determine the interests of the students initially, and I chose modules for my course based on their responses. A main component of the course, however, is work with the applications of the computer, which I approached with the use of the Time magazine article, "The Computer Moves In."[1] (See Appendix 1.) Another main component was the vocabulary handout, (See Appendix 2.) which is an easily-understood list of some of the most common vocabulary terminology needed by people using computers or reading about them.

Objectives:

The objectives were to allow students to develop a sizable, standard computer-related vocabulary and increase their knowledge of computer hardware, software, applications, careers, school programs, flowcharts, and (in general only) languages.

General Course Description:

There were discussions, a field trip, readings, exercises, tapes, and student talks to develop computer vocabulary and understanding.

Materials:

The materials included a vocabulary handout, (See Appendix 2.), newspaper and magazine articles, exercises, and questionnaires.

Activities:

These consisted of discussions, readings, talks by the students, exercises, listening activities, and actual work on a computer through a field trip.

Evaluation:

There was no formal final evaluation as this was an elective course.

Preliminary work:

In designing the course, I followed this set of steps, which might be of assistance for any person designing a similar course.

1. Determining a need: I had taken courses in computer programming, because I felt that the "computer revolution" was happening and I was on the fringes, not understanding what a computer could do. I felt that our school would eventually get some computers, and that the students would be interested in learning about the computer world into which the U.S. was moving so strongly. My supervisor also felt that a course on computers would appeal to the students we were trying to attract, many of whom go on to American colleges and universities where use of a computer is a requirement.

2. Setting the objectives: These can change depending on circumstances. I approached the problem of the possibility of changing objectives by designing modules which can be used or not, or added to, depending on the interests of the students each time the class if offered. Certain modules are basic to the objectives of the course, however. These are modules 1, 2, 3, 7, 8, and if possible, 11. They focus on hardware, and understanding applications and include student presentations and a field trip.

3. Searching for materials: I began by looking in catalogs from all the leading ESL/EFL publishing companies to determine what materials were available. I found only one book related to the subject of computers. It was <u>English for Careers: The Language of Computer Programming.</u>[2]

(Those publishers whose catalogs I consulted are listed in Appendix number 3.) The English for Careers book was published in 1976 and, unfortunately, upon investigation, it was determined to be out-dated. Next I called the public schools in the area and asked them about their own computer courses. I found that the materials they were using they had developed themselves for specific needs or were specifically for teaching math. I also tried bookstores, both general and textbook firms. The materials I found there, were, I felt, too technical or too difficult for limited-English speakers or non-native speakers. I then went to the public library and again encountered the problem of materials being too complicated, until I tried the children's section. There I found two books which were easy to understand and which I found helpful. They were Home Computers: A Simple and Informative Guide,[3] and My Computer Dictionary.[4] The first gives very helpful general information and the latter gives good, basic definitions of computer terms. From these books I developed my computer vocabulary handout (See Appendix 2.) for the students in the class.

The Time magazine article I used in the course (See Appendix 1.) I happened to read during the time that I was doing the other research. I felt the article raised many interesting questions about the advent of computers and also presented many applications and suggestions for future applications in a variety of interesting ways. Therefore, I decided to use it for background information and as a basis for discussions of computer uses.

During this time of preliminary planning and research, I collected articles from magazines and newspapers on all aspects of computers. I used this file to provide articles for the student presentations in cases where students didn't have something in mind which they wanted to present to the class.

I collected several Sunday "help-wanted" sections from newspapers also, so that for the portion of the course where we reviewed the kinds of jobs available and the titles and pay for these jobs, I would have enough sections on hand for all the students.

I also called some local computer schools to see if I could bring the students in to take the preliminary placement tests so they could see how much computer aptitude they had already. I got permission to bring them any time, but then I discovered that one of the schools, Computer Learning Center of Washington, had been sending copies of their examination, complete with answers, to our student advisor for her to use with any students who wanted to go to their school. Therefore, I used the same test (See Appendix 4.) in the class one day so that the students could test their "computer logic." The test consists mostly of numerical and spatial logic and mathematics.

A further source of material came from National Public

Radio tapes. The tape I used was entitled, "Computers" from the Science Modules Series of National Public Radio's Education Services.[5] I used the part entitled "Computer Satire," a computer-simulated voice. This was done after the students finished the Time magazine article which talked of a computer speaking. There was also a part which tied in with a previous discussion of the future directions of computer technology. It was entitled "Advances in the Computer Industry."

For visual aids I visited a local computer store and picked up some free literature which showed pictures of micro-computers, including disk drives and floppy disks. This was very helpful for vocabulary development.

4. Planning the modules: I was planning a course for a very short time-frame, which had the potential of being repeated often with students of very different backgrounds and future interests. Therefore, I planned short modules of varying lengths which I felt I could expand, contract, or add to. I felt the students would all be interested in applications, and that some would be interested in careers in computer science, some would have a background in computer use already, and many would need computer terminology, and often a computer language, in order to complete their future college courses.

The course would be taught as an elective, based on student interest only. This meant that there was to be little, if any, outside work required of the students. (This, of course, could be changed depending on the circumstances of the institution offering such a course.)

In the next section I will be detailing the different modules, and giving suggestions for their implementation. I will also try to give an evaluation of how I felt the sections which I gave were received by the students.

PRELIMINARY OUTLINE

Actual Hours	Anticipated Hours	Activity and Appendix Number ( )	Objective
½	1	Go over outline of course, give out vocabulary handout (2)	develop unerstanding of course
8½	3	Computer applications article, read and discuss (1)	reading, vocabulary, discussion
1¼	1	Applications exercise (5)	discussion
-	1 to 3	Languages, hardware, software, and computerized home part-Corbett book	listening comprehension, discussion
½	?	Questions	
-	½	Assignment of local school computer programs to investigate (10)	student participation, listening comp.
-	½	Discussion of visit to computer school (group visit)	personal iput
-	1	Flowchart, students make after viewing (6)	personal experience, vocab.
½	1	Study job ads; What are the abbreviations and positions and what do the people do?	reading, vocab., discussion
1	1	Game of matching the costs and functions of computers to uses (7,8)	discussion, reading
-	2 or 3	Individual reports on school programs; others take notes	note taking, discussion
¼	¼	Test for computer school (4)	practical experience
-	1	Game to assign people by interest to local computer programs (9)	test of note-taking, practical application

PRELIMINARY OUTLINE (continued)

Actual Hours	Anticipated Hours	Activity and Appendix Number ( )	Objective
3	2 or 3	Student presentations of articles read or areas of expertise, discussions	student participation, vocabulary, speaking
-	1	Discussions of questions in Keegel book (if time)	vocabulary, discussion
½	½	Tapes	listening comprehension
1	1	Field trip to computer store	hands-on experience
-	¼	Final questionnaire (13)	future planning

Total hours:
17 16 to 18, depending on holidays, scheduling, and modules chosen

Module I, Introduction:

The first part of the first class was spent with the teacher (myself) explaining the objectives of the course. Then the students and teacher introduced themselves and the students explained why they were interested in taking the course. A simple questionnaire (See Appendix 11.) was used to determine each student's personal experience with computers and to clarify the students' expectations and present the goals of the course. Few of the students said that they had used a computer before. None planned to study computer science in a college or university in the U.S., so that portion of the course which I had planned for students interested in attending schools in the area was not used with this group.

After discussing the questionnaire and reiterating what the objectives of the course were going to be, the students were given a copy of the vocabulary hand-out, (See Appendix 2.) and instructed to bring it to class every day, as we would be using it like a small dictionary in conjunction with the other activities in the course.

Module II, Computer applications:

I focused the students' interest on applications with the use of the article from Time magazine called "The Computer Moves In." (See Appendix 1.) I think the article is strong in several areas. It discusses personal applications of many people with many varied backgrounds. With so many students of differing interests and career goals, I felt this might spark their own personal application ideas, which in fact it did do. I also liked the article for the questions it raised which I felt would be good for discussions. These questions proved to be of great interest to the students, and planning only three days for discussion turned out to be very unrealistic. I could have probably even extended the discussions more than the time I finally allowed for them. (See the preliminary course outline for anticipated time allowed and actual time spent on each module.)

I approached the use of the article in class in three different ways. I considered that the students were at intermediate and advanced levels of English with one beginning student with lots of interest and fairly good listening comprehension for a beginner. I had everyone read the paragraphs together one by one, and then we discussed the main points or questions together. At other times, when there were many examples of people and their personal applications, I had students read the paragraphs about each individual, giving the longer examples to those students with faster reading ability. The students then told the rest of the class the main ideas of their sections with my help and intervention, if necessary to clarify a main point. At other times when the vocabulary was difficult in the article, I would read sections while the students followed along on their copies, and then I would summarize and we would discuss the points. I always stressed that it wasn't important to understand all the vocabulary and that we were reading for main ideas, as the language in the article can be intimidatingly difficult. When we came across any computer vocabulary which was important for the students to know, we used the vocabulary handout and looked the words up.

Some of the questions which we discussed during this module were the following:

Do computers think?

Will computers improve general education?

Will I.Q.'s rise with computer use?

Will people become lazier with computer use?

If you had more free time because of a computer, would you become lazier or more creative?

Do computers help a person think more logically and is that good or bad?

Will problems not able to be solved on a computer be ignored?

Would you want to work at home on a computer or would you miss the work place?

Would people make friends with their neighbors instead of their co-workers if they worked at home?

Are computers dehumanizing?

Will computers become common-place all over the world?

Will computers become common in your country if they aren't already?

Will computers raise living standards? How or why not?

Will computers help developing nations by-pass the industrial revolution?

Why do some people fear computers?

Will computers replace too many jobs? Which ones? Will it replace yours?

What groups are especially helped by computers?

The discussion part of the course was especially popular, although it was important to know when to change approaches in reading the article to most fully involve the students and not overwhelm them with vocabulary. I felt that the changes I made and the switches from reading to discussion to vocabulary handout were all important to maintain student interest.

Module III, Applications exercises:

This exercise (See Appendix 5.) was designed to be used following the work with Module II. It was a way of reviewing the applications already worked with, and it was an opportunity for the students to use their imaginations to think of new application ideas. I think it would have been better to have divided the topics up among the students to be able to finish in one class period. The students were working with partners, and the first day went smoothly. However, the second day interest lagged. I think the students needed to have more class discussion of each other's suggestions as a whole class sooner, and I think there was too much repetition of application ideas among the areas listed because it was such a long exercise.

Another plan might have been to add all the students' careers to the list for final reinforcement of personal applications. Although the students had talked about personal applications in Module II, perhaps writing them down would have been a good final summary.

Module IV, Assignment of local school computer programs to investigate, individual reports on the information gathered to the class, and follow-up game to test listening comprehension on information reported:

As none of my students indicated any interest in studying computers in school on the entrance quesitonnaire, (See Appendix 11.) I did not use Module IV, but I will explain what I envisioned.

I had an idea of the local private schools and universities which offered computer programs. I was planning to have the students use the telephone questionnaire to gather information on programs from any schools in which they were interested. The questionnaire consisted of questions in which I felt students entering a computer program would be interested. (Please refer to Appendix 10.)

After using the questionnaire the students would report the information to the class, and then the students would test their comprehension with a game (See Appendix 9.) where they would match hypothetical people with varying interests and backgrounds with the schools programs reported on. (Our particular area offers quite a distinct variety of 4-year university, 2-year community college and 6 to 12 month private intensive programs to allow a wide variety of degrees, time-frames and costs. This may not be true in all areas.)

I thought the students listening to the reported information would then work in small groups to practice conversation and compare their decisions on the game hand-out with those of the other members of the class. (I did not envision any particular right or wrong conclusions on the hand-out and would let the students know that.)

Module V, Flowchart:

I had planned the flowchart exercise as a kind of general interest module, applicable to anyone studying any kind of programming. I felt most of the students would eventually have at least one programming course requirement, because many were planning to attend U.S. colleges and universities. I planned to give them a very simple flowchart, (See Appendix 6.) and then I was going to give them a task such as deciding which universities to apply to, or how to cook an egg, and have them make a flowchart to test their comprehension of the detailing of tasks required. In fact, I didn't give them the exercise to do, because one of the students in an individual presentation went into great detail about flowcharts. The students really enjoyed the talk, and I didn't want to take away any of the student's glory in doing such a fine job. The flowchart exercise is one that could be used with writing exercises to get the students to initially organize their ideas for a process composition, as it shows the importance of detailed steps and proper order. It could be used as a speaking exercise in the same way.

Module VI, Jobs:

This exercise was designed for any students who might be interested in the computer field to give an idea of the kinds of jobs available, as well as those most advertised, and therefore needed at present. The students looked at the different titles and discussed the responsibilities and pay for each kind of position. They were also asked to find which jobs had the most want-ads and to try to speculate on why they did. The students worked in pairs on this exercise. I did this exercise with the class I taught. I allowed half a class period for the exercise, but it would have benefited from more time. The students had more trouble than I had anticipated reading the ads and understanding the advertising abbreviations. Therefore I needed more time to answer questions than I had anticipated. Many jobs had no pay listed, and we discussed what that meant for a job-seeker. This exercise was mostly used to work on vocabulary development and for general interest discussion.

Module VII, Costs, functions, and uses of computers:

In this exercise there were two sections. The first part was the handout which listed computers, their costs, and some functions. (See Appendix 7.) This information was gathered from the article, "The Hottest Selling Hardware," in Time magazine,[6] in the same January 8, 1983, issue as the article on applications mentioned earlier. After we had gone over the information on the first sheet, the students were asked to work in pairs in determining which computer or computers some hypothetical people might choose from a second handout. (See Appendix 8.)

This exercise could easily be expanded. It provides general information on the names of available micro-computers for students interested in purchasing one, and it shows a comparison of prices and functions after applications had already been studied. It also works on discussion and vocabulary with some reading.

At the end of the period the various answers from each group were compared and discussed as to logic. The students were told that there was no one answer which was anticipated, and that they were free to choose. (For example, one group decided in situation 5 that the family should take a course similar to the one they were taking to decide what computer they should buy.)

Module VIII, Individual Student Projects:

All the students in the class were asked to give an oral presentation on some topic related to computers. The topics were chosen by the students. I had collected a file of magazine and newspaper articles which students could use as the basis for the presentation if they desired, or they could choose their own materials. I was hoping that with this project I could develop an interesting exchange of information and provide an outlet for any students with a considerable background in computers to communicate their knowledge to the other students. This activity was initially met with a mixed reaction by the students. Some of the students had had some experience in using computers, and they were able to give presentations of great interest to the other students. Other students were less enthusiastic about the assignment, because the class was an elective course, one of the few classes for which homework was not normally required. For students used to this system, and less interested in computers in their futures, the presentation was rather academic and not as interesting to the class nor to themselves. I think that a problem too, was that few of the articles I had were written on an easy level, so that the intermediate students had some trouble working on their own. I think that I need to develop my file so that there is more variety of topics and difficulty. Some easily understood articles are necessary so that nobody finds the projects too difficult and more variety of topics would prove more interesting to both the presenter and the listeners. It is also worthwhile to note that although some students were more interested in this assignment than others, they all felt they had learned something afterwards.

Module IX, Test for computer school:

This exercise was one which proved more difficult for the students and more popular than I had anticipated. I was using the module for general interest, although it would be a more serious assignment for a class where some of the students were considering attending a computer school or were thinking of majoring in computer programming. The test (See Appendix 4.) requires logical thinking as well as spatial reasoning. It was from the Computer Learning Center of Washington and had been sent to our student advisor for any prospective students to take.

Having taken the exam myself, I thought that the time suggestions for the test were much more than adequate. However, it took the students more time than I had anticipated. I would recommend that the time frame established be the same as that suggested in the instructions. The method of using the test for initial evaluation was not revealed by the company. They had merely sent the copies so that the students could see what kinds of questions they could anticipate on their preliminary placement tests.

The test is fairly direct, and the answers and explanations are provided. However, I think that more follow-up could be done on the questions in the test. I feel such questions as "Why are such skills as tested important to a computer programmer?' might be discussed.

Module X, National Public Radio Tapes:

To work on listening comprehension, ELS had purchased some National Public Radio tapes. There was one particular tape on computer topics entitled "Computers" from the Science Modules Series of the Education Services section.[7] The segments filling the tape were, in general, about many of the problems associated with computer technology and computer use, such as the problem of changing technology, eye fatigue, computer-addiction, etc. Since most of the students were very enthusiastic about the use of computers, and I didn't want to discourage them, I tried only two sections of the tape. The first was entitled, "Computer Satire." It featured a computer-simulated voice. This was very interesting to the class, as during the module on applications there had been mention of a computer voice, which was hard for some of the students to visualize. Besides the computer voice being very different, the section was also short, which was helpful, since we could replay it several times until everyone could understand the message. I tried a second part, but it was too long to hold the attention of the students and too difficult for the majority of the students to understand. It was the segment entitled "Advances in the Computer Industry."

I think that the use of the first tape really focused attention on listening comprehension, but the second segment was overwhelming for my intermediate students. I had to explain the main idea to a frustrated group. However, these tapes could be a valuable resource for a uniformly advanced group.

Module XI, Field trip:

Since the school did not have computers when I taught my course, I felt it was important to go somewhere where the students could actually experience using computers. Radio Shack in Washington was more than agreeable to the idea of doing a presentation for the students, free of charge, incorporating all the information and topics which the students had specified they were interested in. The trip was a highlight for those students who felt that they would eventually work with a computer, since the demonstration included some actual programming by each student. Radio Shack is especially promoting education for teachers interested in computers, and in the Washington area they are also promoting working with school groups. If a school doesn't have access to computers, a trip is one avanue to explore for giving the students a chance to actually use a computer. Other computer stores in this area were more than happy to provide students with free trial sessions on their computers. Therefore, even if one's area doesn't have a Radio Shack outlet, there are other ways to gain computer use for students. Even if students must go alone, rather than all together with their teacher, I think such exposure is helpful and interesting to the students.

Final student evaluations:

The only time which I could arrange the trip to Radio Shack was the last day of class. As a result, I had to ask the students to do the final course evaluation, (See Appendix 13.) after the end of the course. This resulted in problems tracking down the students in various classes, and consequently, I did not get a complete set. However, the responses I did receive indicated that people felt that they had learned vocabulary, applications, and had gained a general idea of what computers were about. In other words the class objectives had been met. In answer to question number 2, "Was the course what you expected," I recieved both "yes" and "no" answers. The "no" answers emphasized that some students had wanted to learn a computer language, although they had been told twice before the course was offered and again at the beginning of the course, that there would be no computer language training. I believe that the response was a matter of wishful thinking rather than a real lack of understanding of what the course would offer. Moreover, all the students said they they had enjoyed the course, both because they had learned about computers as outlined in the objectives, and because they had had opportunities to practice English. I think the evaluation was a good idea, and I only wish I had been able to get one from each of the students.

Final suggestions for future courses or adaptations:

After the course was over, our school purchased two computers on a trial basis. This access to computers was completely unanticipated when I designed the course, but I think this development is a great asset. In the future, and in response to the students' desires for programming skills I see a modification of the course necessary to keep the students' interest piqued. I would suggest teaching the course much as it is, but concurrently allowing two students at a time to rotate out of the class into the computer room to work individually on self-taught programming books. This would be done after completion of the first three modules, so that everyone would have the same basic knowledge. Then students would elect to miss certain modules. As the modules are mostly self-contained, I don't believe this would cause too much class disruption.

For working on the computers, I had in mind a specific book, <u>Creative Programming for Young Minds.</u> This is a book designed to be used by children to teach them programming skills. There are some cultural items contained in the book which would have to be explained like "Cool Dude," but the programming steps are fairly logical and fun. The class would be conducted in an adjoining room in case of real problems, but students would be encouraged to help each other, thus leading to communication in English (if the students weren't from the same language group). Currently the students in our school who wish to use the new computers must first do two introductory programs entitled "Apple Presents Apple" by the Apple Computer Company and "Computer Literacy" by Plato (Control Data Corporation), and then they are allowed to choose any program in the library to do. The two programs cited teach the users how the computers work, step by step, and overlap somewhat, so that really only one program is necessary. The students have done well working by themselves, and there have been no major problems with their understanding what is required of them. I would anticipate a similar situation with the Creative Programming for Young Minds series. Even if the students did not finish the first book by the end of the session (four weeks), they would at least have had the satisfaction of working on the computer, beginning to learn some computer language (BASIC), and they would have gained the confidence to continue working by themselves. The whole class would have the opportunity to both work alone and benefit from the vocabulary and general English work in the computer class I designed. I am not saying that there is no place for my class without computers as it was designed to be taught without them, but when computers are available, I feel they should be used.

Other miscellaneous aspects of the course:

Some of the time in the course was devoted to activities outside the modules. For example, some students had many questions, which took up part of the time. Furthermore, because my class was so interested, I did give them a very elementary explanation of some commands in BASIC and how the program would look, although the course was not designed to teach programming. (See Appendix 12.) This would not be necessary for a teacher who didn't know a computer language. I believe that if the course is emphasized to be an ESL course primarily, with a focus on the topic of computers, that very little personal knowledge beyond that gained from the magazine articles and books in my bibliography would be required. As mentioned earlier, the books are written for children, so they are easy to comprehend and do not require much time to complete. And as I mentioned earlier, the objectives of the course, which did not include learning a programming language, were met as determined by the final evaluation questionnaire. The students had learned the vocabulary needed to understand computers and their applications, and they had become "computer literate" in the process.

MACHINE OF THE YEAR

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TIME/JANUARY 3, 1983

The Computer Moves In

By the millions, it is beeping its way into offices, schools and homes

WILL SOMEONE PLEASE TELL ME, the bright red advertisement asks in mock irritation, WHAT A PERSONAL COMPUTER CAN DO? The ad provides not merely an answer, but 100 of them. A personal computer, it says, can send letters at the speed of light, diagnose a sick poodle, custom-tailor an insurance program in minutes, test recipes for beer. Testimonials abound. Michael Lamb of Tucson figured out how a personal computer could monitor anesthesia during surgery; the rock group Earth, Wind and Fire uses one to explode smoke bombs onstage during concerts; the Rev. Ron Jaenisch of Sunnyvale, Calif., programmed his machine so it can recite an entire wedding ceremony.

In the cavernous Las Vegas Convention Center a month ago, more than 1,000 computer companies large and small were showing off their wares, their floppy discs and disc drives, joy sticks and modems, to a mob of some 50,000 buyers, middlemen and assorted technology buffs. Look! Here is Hewlett-Packard's HP9000, on which you can sketch a new airplane, say, and immediately see the results in 3-D through holograph imaging; here is how the Votan can answer and act on a telephone call in the middle of the night from a salesman on the other side of the country; here is the Olivetti M20 that entertains bystanders by drawing garishly colored pictures of Marilyn Monroe; here is a program designed by The Alien Group that enables an Atari computer to say aloud anything typed on its keyboard in any language. It also sings, in a buzzing humanoid voice, *Amazing Grace* and *When I'm 64* or anything else that anyone wants to teach it.

As both the Apple Computer advertisement and the Las Vegas circus indicate, the enduring American love affairs with the automobile and the television set are now being transformed into a giddy passion for the personal computer. This passion is partly fad, partly a sense of how life could be made better, partly a gigantic sales campaign. Above all, it is the end result of a technological revolution that has been in the making for four decades and is now, quite literally, hitting home.

Americans are receptive to the revolution and optimistic about its impact. A new poll* for TIME by Yankelovich, Skelly and White indicates that nearly 80% of Americans expect that in the fairly near future, home computers will be as commonplace as television sets or dishwashers. Although they see dangers of unemployment and dehumanization, solid majorities feel that the computer revolution will ultimately raise production and therefore living standards (67%), and that it will improve the quality of their children's education (68%).

The sales figures are awesome and will become more so. In 1980 some two dozen firms sold 724,000 personal computers for $1.8 billion. The following year 20 more companies joined the stampede, including giant IBM, and sales doubled to 1.4 million units at just under $3 billion. When the final figures are in for 1982, according to Dataquest, a California research firm, more than 100 companies will probably have sold 2.8 million units for $4.9 billion.

To be sure, the big, complex, costly "mainframe" computer has been playing an increasingly important role in practically everyone's life for the past quarter-century. It predicts the weather, processes checks, scrutinizes tax returns, guides intercontinental missiles and performs innumerable other operations for governments and corporations. The computer has made possible the exploration of space. It has changed the way wars are fought, as the Exocet missile proved in the South Atlantic and Israel's electronically sophisticated forces did in Lebanon.

Despite its size, however, the mainframe does its work all but invisibly, behind the closed doors of a special, climate-controlled room. Now, thanks to the transistor and the silicon chip, the computer has been reduced so dramatically in both bulk and price that it is accessible to millions. In 1982 a cascade of computers beeped and blipped their way into the American office, the American school, the American home. The "information revolution" that futurists have long predicted has arrived, bringing with it the promise of dramatic changes in the way people live and work, perhaps even in the way they think. America will never be the same.

In a larger perspective, the entire world will never be the same. The industrialized nations of the West are already scrambling to computerize (1982 sales: 435,000 in Japan, 392,000 in Western Europe). The effect of the machines on the Third World is more uncertain. Some experts argue that computers will, if anything, widen the gap between haves and have-nots. But the prophets of high technology believe the computer is so cheap and so powerful that it could enable underdeveloped nations to bypass the whole industrial revolution. While robot factories could fill the need for manufactured goods, the microprocessor would create myriad new industries, and an international computer network could bring important agricultural and medical information to even the most remote villages. "What networks of railroads, highways and canals were in another age, networks of telecommunications, information and computerization . . . are today," says Austrian Chancellor Bruno Kreisky. Says French Editor Jean-Jacques Servan-Schreiber, who believes that the computer's teaching capability can conquer the Third World's illiteracy and even its tradition of high birth rates: "It is the source of new life that has been delivered to us."

The year 1982 was filled with notable events around the globe. It was a year in which death finally pried loose Leonid Brezhnev's frozen grip on the Soviet Union, and Yuri Andropov, the cold-eyed ex-chief of the KGB, took command. It was a year in which Israel's truculent Prime Minister Menachem Begin completely redrew the power map of the Middle East by invading neighboring Lebanon and smashing the Palestinian guerrilla forces there. The military campaign was a success, but all the world looked with dismay at the thunder of Israeli bombs on Beirut's civilians and at the massacres in the Palestinian refugee camps. It was a year in which Argentina tested the decline of European power by seizing the Falkland Islands, only to see Britain, led by doughty Margaret Thatcher, meet the test by taking them back again.

Nor did all of the year's major news derive from wars or the threat of international violence. Even as Ronald Reagan cheered the sharpest decline in the U.S. inflation rate in ten years, 1982 brought the worst unemployment since the Great Depression (12 million jobless) as well as budget deficits that may reach an unprecedented $180 billion in fiscal 1983. High unemployment plagued Western Europe as well, and the multibillion-dollar debts of more than two dozen nations gave international financiers a severe fright. It was also a year in which the first artificial heart began pumping life inside a dying man's chest, a year in which millions cheered the birth of cherubic Prince William Arthur Philip Louis of Britain, and millions more

*The telephone survey of 1,019 registered voters was conducted on Dec. 8 and 9. The margin of sampling error is plus or minus 3%.

rooted for a wrinkled, turtle-like figure struggling to find its way home to outer space.

There are some occasions, though, when the most significant force in a year's news is not a single individual but a process, and a widespread recognition by a whole society that this process is changing the course of all other processes. That is why, after weighing the ebb and flow of events around the world, TIME has decided that 1982 is the year of the computer. It would have been possible to single out as Man of the Year one of the engineers or entrepreneurs who masterminded this technological revolution, but no one person has clearly dominated those turbulent events. More important, such a selection would obscure the main point. TIME's Man of the Year for 1982, the greatest influence for good or evil, is not a man at all. It is a machine: the computer.

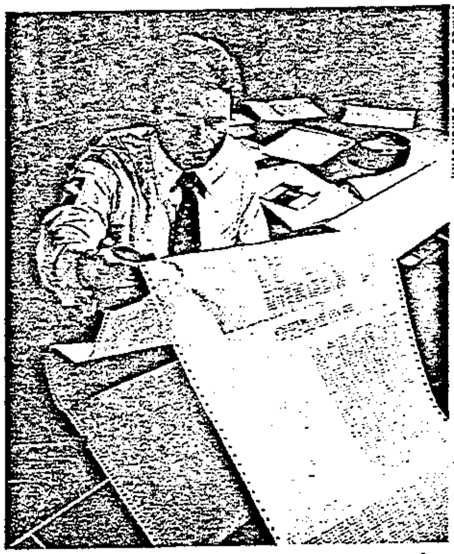
It is easy enough to look at the world around us and conclude that the computer has not changed things all that drastically. But one can conclude from similar observations that the earth is flat, and that the sun circles it every 24 hours. Although everything seems much the same from one day to the next, changes under the surface of life's routines are actually occurring at almost unimaginable speed. Just 100 years ago, parts of New York City were lighted for the first time by a strange new force called electricity; just 100 years ago, the German Engineer Gottlieb Daimler began building a gasoline-fueled internal combustion engine (three more years passed before he fitted it to a bicycle). So it is with the computer.

The first fully electronic digital computer built in the U.S. dates back only to the end of World War II. Created at the University of Pennsylvania, ENIAC weighed 30 tons and contained 18,000 vacuum tubes, which failed at an average of one every seven minutes. The arrival of the transistor and the miniaturized circuit in the 1950s made it possible to reduce a room-size computer to a silicon chip the size of a pea. And prices kept dropping. In contrast to the $487,000 paid for ENIAC, a top IBM personal computer today costs about $4,000, and some discounters offer a basic Timex-Sinclair 1000 for $77.95. One computer expert illustrates the trend by estimating that if the automobile business had developed like the computer business, a Rolls-Royce would now cost $2.75 and run 3 million miles on a gallon of gas.

Looking ahead, the computer industry sees pure gold. There are 83 million U.S. homes with TV sets, 54 million white-collar workers, 26 million professionals, 4 million small businesses. Computer salesmen are hungrily eyeing every one of them. Estimates for the number of personal computers in use by the end of the century run as high as 80 million. Then there are all the auxiliary industries: desks to hold computers, luggage to carry them, cleansers to polish them. "The surface is barely scratched," says Ulric Weil, an analyst for Morgan Stanley.

Beyond the computer hardware lies the virtually limitless market for software, all those prerecorded programs that tell the willing but mindless computer what to do. These discs and cassettes range from John Wiley & Sons' investment analysis program for $59.95 (some run as high as $5,000) to Control Data's PLATO programs that teach Spanish or physics ($45 for the first lesson, $35 for succeeding ones) to a profusion of space wars, treasure hunts and other electronic games.

This most visible aspect of the computer revolution, the video game, is its least significant. But even if the buzz and clang of the arcades is largely a teen-age fad, doomed to go the way of Rubik's Cube and the Hula Hoop, it is nonetheless a remarkable phenomenon. About 20 corporations are selling some 250 different game cassettes for roughly $2 billion this year. According to some estimates, more than half of all the personal computers bought for home use are devoted mainly to games.


JAMES BALOG—BLACK STAR

ANALYZING BUSINESS DATA: Transamerica Executive Frank Herringer studies print-outs

Computer enthusiasts argue that these games have educational value, by teaching logic, or vocabulary, or something. Some are even used for medical therapy. Probably the most important effect of these games, however, is that they have brought a form of the computer into millions of homes and convinced millions of people that it is both pleasant and easy to operate, what computer buffs call "user friendly." Games, says Philip D. Estridge, head of IBM's personal computer operations, "aid in the discovery process."

Apart from games, the two things that the computer does best have wide implications but are quite basic. One is simply computation, manipulating thousands of numbers per second. The other is the ability to store, sort through and rapidly retrieve immense amounts of information. More than half of all employed Americans now earn their living not by producing things but as "knowledge workers," exchanging various kinds of information, and the personal computer stands ready to change how all of them do their jobs.

▸ Frank Herringer, a group vice president of Transamerica Corp., installed an Apple in his suburban home in Lafayette, Calif., and spent a weekend analyzing various proposals for Transamerica's $300 million takeover of the New York insurance brokerage firm of Fred S. James Co. Inc. "It allowed me to get a good feel for the critical numbers," says Herringer. "I could work through alternative options, and there were no leaks."

▸ Terry Howard, 44, used to have a long commute to his job at a San Francisco stock brokerage, where all his work involved computer data and telephoning. With a personal computer, he set up his own firm at home in San Rafael. Instead of rising at 6 a.m. to drive to the city, he runs five miles before settling down to work. Says he: "It didn't make sense to spend two hours of every day burning up gas, when my customers on the telephone don't care whether I'm sitting at home or in a high rise in San Francisco."

▸ John Watkins, safety director at Harriet & Henderson Yarns, in Henderson, N.C., is one of 20 key employees whom the company helped to buy home computers and paid to get trained this year. Watkins is trying to design a program that will record and analyze all mill accidents: who was injured, how, when, why. Says he: "I keep track of all the cases that are referred to a doctor, but for every doctor case, there are 25 times as many first-aid cases that should be recorded." Meantime, he has designed a math program for his son Brent and is shopping for a word-processing program to help his wife Mary Edith write her master's thesis in psychology. Says he: "I don't know what it can't do. It's like asking yourself, 'What's the most exciting thing you've ever done?' Well, I don't know because I haven't done it yet."

▸ Aaron Brown, a former defensive end for the Kansas City Chiefs and now an office-furniture salesman in Minneapolis, was converted to the computer by his son Sean, 15, who was converted at a summer course in computer math. "I thought of computers very much as toys," says Brown, "but Sean started telling me, 'You could use a computer in your work.' I said, 'Yeah, yeah, yeah.' " Three years ago, the family took a vote on whether to go to California for a vacation or to buy an Apple. The Apple won, 3 to 1, and to prove its value, Sean wrote his father a program that computes gross profits and commissions on any sale.

Brown started with "simple things," like filing the names and telephone numbers of potential customers. "Say I was going to a particular area of the city," Brown says. "I would ask the computer to pull up the accounts in a certain zip-code area, or if I wanted all the customers who were in-

DAVID BURNETT—CONTACT

PUBLISHING A NEWSLETTER AT HOME: Rohn Engh, who with Wife Jeri puts out *Photo Letter*, a weekly that helps photographers market pictures, uses a TRS-80 in the barn that serves as his office in Star Prairie, Wis., to keep track of 1,400 subscribers

terested in whole office systems, I could pull that up too." The payoff: since he started using the computer, he has doubled his annual sales to more than $1 million.

Brown has spent about $1,500 on software, all bound in vinyl notebooks along a wall of his home in Golden Valley, Minn., but Sean still does a lot of programming on his own. He likes to demonstrate one that he designed to teach French. *"Vive la France!"* it says, and then starts beeping the first notes of *La Marseillaise.* His mother Reatha uses the computer to help her manage a gourmet cookware store, and even Sister Terri, who originally cast the family's lone vote against the computer, uses it to store her high school class notes. Says Brown: "It's become kind of like the bathroom. If someone is using it, you wait your turn."

Reatha Brown has been lobbying for a new carpet, but she is becoming resigned to the prospect that the family will acquire a new hard-disc drive instead. "The videocassette recorder," she sighs, pointing across the room, "that was my other carpet." Replies her husband, setting forth an argument that is likely to be replayed in millions of households in the years just ahead: "We make money with the computer, but all we can do with a new carpet is walk on it. Somebody once said there were five reasons to spend money: on necessities, on investments, on self-improvement, on memories and to impress your friends. The carpet falls in that last category, but the computer falls in all five."

By itself, the personal computer is a machine with formidable capabilities for tabulating, modeling or recording. Those capabilities can be multiplied almost indefinitely by plugging it into a network of other computers. This is generally done by attaching a desktop model to a telephone line (two-way cables and earth satellites are coming increasingly into use). One can then dial an electronic data base, which not only provides all manner of information but also collects and transmits messages: electronic mail.

The 1,450 data bases that now exist in the U.S. range from general information services like the Source, a *Reader's Digest* subsidiary in McLean, Va., which can provide stock prices, airline schedules or movie reviews, to more specialized services like the American Medical Association's AMA/NET, to real esoterica like the Hughes Rotary Rig Report. Fees vary from $300 an hour to less than $10.

Just as the term personal computer can apply to both a home machine and an office machine (and indeed blurs the distinction between the two places) many of the first enthusiastic users of these devices have been people who do much of their work at home: doctors, lawyers, small businessmen, writers, engineers. Such people also have special needs for the networks of specialized data.

Orthopedic Surgeon Jon Love, of Madisonville, Ky., connects the Apple in his home to both the AMA/NET, which offers, among other things, information on 1,500 different drugs, and Medline, a compendium of all medical articles published in the U.S. "One day I accessed the computer three times in twelve minutes," he says. "I needed information on arthritis and cancer in the leg. It saved me an hour and a half of reading time. I want it to pay me back every time I sit down at it."

Charles Manly III practices law in Grinnell, Iowa (pop. 8,700), a town without a law library, so he pays $425 a month to connect his CPT word processor to Westlaw, a legal data base in St. Paul. Just now he needs precedents in an auto insurance case. He dials the Westlaw telephone number, identifies himself by code, then types: "Courts (Iowa) underinsurance." The computer promptly tells him there is only one such Iowa case, and it is 14 years old. Manly asks for a check on other Midwestern states, and it gives him a long list of precedents in Michigan and Minnesota. "I'm not a chiphead," he says, "but if you don't keep up with the new developments, even in a rural general practice, you're not going to have the competitive edge."

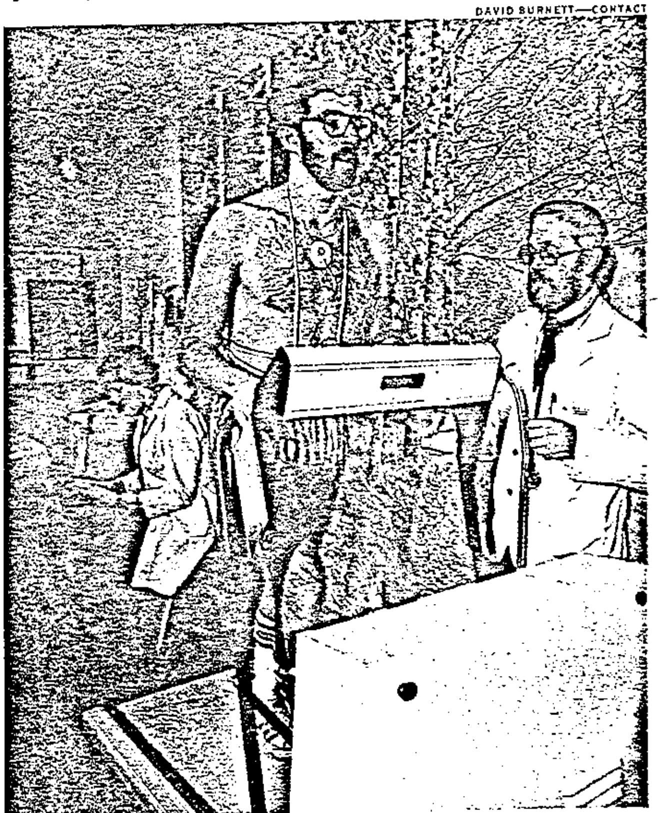
The personal computer and its networks are even changing that oldest of all home businesses, the family farm. Though only about 3% of commercial farmers and ranchers now have computers, that number is expected to rise to nearly 20% within the next five years. One who has grasped the true faith is Bob Johnson, who helps run his family's 2,800-acre pig farm near De Kalb, Ill. Outside, the winter's first snowflakes have dusted the low-slung roofs of the six red-and-white barns and the brown fields specked with corn stubble. Inside the two-room office building, Johnson slips a disc into his computer and types "D" (for dial) and a telephone number. He is immediately connected to the Illinois farm bureau's newly computerized AgriVisor service. It not only gives him weather conditions to the west and the latest hog prices on the Chicago commodities exchange, but also offers advice. Should farmers continue to postpone the sale of their newly harvested corn? "Remember," the computer counsels, "that holding on for a dime or a nickel may not be worth the long-term wait."

Johnson started out playing computer games on an Apple II, but then "those got shoved in the file cabinet." He began computerizing all his farm records, which was not easy. "We could keep track of the hogs we sold in dollars, but we couldn't keep track of them by pounds and numbers at the same time." He started shopping around and finally acquired a $12,000 combination at a shop in Lafayette, Ind.: a microcomputer from California Computer Systems, a video screen from Ampex, a Diablo word printer and an array of agricultural programs.

Johnson's computer now knows the yields on 35 test plots of corn, the breeding records of his 300 sows, how much feed his hogs have eaten (2,787,260 lbs.) and at what cost ($166,047.73). "This way, you can charge your hogs the cost of the feed when you sell them and figure out if you're making any money," says Johnson. "We never had this kind of information before. It would have taken too long to calculate. But we knew we needed it."

Just as the computer is changing the way work is done in home offices, so it is revolutionizing the office. Routine tasks like managing payrolls and checking inventories have long since been turned over to computers, but now the typewriter is giving way to the word processor, and every office thus becomes part of a network. This change has barely begun; about 10% of the typewriters in the 500 largest industrial corporations have so far been replaced. But the economic imperatives are inescapable. All told, office professionals could save about 15% of their time if they used the technology now available, says a study by Booz, Allen & Hamilton, and that technology is constantly improving. In one survey of corporations, 55% said they were planning to acquire the latest equipment. This technology involves not just word processors but computerized electronic message systems that could eventually make paper obsolete, and wall-size, two-way TV teleconference screens that will obviate traveling to meetings.

DAVID BURNETT—CONTACT



CHECKING A MEDICAL PROGRAM: Dr. Don Hall records cardiovascular-fitness test results on a TRS-80 in Portland, Ore.

The standard home computer is sold only to somebody who wants one, but the same machine can seem menacing when it appears in an office. Secretaries are often suspicious of new equipment, particularly if it appears to threaten their jobs, and so are executives. Some senior officials resist using a keyboard on the ground that such work is demeaning. Two executives in a large firm reportedly refuse to read any computer print-out until their secretaries have retyped it into the form of a standard memo. "The biggest problem in introducing computers into an office is management itself," says Ted Stout of National Systems Inc., an office design firm in Atlanta. "They don't understand it, and they are scared to death of it."

But there is an opposite fear that drives anxious executives toward the machines: the worry that younger and more sophisticated rivals will push ahead of them. "All you have to do," says Alexander Horniman, an industrial psychologist at the University of Virginia's Darden School of Business, "is walk down the hall and see people using the computer and imagine they have access to all sorts of information you don't." Argues Harold Todd, executive vice president at First Atlanta Bank: "Managers who do not have the ability to use a terminal within three to five years may become organizationally dysfunctional." That is to say, useless.

If more and more offices do most of their work on computers, and if a personal computer can be put in a living room, why should anyone have to go to work in an office at all? The question can bring a stab of hope to anybody who spends hours every day on the San Diego Freeway or the Long Island Rail Road. Nor is "telecommuting" as unrealistic as it sounds. Futurist Jack Nilles of the University of Southern California has estimated that any home computer would soon pay for itself from savings in commuting expenses and in city office rentals.

Is the great megalopolis, the marketplace of information, about to be doomed by the new technology? Another futurist, Alvin Toffler, suggests at least a trend in that direction. In his 1980 book, *The Third Wave*, he portrays a 21st century world in which the computer revolution has canceled out many of the fundamental changes wrought by the Industrial Revolution: the centralization and standardization of work in the factory, the office, the assembly line. These changes may seem eternal, but they are less than two centuries old. Instead, Toffler imagines a revived version of pre-industrial life in what he has named "the electronic cottage," a utopian abode where all members of the family work, learn and enjoy their leisure around the electronic hearth, the computer. Says Vice President Louis H. Mertes of the Continental Illinois Bank and Trust Co. of Chicago, who is such a computer enthusiast that he allows no paper to be seen in his office (though he does admit to keeping a few files in the drawer of an end table): "We're talking when—not if—the electronic cottage will emerge."

Continental Illinois has experimented with such electronic cottages by providing half a dozen workers with word processors so they could stay at home. Control Data tried a similar experiment and ran into a problem: some of its 50 "alternate site workers" felt isolated, deprived of their social life around the water cooler. The company decided to ask them to the office for lunch and meetings every week. "People are like ants, they're communal creatures," says Dean Scheff, chairman and founder of CPT Corp., a word-processing firm near Minneapolis. "They need to interact to get the creative juices flowing. Very few of us are hermits."

TIME's Yankelovich poll underlines the point. Some 73% of the respondents believed that the computer revolution would enable more people to work at home. But only 31% said they would prefer to do so themselves. Most work no longer involves a hayfield, a coal mine or a sweatshop, but a field for social intercourse. Psychologist Abraham Maslow defined work as a hierarchy of functions: it first provides food and shelter, the basics, but then it offers security, friendship, "belongingness." This is not just a matter of trading gossip in the corridors; work itself, particularly in the information industries, requires the stimulation of personal contact in the exchange of ideas: sometimes organized conferences, sometimes simply what is called "the schmooze factor." Says Sociologist Robert Schrank: "The workplace performs the function of community."

But is this a basic psychological reality or simply another rut dug by the Industrial Revolution? Put another way, why do so many people make friends at the office rather than among their neighbors? Prophets of the electronic cottage predict that it will once again enable people to find community where they once did: in their communities. Continental Illinois Bank, for one, has opened a suburban "satellite work station" that gets employees out of the house but not all the way downtown. Ford, Atlantic Richfield and Merrill Lynch have found that teleconferencing can reach far more people for far less money than traditional sales conferences.

Whatever the obstacles, telecommuting seems particularly rich with promise for millions of women who feel tied to the home because of young children. Sarah Sue Hardinger has a son, 3, and a daughter three months old; the computer in her cream-colored stucco house in South Minneapolis is surrounded by children's books, laundry, a jar of Dippity Do. An experienced programmer at Control Data before she decided to have children, she now settles in at the computer right after breakfast, sometimes holding the baby in a sling. She starts by reading her computer mail, then sets to work converting a PLATO grammar program to a disc that will be compatible with Texas Instruments machines. "Mid-morning I have to start paying attention to the three-year-old, because he gets antsy," says Hardinger. "Then at 11:30 comes *Sesame Street* and *Mr. Rogers,* so that's when I usually get a whole lot done." When her husband, a building contractor, comes home and takes over the children, she returns to the computer. "I use part of my house time for work, part of my work time for the house," she says. "The baby has demand feeding; I have demand working."

DAVID BURNETT—CONTACT

KEEPING UP DOWN ON THE FARM: Missouri rancher's wife Melesa Beckett uses her computer to update records on 350 cattle

To the nation's 10 million physically handicapped, telecommuting encourages new hopes of earning a livelihood. A Chicago-area organization called Lift has taught computer programming to 50 people with such devastating afflictions as polio, cerebral palsy and spinal damage. Lift President Charles Schmidt cites a 46-year-old man paralyzed by polio: "He never held a job in his life until he entered our program three years ago, and now he's a programmer for Walgreens."

Just as the vast powers of the personal computer can be vastly multiplied by plugging it into an information network, they can be extended in all directions by attaching the mechanical brain to sensors, mechanical arms and other robotic devices. Robots are already at work in a large variety of dull, dirty or dangerous jobs: painting automobiles on assembly lines and transporting containers of plutonium without being harmed by radiation. Because a computerized robot is so easy to reprogram, some experts foresee drastic changes in the way manufacturing work is done: toward customization, away from assembly-line standards. When the citizen of tomorrow wants a new suit, one futurist scenario suggests, his personal computer will take his measurements and pass them on to a robot that will cut his choice of cloth with a laser beam and provide him with a perfectly tailored garment. In the home too, computer enthusiasts delight in imagining machines performing the domestic chores. A little of that fantasy is already reality. New York City Real Estate Executive David Rose, for example, uses his Apple in business deals, to catalogue his 4,000 books and to write fund-raising letters to his Yale classmates. But he also uses it to wake him in the morning with soft music, turn on the TV, adjust the lights and make the coffee.

In medicine, the computer, which started by keeping records and sending bills, now suggests diagnoses. CADUCEUS knows some 4,000 symptoms of more than 500 diseases; MYCIN specializes in infectious diseases; PUFF measures lung functions. All can be plugged into a master network called SUMEX-AIM, with headquarters at Stanford in the West and Rutgers in the East. This may all sound like another step toward the disappearance of the friendly neighborhood G.P., but while it is possible that a family doctor would recognize 4,000 different symptoms, CADUCEUS is more likely to see patterns in what patients report and can then suggest a diagnosis. The process may sound dehumanized, but in one hospital where the computer specializes in peptic ulcers, a survey of patients showed that they found the machine "more friendly, polite, relaxing and comprehensible" than the average physician.

The microcomputer is achieving dramatic effects on the ailing human body. These devices control the pacemakers implanted in victims of heart disease; they pump carefully measured quantities of insulin into the bodies of diabetics; they test blood samples for hundreds of different allergies; they translate sounds into vibrations that the deaf can "hear"; they stimulate deadened muscles with electric impulses that may eventually enable the paralyzed to walk.

In all the technologists' images of the future, however, there are elements of exaggeration and wishful thinking. Though the speed of change is extraordinary, so is the vastness of the landscape to be changed. New technologies have generally taken at least 20 years to establish themselves, which implies that a computer salesman's dream of a micro on every desk will not be fulfilled in the very near future. If ever.

Certainly the personal computer is not without its flaws. As most new buyers soon learn, it is not that easy for a novice to use, particularly when the manuals contain instructions like this specimen from Apple: "This character prevents script from terminating the currently forming output line when it encounters the script command in the input stream."

Another problem is that most personal computers end up costing considerably more than the ads imply. The $100 model does not really do very much, and the $1,000 version usually requires additional payments for the disc drive or the printer or the modem. Since there is very little standardization of parts among the dozens of new competitors, a buyer who has not done considerable homework is apt to find that the parts he needs do not fit the machine he bought.

Software can be a major difficulty *(see box)*. The first computer buyers tended to be people who enjoyed playing with their machines and designing their own programs. But the more widely the computer spreads, the more it will have to be used by people who know no more about its inner workings than they do about the insides of their TV sets—and do not want to. They will depend entirely on the commercial programmers. Good programs are expensive both to make and to buy. Control Data has invested $900 million in its PLATO educational series and has not yet turned a profit, though its hopes run into the billions. A number of firms have marketed plenty of shoddy programs, but they are not cheap either. "Software is the new bandwagon, but only 20% of it is any good," says Diana Hestwood, a Minneapolis-based educational consultant. She inserts a math program and deliberately makes ten mistakes. The machine gives its illiterate verdict: "You taken ten guesses." Says Atari's chief scientist, Alan Kay: "Software is getting to be embarrassing."

Many of the programs now being touted are hardly worth the cost, or hardly worth doing at all. Why should a computer be needed to balance a checkbook or to turn off the living-room lights? Or to recommend a dinner menu, particularly when it can consider (as did a $34 item called the Pizza Program) ice cream as an appetizer? Indeed, there are many people who may quite reasonably decide that they can get along very nicely without a computer. Even the most impressive information networks may provide the customer with nothing but a large telephone bill. "You cannot rely on being able to find what you want," says Atari's Kay. "It's really more useful to go to a library."

It is becoming increasingly evident that a fool assigned to work with a computer can conceal his own foolishness in the guise of high-tech authority. Lives there a single citizen who has not been commanded by a misguided computer to pay an income tax installment or department store bill that he has already paid?

What is true for fools is no less true for criminals, who are now able to commit electronic larceny from the comfort of their living rooms. The probable champion is Stanley Mark Rifkin, a computer analyst in Los Angeles, who tricked the machines at the Security Pacific National Bank into giving him $10 million. While free on bail for that in 1979 (he was eventually sentenced to eight years), he was arrested for trying to steal $50 million from Union Bank (the charges were eventually dropped). According to Donn Parker, a specialist in computer abuse at SRI International (formerly the Stanford Research Institute), "Nobody seems to know exactly what computer crime is, how much of it there is, and whether it is increasing or decreasing. We do know that computers are changing the nature of business crime significantly."


ROBIN MOYER

CATALOGUING A BOOK COLLECTION:
David Rose also uses his Apple to awaken him

Even if all the technical and intellectual problems can be solved, there are major social problems inherent in the computer revolution. The most obvious is unemployment, since the basic purpose of commercial computerization is to get more work done by fewer people. One British study predicts that "automation-induced unemployment" in Western Europe could reach 16% in the next decade, but most analyses are more optimistic. The general rule seems to be that new technology eventually creates as many jobs as it destroys, and often more. "People who put in computers usually increase their staffs as well," says CPT's Scheff. "Of course," he adds, "one industry may kill another industry. That's tough on some people."

Theoretically, all unemployed workers can be retrained, but retraining programs are not high on the nation's agenda. Many new jobs, moreover, will require an aptitude in using computers, and the retraining needed to use them will have to be repeated as the technology keeps improving. Says a chilling report by the Congressional Office of Technology Assessments: "Lifelong retraining is expected to become the norm for many people." There is already considerable evidence that the schoolchildren now being educated in the use of computers are generally the children of the white middle class. Young blacks, whose unemployment rate stands today at 50%, will find another barrier in front of them.

Such social problems are not the fault of the computer, of course, but a consequence of the way the American society might use the computer. "Even in the days of the big mainframe computers, they were a machine for the few," says Katharine Davis Fishman, author of *The Computer Establishment*. "It was a tool to help the rich get richer. It still is to a large extent. One of the great values of the personal computer is that smaller concerns, smaller organizations can now have some of the advantages of the bigger organizations."

How society uses its computers depends greatly on what kind of computers are made and sold, and that depends, in turn, on an industry in a state of chaotic growth. Even the name of the product is a matter of debate: "microcomputer" sounds too technical, but "home computer" does not fit an office machine. "Desktop" sounds awkward, and "personal computer" is at best a compromise. Innovators are pushing off in different directions. Hewlett Packard is experimenting with machines that respond to vocal commands; Osborne is leading a rush toward portable computers, ideally no larger than a book. And for every innovator, there are at least five imitators selling copies.

There is much talk of a coming shakeout, and California Consultant David E. Gold predicts that perhaps no more than a dozen vendors will survive the next five years. At the moment, Dataquest estimates that Texas Instruments leads the low-price parade with a 35% share of the market in computers selling for less than $1,000. Next come Timex (26%), Commodore (15%) and Atari (13%). In the race among machines priced between $1,000 and $5,000, Apple still commands 26%, followed by IBM (17%) and Tandy/Radio Shack (10%). But IBM, which has dominated the mainframe computer market for decades, is coming on very strong. Apple, fighting back, will unveil its new Lisa model in January, putting great emphasis on user friendliness. The user will be able

TEACHING AN OLDER GENERATION NEW TRICKS: Ann Blais, 13, a computer tutor for two years at the Jordan Middle School in Palo Alto, Calif., explains the mysteries of programming to two adventurous septuagenarians, Virgil and Gretchen Miles

to carry out many functions simply by pointing to a picture of what he wants done rather than typing instructions. IBM is also reported to be planning to introduce new machines in 1983, as are Osborne and others.

Just across the horizon, as usual, lurk the Japanese. During the 1970s, U.S. computer manufacturers complacently felt that they were somehow immune from the Japanese combination of engineering and salesmanship that kept gnawing at U.S. auto, steel and appliance industries. One reason was that the Japanese were developing their large domestic market. When they belatedly entered the U.S. battlefield, they concentrated not on selling whole systems but on particular sectors—with dramatic results. In low-speed printers using what is known as the dot-matrix method, the Japanese had only a 6% share of the market in 1980; in 1982, they provided half the 500,000 such printers sold in the U.S. Says Computerland President Ed Faber: "About 75% of the dot-matrix printers we sell are Japanese, and almost all the monitors. There is no better quality electronics than what we see coming from Japan."

Whatever its variations, there is an inevitability about the computerization of America. Commercial efficiency requires it, Big Government requires it, modern life requires it, and so it is coming to pass. But the essential element in this sense of inevitability is the way in which the young take to computers: not as just another obligation imposed by adult society but as a game, a pleasure, a tool, a system that fits naturally into their lives. Unlike anyone over 40, these children have grown up with TV screens; the computer is a screen that responds to them, hooked to a machine that can be programmed to respond the way they want it to. That is power.

There are now more than 100,000 computers in U.S. schools, compared with 52,000 only 18 months ago. This is roughly one for every 400 pupils. The richer and more progressive states do better. Minnesota leads with one computer for every 50 children and a locally produced collection of 700 software programs. To spread this development more evenly and open new doors for business, Apple has offered to donate one computer to every public school in the U.S.—a total of 80,000 computers worth $200 million retail—if Washington will authorize a 25% tax write-off (as is done for donations of scientific equipment to colleges). Congress has so far failed to approve the idea, but California has agreed to a similar proposal.

Many Americans concerned about the erosion of the schools put faith in the computer as a possible savior of their children's education, at school and at home. The Yankelovich poll showed that 57% thought personal computers would enable children to read and to do arithmetic better. Claims William Ridley, Control Data's vice president for education strategy: "If you want to improve youngsters one grade level in reading, our PLATO program with teacher supervision can do it up to four times faster and for 40% less expense than teachers alone."

No less important than this kind of drill, which some critics compare with the old-fashioned flash cards, is the use of computers to teach children about computers. They like to learn programming, and they are good at it, often better than their teachers, even in the early grades. They treat it as play, a secret skill, unknown among many of their parents. They delight in cracking corporate security and filching financial secrets, inventing new games and playing them on military networks, inserting obscene jokes into other people's programs. In soberer versions that sort of skill will become a necessity in thousands of jobs opening up in the future. Beginning in 1986, Carnegie-Mellon University expects to require all of its students to have their own personal computers. "People are willing to spend a large amount of money to educate their children," says Author Fishman. "So they're all buying computers for Johnny to get a head start (though I have not heard anyone say, 'I am buying a computer for Susie')."

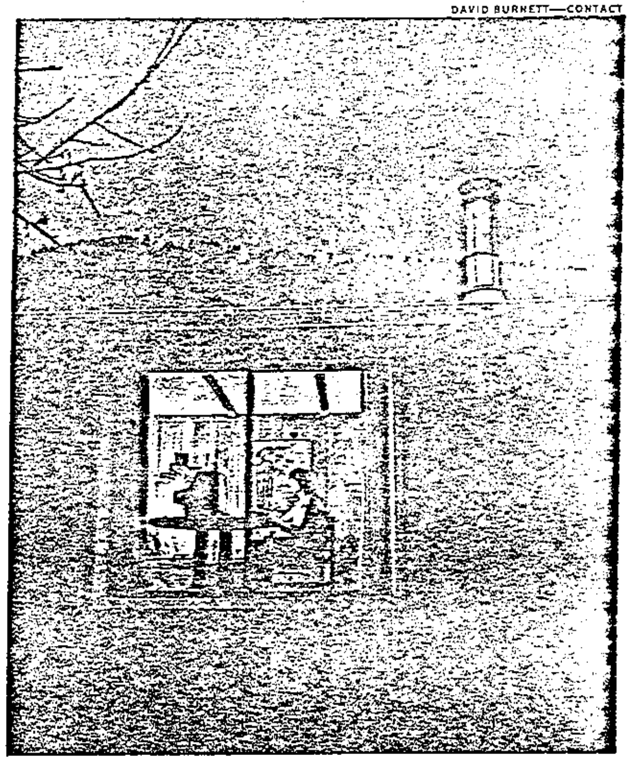
This transformation of the young raises a fundamental and sometimes menacing question: Will the computer change the very nature of human thought? And if so, for better or worse? There has been much time wasted on the debate over whether computers can be made to think, as HAL seemed to be doing in *2001*, when it murdered the astronauts who might challenge its command of the spaceflight. That answer is simple: computers do not think, but they do simulate many of the processes of the human brain: remembering, comparing, analyzing. And as people rely on the computer to do things that they used to do inside their heads, what happens to their heads?

Will the computer's ability to do routine work mean that human thinking will shift to a higher level? Will IQs rise? Will there be more intellectuals? The computer may make a lot of learning as unnecessary as memorizing the multiplication tables. But if a dictionary stored in the computer's memory can easily correct any spelling mistakes, what is the point of learning to spell? And if the mind is freed from intellectual routine, will it race off in pursuit of important ideas or lazily spend its time on more video games?

Too little is known about how the mind works, and less about how the computer might change that process. The neurological researches of Mark Rosenzweig and his colleagues at Berkeley indicate that animals trained to learn and assimilate information develop heavier cerebral cortices, more glial cells and bigger nerve cells. But does the computer really stimulate the brain's activity or, by doing so much of its work, permit it to go slack?

Some educators do believe they see the outlines of change. Seymour Papert, professor of mathematics and education at M.I.T. and author of *Mindstorms: Children, Computers and Powerful Ideas*, invented the computer language named Logo, with which children as young as six can program computers to design mathematical figures. Before they can do that, however, they must learn how to analyze a problem logically, step by step. "Getting a computer to do something," says Papert, "requires the underlying process to be described, on some level, with enough precision to be carried out by the machine." Charles P. Lecht, president of the New York consulting firm Lecht Scientific, argues that "what the lever was to the body, the computer system is to the mind." Says he: "Computers help teach kids to think. Beyond that, they motivate people to think. There is a great difference between intelligence and manipulative capacity. Computers help us to realize that difference."

DAVID BURNETT—CONTACT



TRYING NOVEL METHODS: At his home in Grants Pass in southwestern Oregon, Don Hentich practices on his Atari

The argument that computers train minds to be logical makes some experts want to reach for the computer key that says ERASE. "The last thing you want to do is think more logically," says Atari's Kay. "The great thing about computers is that they have no gravity systems. The logical system is one that you make up. Computers are a wonderful way of being bizarre."

Sherry Turkle, a sociologist now finishing a book titled *The Intimate Machine: Social and Cultural Studies of Computers and People*, sees the prospect of change in terms of perceptions and feelings. Says she: "Children define what's special about people by contrasting them with their nearest neighbors, which have always been the animals. People are special because they know how to think. Now children who work with computers see the computer as their nearest neighbor, so they see that people are special because they feel. This may become much more central to the way people think about themselves. We may be moving toward a re-evaluation of what makes us human."

For all such prophecies, M.I.T. Computer Professor Joseph Weizenbaum has answers ranging from disapproval to scorn. He has insisted that "giving children computers to play with . . . cannot touch . . . any real problem," and he has described the new computer generation as "bright young men of disheveled appearance [playing out] megalomaniacal fantasies of omnipotence."

Weizenbaum's basic objection to the computer enthusiasts is that they have no sense of limits. Says he: "The assertion that all human knowledge is encodable in streams of zeros and ones—philosophically, that's very hard to swallow. In effect, the whole world is made to seem computable. This generates a kind of tunnel vision, where the only problems that seem legitimate are problems that can be put on a computer. There is a whole world of real problems, of human problems, which is essentially ignored."

So the revolution has begun, and as usually happens with revolutions, nobody can agree on where it is going or how it will end. Nils Nilsson, director of the Artificial Intelligence Center at SRI International, believes the personal computer, like television, can "greatly increase the forces of both good and evil." Marvin Minsky, another of M.I.T.'s computer experts, believes the key significance of the personal computer is not the establishment of an intellectual ruling class, as some fear, but rather a kind of democratization of the new technology. Says he: "The desktop revolution has brought the tools that only professionals have had into the hands of the public. God knows what will happen now."

Perhaps the revolution will fulfill itself only when people no longer see anything unusual in the brave New World, when they see their computer not as a fearsome challenger to their intelligence but as a useful linkup of some everyday gadgets: the calculator, the TV and the typewriter. Or as Osborne's Adam Osborne puts it: "The future lies in designing and selling computers that people don't realize are computers at all." —*By Otto Friedrich.*

Reported by Michael Moritz/San Francisco, J. Madeleine Nash/Chicago and Peter Stoler/New York

APPENDIX 2

Vocabulary:

<u>acoustic coupler</u>: An acoustic coupler is a piece of equipment, usually shaped like a small box, which can be used with a computer. The acoustic coupler can be connected to a microcomputer or a terminal. A telephone receiver is put into the acoustic coupler. The terminal or microcomputer can be connected to another computer, because the acoustic coupler changes information into signals. A person can then talk to the other computer a long way away over the telephone lines.

<u>address</u>: An address is a number or name that tells where to find a place in a computer's memory. It is like a house address.

<u>arithmetic unit</u>: The arithmetic unit is the part of a computer which works the mathematics of a problem.

<u>ASCII code</u>: ASCII stands for American Standard Code for Information Interchange. Computers store letters and numbers as ASCII code.

<u>assembly language</u>: Assembly language is a computer language which uses a code made up of letters and numbers for instructions to the computer.

<u>authoring language</u>: An authoring language is a computer program which helps a person to write lessons for a computer. A person does not have to know how to program a computer to write lessons using an authoring language. PILOT is an authoring language.

<u>BASIC</u>: BASIC is a common and easy programming language. It stands for Beginners All-purpose Symbolic Instruction Code. Many computers use the BASIC language.

<u>batch processing</u>: Batch processing is a way of putting together a group of programs for the computer. Punched cards are put together in groups to be run on a computer one after another. This is an example of batch processing.

<u>baud rate</u>: The baud rate is the amount of bits (see bit) that a computer can send out in one second.

<u>binary code</u>: Binary code is a way of writing information for a computer. Binary code uses only 1's and 0's in groups to stand for letters and numbers. "0110000001" is a binary code.

<u>bit</u>: Bit stands for BInary digiT. A bit is either the 0 or 1 used in binary code. A bit is the smallest piece of information a computer can store.

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bug: A bug is a mistake in a computer program. A bug must be corrected before a computer can use a program properly.

bus: A bus is a path that carries electrical signals and information. A computer bus often carries signals to other machines connected to the computer.

byte: A byte is a group of bits, or 1's and 0's to make a letter or number. One byte is 8 bits. 10110111 is a byte.

card reader: A card reader is a machine which reads information from a card. The card may be marked with a pencil or have punched holes. The card reader changes the information on the card into signals the computer can understand.

cassette recorder: A cassette recorder is the same as a tape recorder. (see tape recorder)

cassette tape: A cassette tape is a small magnetic tape about one-eighth inch wide in a case. It is used with a cassette recorder to store computer programs. Cassette tapes are used to load some microcomputers with programs.

cathode ray tube terminal (CRT): A cathode ray tube terminal (CRT) is a machine with a keyboard like a typewriter and a screen like a TV. It is used to send and receive information from a computer.

central processing unit (CPU): The central processing unit (CPU) is the part of a computer where information is worked with.

chip: A chip is a very small piece of silicon material used in computers. A chip can carry many electrical signals. Each chip is about one-fourth inch square and is very thin.

circuit: A circuit is the complete path of an electrical current.

COBOL: COBOL is a computer language often used to program business computers. COBOL stands for COmmon Business Oriented Language.

code: The code is the set of instructions for the computer. To code means to write a program for the computer following a set of rules so it will understand the information. The code is also called the program.

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communications: Communications are a way of talking from a machine (such as a terminal) to a computer, or from one computer to another. This can be done over telephone lines.

computer: A computer is a machine with a memory, which accepts information, works on the information to solve a problem, and puts out an answer.

computer operator: A computer operator is the person who knows how to run a computer and all of the machines a computer uses.

computer science: Computer science is the study of computers and their languages. A computer science student learns about computers and how to use them.

computer system: A computer system is made up of everything the computer needs to work. A computer system is the computer and all of the machines it uses.

control unit: The control unit is the part of the computer that directs the movement of the information in the computer.

coupler: The coupler is another name for acoustic coupler. (see acoustic coupler)

cursor: A cursor is a symbol on a computer screen. On some computers, a cursor is a dash (-) which can be moved around to tell where the next letter or number will appear.

data: Data is the information that a computer needs to solve a problem.

data base: A data base is a collection of information used by a computer.

data processing: Data processing is a way of working on information using a computer. A computer is a kind of data processing machine. It processes the data (information) it is given.

debug: To debug means to find and correct mistakes in a computer program or system. After a program is debugged, the computer can use it correctly.

digital computer: A digital computer is a computer with a memory that works by using numbers. It follows instructions called a program.

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disk: A disk is a shortened form of magnetic disk or floppy disk or diskette. (See magnetic disk.)

disk drive: A disk drive is a machine which is used with large and small computers. A magnetic disk is placed in the disk drive. The computer can then save and use information on the magnetic disk.

disk operating system (DOS): A disk operating system is a program used by a computer with a disk drive. The disk operating system tells the disk drive how to use the disk. It is also called DOS. (see DOS)

documentation: Documentation is a set of written directions that tells how to use a computer program or a computer.

DOS: DOS is a shortened name for Disk Operating System. DOS is pronounced like "Dawss."

download: To download is to send information from a larger computer to a smaller one. Sometimes the information is downloaded over telephone lines.

edit: To edit is to change information in some way.

END: END is the statement used to tell the computer the program has ended.

ENIAC: The ENIAC was the first all-electronic computer. It was built in 1947 and was a first generation computer. It is located in the National Museum of History and Technology in Washington, D.C..

EPROM: EPROM is an abbreviation for Erasable Programmable Read Only Memory. The information in EPROM can be erased and changed (reprogrammed) using a special machine.

file: A computer file is a collection of information that is used together. A file may be made up of words or numbers or both. A computer program may use a file of words.

firmware: Firmware are the programs in ROM. (see ROM)

floppy disk: A floppy disk is the same as a disk. It is called floppy, because it bends easily. Very small disks are called mini-floppy disks.

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flow diagram: A flow diagram is the same as a flowchart. (see flowchart)

flowchart: A flowchart is a drawing or map that tells the steps needed to solve a problem. It also shows the correct order for doing the steps. A computer program may be written from the flowchart.

FORTRAN: FORTRAN stands for FORmula TRANslator. It is a computer language used by scientists.

generation: A computer generation is a group of computers using certain kinds of parts. For example, first generation computers used vacuum tubes. The present generation uses integrated circuits.

graphics: Graphics are charts, pictures, or special letters drawn by a computer. Graphics might be colored and they might move. A printer or a TV screen may be used to display graphics.

hard copy: Hard copy is information from a computer that is printed on paper. A printer can give hard copy.

hardware: Hardware is the computer machinery. A printer is a piece of hardware. So is a chip.

high-level language: A high level language is one easier to understand and use than machine language. An example is BASIC. (see BASIC and machine language)

home computer: A home computer is a small computer used in the home. It has many applications (uses), including playing games.

information retrieval: Information retrieval means that the information that is stored in a computer can be gotten (retrieved) from the computer's memory.

input: Input is the information that goes into the computer. A person may input the information into the computer by typing it on a keyboard.

input device: An input device is a machine that puts the information into a computer. A terminal is an input device.

instruction: An instruction is a symbol or word (PRINT, END) which tells the computer what to do.

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integrated circuit: An integrated circuit (IC) is an electronic circuit on a piece of material called silicon. Integrated circuits control third generation computers.

interface: To interface means to connect a computer to another machine or to a different computer.

joystick: A joystick is a moveable control stick. It is used to steer things on a computer TV screen. A person may use a joystick to play a computer game on a TV screen.

keyboard: A keyboard can be used to type information into a computer. A keyboard has many keys with letters, numbers and symbols on them. Many computer keyboards are similar to typewriter keyboards. Some typewriters can be connected to computers.

K: K or kilo in computer language stands for kilobyte (1000 bytes).

keypunch: A keypunch is a machine that makes holes in cards. The holes in the cards are in a code a computer understands. A keypunch operator types information on a keypunch keyboard, which the machine punches in the cards.

library: Library is the same as software library. (see software library)

light pen: A light pen looks like a writing pen. It can be used to draw or write on special computer screens.

line printer: A line printer is the same as a printer. (see printer)

loop: A loop is one or more instructions that are repeated in order.

log-in: To log-in means to sign in on a computer. To do this, a special codeword is used. A person must log-in on some computers before the computer will work with him.

machine language: Machine language is a special language that a computer understands. It uses only numbers. The computer uses machine language to solve problems.

magnetic cores: Magnetic cores are tiny rings made of a metal. They were used on older computers.

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magnetic disk: A magnetic disk looks like a phonograph record. Information for a computer is stored on the disk.

magnetic drum: A magnetic drum is round like cylinder. It has information for a computer stored on it.

magnetic tape: Magnetic tape is like tape recorder tape, except wider. Information for a computer is recorded on magnetic tape in magnetized spots which stand for symbols, letters, or numbers.

Mark I: The Mark I was the first digital computer. It had both electronic and mechanical parts. It was a first generation computer.

mark-sense card: A mark-sense card is used to record information for a computer. The card is a special size. A user puts pencil marks on the card in a code that a computer understands. The mark-sense card is one way of putting information into a computer. (Some colleges and universitites require these cards for registration.)

memory: The memory is a place in a computer that stores the information. Some are large for a large amount of storage. Others have a small amount of storage.

microprocessor: A microprocessor is a small electrical part in a computer. The microprocessor makes the computer work. Microprocessors may also be used in calculators, cars, and appliances.

modem: Modem is a contraction of the two words MOdulator and DEModulator. It is a piece of equipment which can be used with a computer. It looks like a small box. The modem can be connected to a terminal or a microcomputer. It is wired to a telephone line. When the terminal or microcomputer is connected to another computer, the modem changes information into signals. A person can then talk to the other computer at any distance over the telephone lines.

nanosecond: A nanosecond is a billionth of a second. Computers can work in nanoseconds.

nibble: A nibble is half a byte, or four bits.

object program: An object program is a program that has been changed from a high-level language into a machine language.

off-line: A person is off-line from a computer when he uses a terminal that is not connected to a computer. The terminal can be used like a typewriter when it is off-line.

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on-line: A person is on-line to a computer when he uses a terminal connected to a computer. The terminal may be connected directly to a computer or may be connected over telephone lines.

optical scanner: An optical scanner is a machine that looks at a code that the computer can understand. The code may be pencil marks on mark-sense cards or pen marks on paper. The optical scanner is connected to a computer and sends signals to the computer as it "reads" the marks.

output: The output from a computer is the information the computer sends out. It may be an answer or a problem itself. The output may be seen on a printer or a TV screen.

output device: An output device is a machine that receives information from a computer. A printer is an output device.

paddle: A paddle is used with a computer and a TV screen to make things move on the screen. Paddles are used to play computer games.

Pascal: Pascal is a computer language. It was named after Blaise Pascal who made the first mechanical calculator.

paper tape: Paper tape looks like a paper ribbon. It has holes punched in it. The holes are a code the computer understands. The holes stand for symbols, numbers, or letters.

paper tape reader: A paper tape reader is a machine that looks at the holes in a paper tape. The holes are a code that the computer understands. The paper tape is put in the reader. The paper tape reader is connected to a computer which can use the information on the tape.

patch: A patch is a few lines temporarily inserted into a program for the purpose of correcting a faulty operation.

peripheral: A peripheral is any piece of equipment that is connected to a computer. A printer is a peripheral.

picosecond: A picosecond is a trillioneth, or a million millionth, of a second.

print out: A print out is a paper copy of the information from a computer. The computer may list a program on a print out or it may give an answer to a problem.

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printer: A printer is a machine that prints the information (output) that comes from a computer on paper.

program: A program is a set of instructions which tells the computer what to do. There are many different languages used to write computer programs.

programmer: A programmer is a person who writes a computer program. A programmer uses special languages the computer understands.

PROM: PROM is an abbreviation for Programmable Read Only Memory. It is like ROM except that information can be put in PROM using a special machine.

prompt: A computer uses a prompt to tell the user when to do something. A prompt may be a special mark. When the mark is on a computer screen, it means the computer is waiting for the user to do something.

punched card: A punched card is a card used with a computer. The card is a special size, and it has holes punched in it. The holes are a code that the computer understands. They stand for symbols, numbers, or letters.

RAM: RAM stands for Random Access Memory. It is the part of a computer's memory that stores information for a short period of time. When the computer is turned off, the information in RAM is lost.

read: To read from memory means to get the information that is stored in the computer's memory out of the memory to a place where it can be used. The information may be read into the central processing unit.

ROM: ROM is an abbreviation for Read Only Memory. This means the information in the memory can be used (read) by the computer. The information in this ROM memory cannot be changed by the user. ROM is also called firmware.

silicon: Silicon is the material used to make chips. Crystals of silicon are grown and sliced thinly to make chips.

simulation: A simulation is like a model. Computer simulations are done before projects.

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smart video terminal: A smart video terminal is a terminal that has its own microprocessor (CPU).

software: Programs and data that go into the computer are known as software. A programmer writes software for a computer.

software library: A software library is a collection of the programs for a computer. There may be many programs or only a few.

source program: A source program is the same as an object program. (see object program)

statement: A statement is a line in a computer program. 20 END is a statement.

statement number: A statement number is the number at the beginning of a line in a computer program. A statement number is also called a line number.

storage: Storage is the same as memory. (see memory)

store: To store is to put into memory. (see memory)

string literal: A string literal is any portion of a statement put in quotation marks.

tape drive: A tape drive is a machine that looks at spots on magnetic tape. The spots are a code. The tape is put into the tape drive. The drive is connected to a computer which uses the information.

tape reader: A tape reader is the same as a paper tape reader. (see paper tape reader)

tape recorder: A tape recorder is a machine that looks at magnetic spots on cassette tape. A cassette tape is put in the recorder, which is connected to a computer. The computer can then use the information on the tape.

terminal: A terminal is a machine with a keyboard like a typewriter. It is sometimes connected to a computer over telephone lines.

time-sharing: Time-sharing means many people can use a computer at the same time. They are "sharing time" on the same computer.

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transistor: A transistor is an electrical part. Transistors were used in second generation computers.

upload: To upload means to send information from a small computer to a large computer. The information is sometimes sent (uploaded) over telephone lines.

user: A computer user is a person who works with a computer.

vacuum tubes: Vacuum tubes were electrical parts used in first generation computers.

video display: A video display is like a TV screen. It shows information that is being sent to or recieved from a computer. A video display may be part of a computer terminal or may be a TV screen connected to a computer.

video monitor: A video monitor is the same as video display. (see video display)

write: To write into memory is to put information into the computer's memory for storage.

write-protect: To write-protect means to protect computer programs so they cannot be changed. Programs on a floppy disk have a small piece of tape or a special tab placed over the cut-out notch in the paper cover which protects the disk. The programs are then write-protected. They cannot be changed until the protection is removed.

word processing: Word processing is a system which uses a computer to create written communication such as letters. The computer stores the letter in its memory. The computer can then print out many copies of the letter whenever they are needed. This is word processing.

APPENDIX 3

Catalogues I consulted for information on ESL publications concerning the computer field:

Addison-Wesley
American Book
Ann Arbor Publishers
Barron's Educational Series
Bilingual Educational Services
Cambridge Book Company
Cambridge University Press
Cebco Publishing
Collier-Macmillan
Delta Systems
The Economy Company
ELS Publications
Follett
Harcourt Brace Jovanovich
Harper and Row
Heinemann Educational Books
Institute of Modern Languages
Janus
Litton Educational Publishers International
Longman
McGraw Hill
Melton Peninsula
Modulearn
National Textbooks
Newbury House
Newby Visual Language
Oxford University Press
Pergamon Press
Polasky Company
Prentice Hall
Pro-Lingua
Readers' Digest
Regents
Science Research Associates
Scott-Foresman
University of Michigan Press
University of Pittsburgh

APPENDIX 4

GENERAL INSTRUCTIONS

1. ACCURACY is the most important factor on this test.

2. All three (3) parts are TIMED--the test administrator will start and stop you for each part of the test.

3. DO NOT GUESS!!

4. This test is designed so that you will not have enough time to answer all of the problems.

5. Do not spend too much time on any one problem.

6. If you cannot solve a problem, SKIP IT and go on to the next.

REMEMBER, GUESSING WILL RUIN YOUR TEST PERFORMANCE

For your convenience, refer to the alphabet listed below while you are working on PART I:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

P A R T I

Each question is a seperate problem--a series of letters which is formed according to a specific pattern. To solve the problem, you must first discover the pattern and then decide what letter comes next--<u>ACCORDING</u> <u>TO</u> <u>THAT</u> <u>PATTERN</u>.

		(1)	(2)	(3)	(4)	(5)
1.	f g g h i i j k	j	k	l	f	g
2.	a b b c c c d d d	a	b	c	d	e
3.	d e f t g h i s j k l	r	s	t	m	d
4.	b d g k	m	n	o	p	q
5.	r s t r s t u v w	s	t	u	v	r
6.	a b c a b d a b	a	b	c	d	e

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1.  k-(2)     f  g g  h  i i  j  k . . . . . "k"
              1   2   1   2   1       2

2.  d-(4)     a  b b  c c c  d d d . . . . . "d"
              1   2     3          4

3.  r-(1)     d e f  t  g h i  s  j k l . . . . . . "r"
                3    1    3    1    3

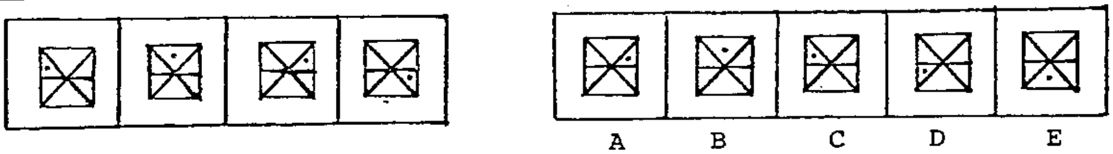
4.  p-(4)     b  (c)  d  (ef)  g  (hij)  k . . (lmno) . . "p"
                  1        2        3             4

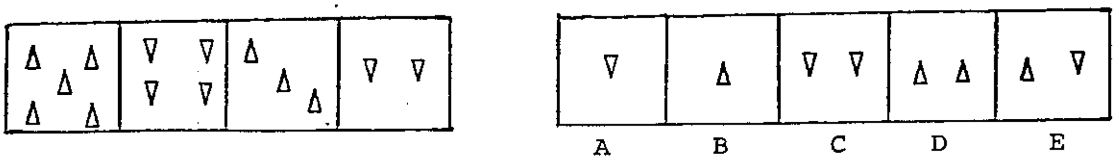
5.  u-(3)     r s t  r s t  u v w . . . . . "u"
               '--2---'      '--------2-----'

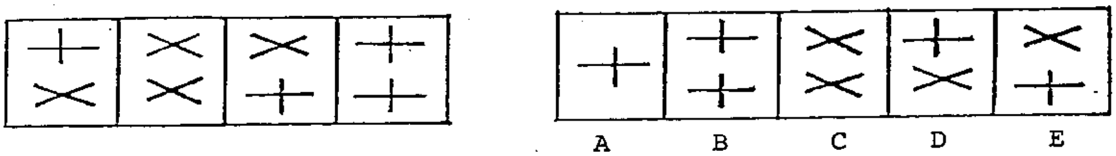
6.  e-(5)     a b  c  a b  d  a b . . . . . "e"
               2   1   2   1   2       1
```

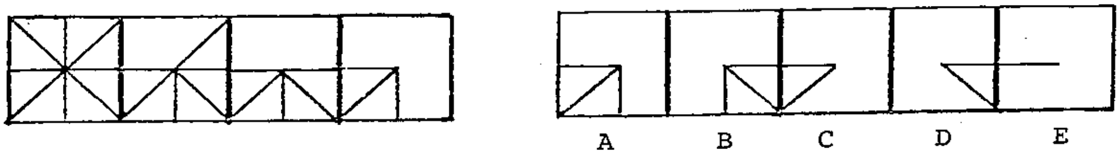
P A R T I I

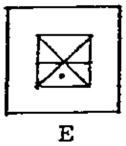
Each question is a separate problem--a series of pictures which are changed according to a specific pattern. To solve the problem, you must first discover the pattern and then decide what picture comes next--<u>ACCORDING TO THAT PATTERN</u>.

1. 

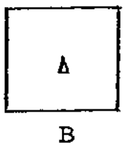
2. 

3. 

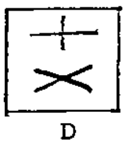
4. 

1. 

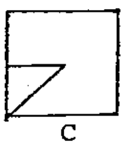
The "dot" is moving around the square in a clockwise direction.

2. 

The number of items in each block are decreasing, 5-4-3-2, so the answer block must have one (1); also, the items are pointing up-down-up-down, so the answer must point "up".

3. 

The pattern is mix-match-mix-match, so the answer block must be a "mix"; also, the "mixed" blocks had bottom-X, then top-X, so the answer block must have a "bottom-X".

4. 

We first remove 2-lines, then 1-line, then 2-lines, so the answer block must remove one (1) more line; also, notice that the lines are being removed in a clockwise direction.

PART III

Each question is a seperate problem in arithmetical reasoning. After each problem there are five (5) answers, but only one of them is the correct answer. You are to solve each problem and indicate the correct answer.

1. A certain computer device can print 1,040 lines/minute. If a page holds 130 lines, how many pages can the device complete in 3-hours?

   (a) 480 (b) 960 (c) 1,540
   (d) 1,440 (e) 1,040

2. In a computer class of 18 students, 2/3 are men. If 1/2 of the women are married, how many single female students are in the class?

   (a) 18 (b) 12 (c) 10
   (d) 6 (e) 3

1. 1,440-(d) 1,040 lines/minute divided by 130 lines = 8 pages/minute.
8 pages/minute multiplied by 60 minutes = 480 pg/hr.
480 pages/hour multiplied by 3 hours = 1,440 pages.

2. 3-(e) If 2/3 are men, then 1/3 are women.
1/3 of 18 students = 6 women.
If 1/2 of these are married, then 1/2 are single.
1/2 of 6 women = 3 single female students.

APPENDIX 5

Try to think of 5 applications for each of these places or functions:

home:

business:

newspaper:

bank:

school:

utility company:

hospital:

insurance company:

museum:

bookstore:

radio and TV:

beauty parlor:

grocery store:

computer dating:

department store:

inventory:

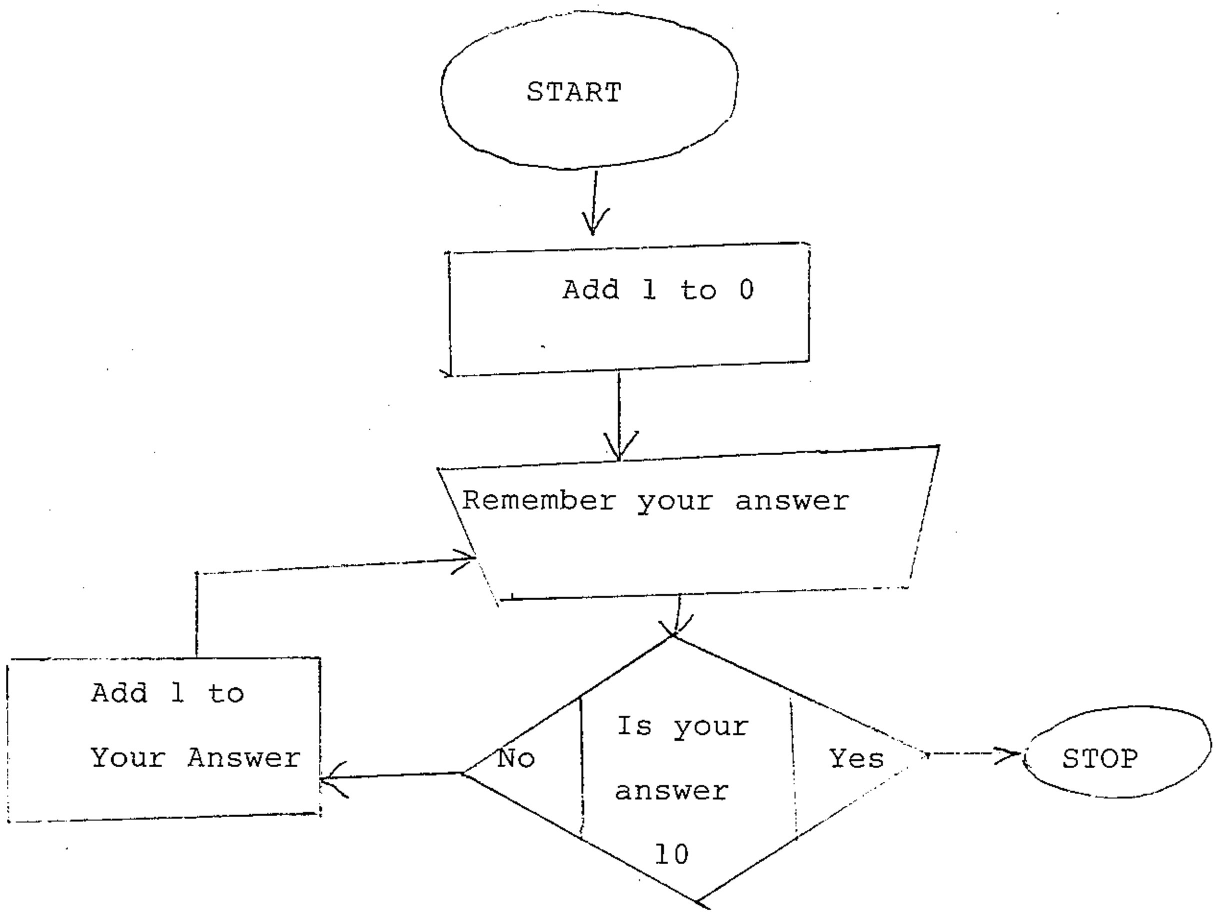
library:

post office:

travel agent:

APPENDIX 6

Flowchart for Counting from 0 to 10



APPENDIX 7

Machine	Cost	Function
Timex Sinclair 1000	$ 99	BASIC only, plays video games, poor written work
Commodore VIC-20	299	touch-type keyboard can be hooked to $110 telephone modem for mail terminal
Commodore 64	595	three times the memory of other cheaper models
Atari 400	299	no touch-typing, 256 colors, graphics, good for game players and writers
Atari 800	899	touch-type, not very good word processing
Texas Instrument 99/4A	450	many educational programs; Logo is an extra $380
Epson HX-20	795	book-sized, portable, 4-lbs. full-sized keyboard
TRS 80 Model III	999	4-line display printer, large memory
Apple II Plus	1330	most software, most user groups, most peripherals
IBM Personal	1565	clear instruction manuals, lots of software, $300 extra for color graphics
Osborne I	1795	24 pounds, video monitor, 5-inch screen, 2 disk drives
Altos, Corvus, Control Data, Cromemco, Digital Equipment, Fortune, Hewlett-Packard Nippon Electric, North Star, Olivetti, Tele-Video, Toshiba, Vector, Victor, Xerox, Zenith, Apple IV (Lisa)	2000 to 10,000	small businesses

APPENDIX 8

Find a computer for these people:

1. A small business is looking for an easy-to-use computer which will do the payroll, keep track of the accounts payable and receivable and do sales charts.

2. A man's children, aged seven and ten, are studying math on computers in school. He wants to help them to study at home and encourage them to learn more about computers.

3. A man and his wife are worried that their son, nine years of age, likes to go to the drugstore to play video games every day after school. They have decided to buy him a computer and some video games to use at home, but they don't want to spend a lot of money.

4. A woman runs an accounting business at home. She needs a lot of memory, and she wants to be able to carry her computer with her to her customers' homes. She needs a keyboard which is fast and easy to use. She sometimes needs print-outs.

5. A family isn't sure what they want a computer for. They just think everyone should have one in the future.

APPENDIX 9

Where should these people go to school?

1. Brad is nineteen years old. He graduated from high school last year. He doesn't have much money, so he is working in a gas station to save money for a college or university where he wants to study computer science. Where should he go?

2. Jack is 35 years old. He was an office worker for the U.S. government, but he recently lost his job. Now he thinks he should learn about computers quickly so he can get another job. He has $4,000 in savings. Where should he go?

3. Maria's parents can afford to send her anywhere to go to school. She wants to be a computer engineer. Her parents want her to go into the best program. Where should she go?

4. Jane doesn't have a car. She lives in Bethesda and wants to study near her home to be a computer operator. She doesn't care whether she goes to a college, university, or computer school. Where should she go?

5. Tsuyako is from Japan. She wants to get a Bachelor's degree from an American university. She want to study computer graphics. Where should she go?

APPENDIX 10

Telephone questionnaire for computer schools and programs:

ASK:

1. "Do you have any computer programs?" If so, "What are they?"

2. "Do you have graduate and undergraduate programs?" (for colleges and universities)

3. "How long do the programs take to complete?"

4. "How much is the tuition for the program/cost of the program?"

5. "Do you help with job placemnt after the program?"

6. "What kinds of computers do you have?"

7. "What computer languages are taught?"

APPENDIX 11

Entrance Questionnaire: Name____________________

1. Have you used a computer before?

2. If so, how much have you used one and for what have you used it? Also, what kind of computer was it?

3. Are you planning to study some kind of computer science in a college or university in the U.S.?

4. What do you want to learn in this course?

APPENDIX 12

BASIC Language:

Here are some simple commands in BASIC and the results as seen on a print-out.

```
10  PRINT "My name is Anne."
20  END
```

```
My name is Anne.
```

```
10  PRINT (10+5+2)*2
20  PRINT 2/1
30  END
```

```
34
2
```

```
10 PRINT "The number is:"
20  LET A=6
30  LET B=2
40  LET C=8
50  PRINT (A*B)/(C/B)
60  END
```

```
The number is:
3
```

```
10  LET A=0
20  PRINT A+1
30  IF A<10 THEN GO TO 20
40  END
```

```
1
2
3
4
5
6
7
8
9
10
```

APPENDIX 13

Final Course Evaluation:

1. What did you learn:

2. Was the course what you expected? Why or why not?

3. Did you enjoy the course? Why or why not?

4. What recommendations would you make for future courses?

Notes

[1]Otto Friedrich, "The Computer Moves In," Time (New York, January 3, 1983), pp. 14-24.

[2]John C. Keegel, English for Careers; The Language of Computer Programming (New York, Regent, 1976)

[3]Scott Corbett, Home Computers: A Simple and Informative Guide (Boston, Atlantic Monthly Press Book Section of Little, Brown and Company, 1980)

[4]Jean Rice and Marien Haley, My Computer Picture Dictionary (Minneapolis: T.S. Denison, and Company, 1981)

[5]"Computers" from the Science Modules Series of the Education Services section of National Public Radio (Washington, D.C., 1981)

[6]Philip Faflick, "The Hottest-Selling Hardware," Time (New York, January 3, 1983), p. 37.

[7]"Computers"

[8]Devin Brown, Creative Programming for Young Minds (Charleston, Illinois: Creative Programming, Inc., A Subsidiary of R.V. Weatherford Company, 1981)

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Brown, Devin. Creative Programming for Young Minds on the Apple: Volume 1. Charleston, Illinois: Creative Programming, Inc., A Subsidiary of R.V. Weatherford Company, 1981.

"Computers" from the Science Modules Series of the Education Services section of National Public Radio. Washington, D.C.: 1981.

Corbett, Scott. Home Computers: A Simple and Informative Guide. Boston: Atlantic Monthly Press Book Section of Little, Brown and Co., 1980.

Faflich, Philip. "The Hottest Selling Hardware." Time, Jan. 3, 1983. p. 37.

Friedrich, Otto. "The Computer Moves In" Time, Jan. 3, 1983, pp. 14-24.

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Srivastava, Jane Jonas. Computers. New York: Thomas Y. Crowell, 1972.