

4-H COMPUTER PROJECT I:
Learning About Computers



**Virginia
Cooperative
Extension**

Virginia Tech • Virginia State

Publication 388-141
Reprinted 1992



VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY

LD
5655
A762
no 388-141
1992
VPI
Spec



4-H COMPUTER PROJECT I:

Exploring Computers

Steven J. Thomson, Extension Specialist
Agricultural Engineering, Virginia Tech

Introduction

Computers are everywhere these days. Whether you know it or not, computers affect you and the things you do every day. Restaurants, banks, department stores, toys, and arcade video games use computers. Present day automobiles use very small computers to control the engine for economy, pollution control, and performance. Industry uses them to control complex operations in manufacturing.

Why have computers become so popular and why do we need them, anyway? The answer is very simple - Savings of TIME, SPACE, and MONEY. In every use of the computer, whether it be in automobiles, agriculture, or other businesses, our quality of life has been greatly improved. We can now perform tasks much more efficiently. Let's show some examples of how a computer can do this for us.

1. Perform complex math operations very fast and accurately.
2. Store large amounts of information in a small space for later retrieval.
3. Sort large amounts of data and make meaningful comparisons between them (statistics).

4. Make expert decisions for us by examining stored facts or programmed knowledge.

The Purpose of This Project

The purpose of this project is to introduce you, the student, to computers. This involves learning the basic parts of a computer, how computers work, and how to program a computer with a simple example.

A computer needs to be programmed by a human before it can do anything. This "program" tells the computer to do what you want it to do. Programs are sometimes referred to as computer "software." There is nothing scary about running a computer. This project is designed to teach persons with little or no computer background how to use a computer. You will then write a simple program and be introduced to programming. Do not ever be afraid to make mistakes. The computer will not penalize you if you do.

In This Project, You Will Learn:

1. The basic parts of the computer and how they function together.

2. How to write a program and save it for later use.

3. How to run programs already stored on diskettes (including your own).

At the End of this Project, You Will:

1. Demonstrate what you have learned.

2. Fill out a record form detailing the 4-H project.

The Microcomputer

The computer you will use is called a microcomputer. These computers are small, portable, and can fit on a desktop. There are many brands of microcomputers, and all of them have similar characteristics. A typical microcomputer with the parts labeled is shown in Figure 1. The diskettes (which go in the disk drives) and hard disk (internal to the machine) are called storage devices. These allow you to save programs for future use. Some machines have both diskette drives and hard disk drives. Some machines have only diskette drives.

Hardware Components of a Computer

Figure 2 shows computer hardware illustrating the flow of information. These components are typical of all computer systems, not just microcomputers. The basic components are the CPU (Central Processing Unit), memory, storage media, keyboard, mouse, video display, and printer if a hardcopy of a program

or results is desired. Larger computers can support more printers, storage devices, and memory in the system. Many of today's microcomputers can also support large numbers of these devices. A few years back, only large computers could support multiple devices and added memory.

CPU (Central Processing Unit)

The CPU is the "brain" of the computer. It is a complex integrated circuit on the main circuit board called a "microprocessor." The CPU communicates our instructions (programs) to the computer and can perform operations. In order to communicate our instructions, it "talks" to and receives information from other components using electrical signals.

Memory

One of the components the microprocessor "talks" to and receives information from is memory. Computer memory consists of several solid state devices (or "chips") that store information. Each chip is only about 1/4 by 7/8 inch in size.

There are two types of memory found in the microcomputer. ROM (or read-only memory) consists of program code or data that cannot be changed. The CPU can only ask for information from ROM, but cannot change its contents. Many computers have "system programs" stored in ROM. These are permanent programs the computer needs to help manage its operations. When you first turn on the computer, this program in ROM is automatically activated.

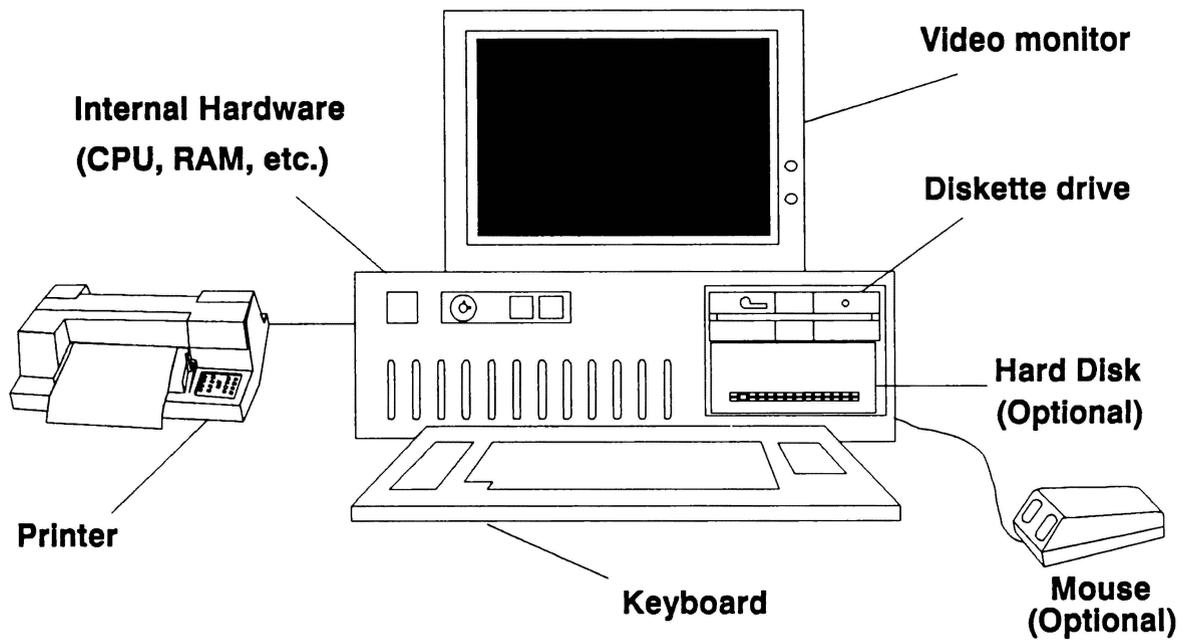


Fig.1. Microcomputer system hardware.

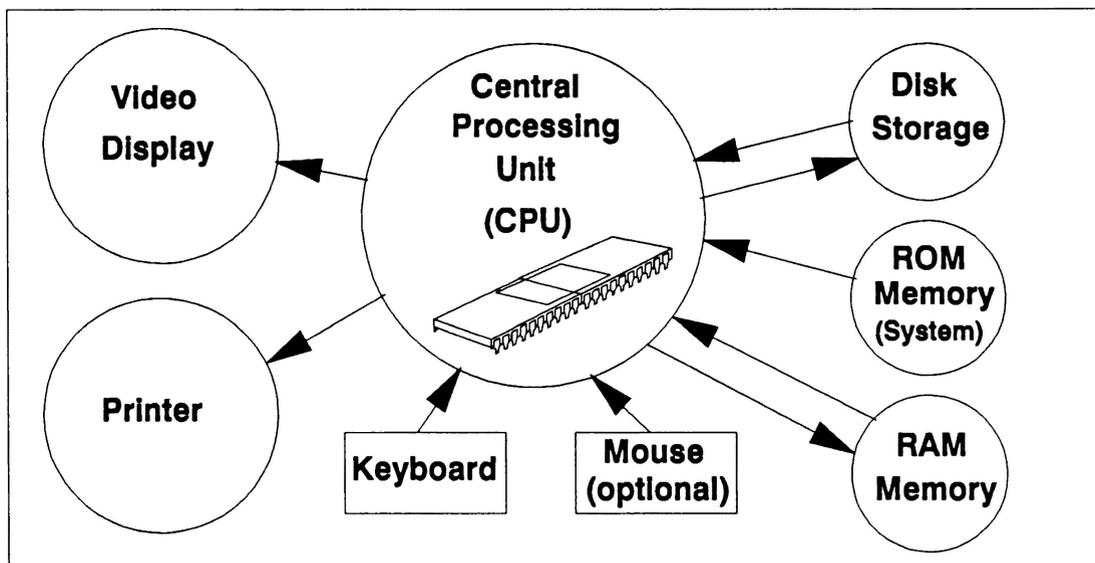
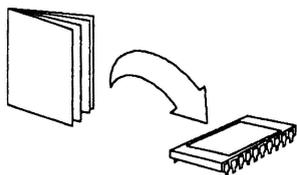


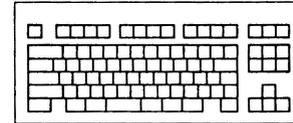
Fig. 2. Computer hardware illustrating flow of information

RAM memory (Random Access Memory), on the other hand, can be changed and manipulated as well as read. RAM memory can be thought of as the computer's workspace. A program the user writes can be temporarily stored in RAM so it can run right away. Commercial programs also use this memory. Many of these programs require a lot of memory to run. For this reason, computers have been designed in recent years to accommodate large amounts of memory. The number of RAM chips on the main computer board determines the amount of memory the computer has. As an example, a computer may require 8 memory chips for 256K-bytes of memory. One "K-byte" is approximately 1000 bytes. A "byte" of memory is 8 "bits" or pieces of data that represent coded numbers, letters, or characters. Each bit is actually an electrical signal that represents either a "1" (voltage present) or a "0" (voltage absent). Computer programs that you write are converted to several "byte-length" codes that are combinations of 1's and 0's. These programs are temporarily stored in RAM. As an example of just how much information can be stored in a small space, the contents of an entire 200 page book can fit in 256K-bytes of memory.



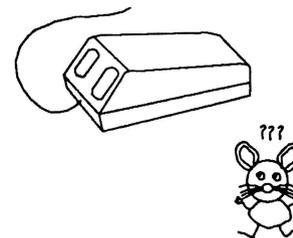
Keyboard

The keyboard is an input device that allows you to communicate with the computer. From the keyboard you can type instructions that the computer's system program or other programs understand to allow it to do what you want it to do.



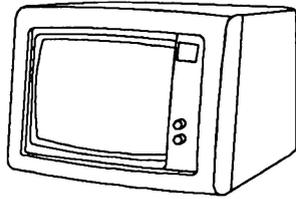
Mouse

Some computers use a small input device nicknamed a "mouse." This device has become popular recently because the user can tell the computer what to do without needing the keyboard to type in commands. As you move the mouse on the table, a little symbol (usually an arrow) moves around the screen. Many of today's sophisticated software packages allow the user to simply "click" the arrow on an object representing a command. "Clicking" on an object is accomplished by pushing a button on top of the mouse.



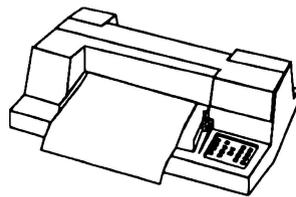
Video Display

The video display allows the user to view computer output. This display has a cathode ray tube (CRT) like a television set. There are monochrome and color video displays used in microcomputer systems.



Printer

The printer is an output device that allows the user to get a permanent record (or hard copy) of computer output. Printers are useful to print out programs so they can be edited and improved. The user might also want a permanent record of output from a program that would otherwise be lost when the computer is turned off.



Storage Media

Computers must have a way of saving important programs and data permanently so they can be re-used. While the user is writing a program, it is temporarily stored in RAM memory. If the program is not saved to a

permanent media (using a special command to the computer system program), it will be lost when the computer is shut off.

Most microcomputers use magnetic storage media for permanent storage of programs and data. Bits of data are stored magnetically by special heads that ride over the magnetic media. Magnetic areas on disks used to store data can be used over and over again. Most microcomputers in use today use two methods to store programs and data. These are hard disk storage and diskette storage. For this project, you will use diskettes to store your programs and data.

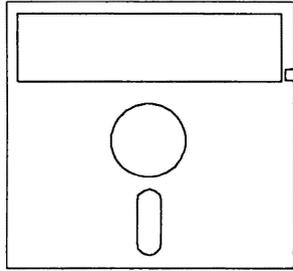
Hard Disk Storage

Many microcomputers use storage devices called hard disks to store large amounts of data. Some computers you will use in this project may have these storage devices inside of them. Hard disks have enormous capacities to store data. A typical hard disk customarily found on a microcomputer can store 20 to 80 Megabytes of data (20 to 80 million bytes). Unlike diskettes, hard disks stay in the computer.

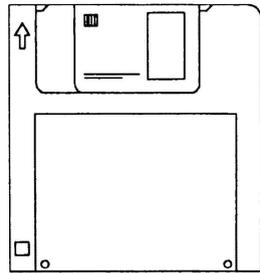
Diskette Storage

The storage media you will use are called diskettes. Diskettes are magnetic storage devices (like hard disks) but can be stored outside the computer. Two popular types of diskettes are floppy disks and microdisks. Floppy disks are 5.25 inches in diameter and look like a phonograph record in a square sleeve.

You insert this diskette into the "floppy disk drive" and close a latch.



Microdisks are 3.5 inches in diameter and are small, flat cartridges. These types of diskettes have become very popular recently because they can hold large amounts of data in a smaller space than floppies. Similar to floppy diskettes, you insert these into the computer's "microdisk drive."

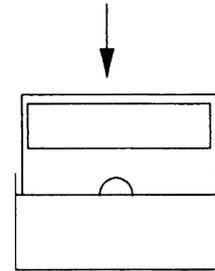


Your computer will have at least one floppy, or one microdisk drive, or both. A program you need to start the computer may be on either of these media or on the hard drive (if your computer has one). This is a high level program used together with the system program (stored in ROM). Study the manual for your computer to determine which disk media contains this program.

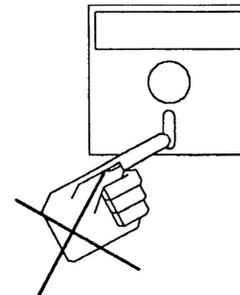
Care of Diskettes

Since diskettes are magnetically coated, never place them near magnetic or electric fields such as under a telephone, on top of a monitor, or other electrical appliance. Additional care must also be taken with flexible floppy diskettes. The following rules apply to the care of these diskettes:

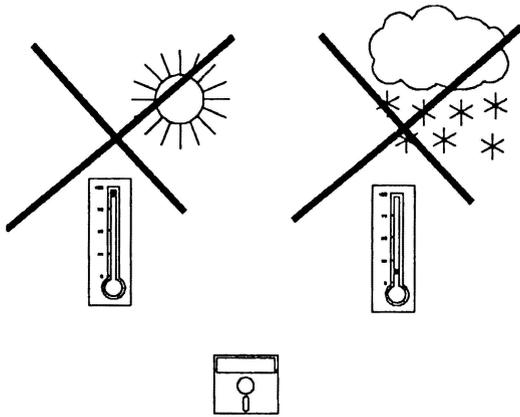
1. Always store your diskette in its sleeve while not in use to protect it from dust. Dust can interfere with sensitive components in the disk drive and cause faulty reading of data or, in extreme cases, loss of data.



2. Do not bend your diskette.
3. Do not touch any exposed parts of your diskette.



4. Do not expose your diskette to extremes in temperature.



5. Write only on disk labels with a felt-tipped pen.

What Have You Learned?

Below are some questions you should answer. If you have trouble with any of them, re-read the proper sections in this article and try again.

1. Computer programs are:

- a. Portions of computer hardware that allow you to communicate with the computer.
- b. Computer code that instructs the computer to perform a desired function.
- c. Usually found on the computer's system disk.

- d. a & c.
- e. b & c.
- f. none of the above.

2. RAM memory:

- a. Can be changed.
- b. Is another name for temporary diskette storage.
- c. a & b.
- d. Is the "brain" of the computer.

3. A hard disk:

- a. Contains hard-coded instructions that cannot be changed.
- b. Uses laser technology to store data.
- c. Can hold many times more data than a diskette and can be erased.
- d. All of the above.

4. List two advantages hard disk storage has over diskette storage.

5. What part of the computer system allows you to input instructions and data?

6. What is the printer's function?

7. What program is usually found in ROM in most computers?

8. List five points to remember to properly care for floppy diskettes.

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____

Let's start computing!

Operating the Microcomputer

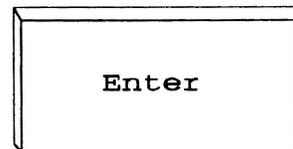
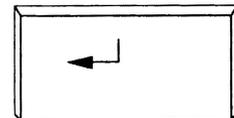
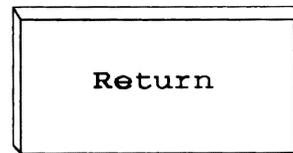
The first thing you use is the keyboard. Before you start computing, however, be sure that you have gone through the proper sequence to start the computer and allow you to use the

BASIC programming language. BASIC stands for **B**eginner's **A**ll-purpose **S**ymbolic **I**nstruction **C**ode. Your leader will help you go through the following steps:

1. Powering up
2. Entering the date and time from the keyboard
3. Inserting the diskette that contains the disk operating system
4. Loading BASIC

Once you have loaded BASIC properly, you can start programming. First, however, you should be familiar with some of the important keys on the keyboard and their special functions.

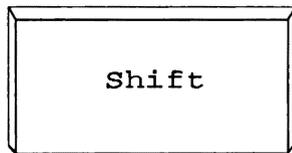
We will separate keys into ones needed for all applications and ones especially useful in writing programs. Important keys needed for all applications include:



Return or Enter allow you to go to the next line of text. This acts like a carriage return on a typewriter.

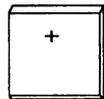


The space bar is at the bottom of the keyboard. It allows you to place a blank space between text.

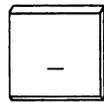


The "shift" key is used with other keys. For keys that have two characters on them, the upper character is typed when the "shift" key is pressed at the same time.

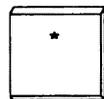
Other important keys are especially useful when writing programs. You will use many of these keys in the following exercises. These keys are listed below. Try and locate these keys on the keyboard you are using.



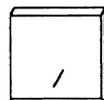
"Addition" key



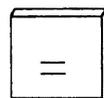
"Subtraction" key



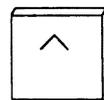
"Multiplication" key



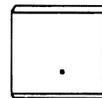
"Divide" key



"Equal" key



"Exponential" key



"Decimal" or "Period" key



Function keys. These are found on some computers. They allow execution of special tasks with only one keystroke.



"Parentheses" keys

Now that you know what many of the important keys do, it's time to start programming!

Writing simple math programs

Computers were first created as mathematics tools. The incredible speed with which computers can perform math operations is why computers are still so important to us today. One of the greatest uses of a computer is for "number crunching." Just imagine the countless calculations needed for guidance and operations management for NASA space flights. Computers, because of their rapid "number crunching" capabilities, make the job possible.

In the following exercises, you will write simple statements to perform math operations. To become familiar with the machine, you will use the PRINT statement (from the BASIC language) to display results of simple math operations. In this way, the computer will act much like a

calculator. If you have questions, ask your leader.

Hierarchy

Remember the keys you learned which I said would be valuable for programming? Well, now you get to use them.

The computer always follows a set of rules that define the order of performing calculations. These rules are called a HIERARCHY. The order is shown below:

Priority	Operation	
1	()	Operations in parentheses
2	^	Exponentiation
3	* OI /	Multiplication or Division
4	+ OI -	Addition or Subtraction
5	Left to Right	If two or more symbols with same priority, computations are done left to right

In the BASIC programming language, the PRINT statement writes text or the result of calculations to the screen. Below are some exercises you can run on the computer. Refer to the above rules on hierarchy if you need to. It will help you arrive at the right answer. Be sure you have loaded BASIC first. If you have questions, ask your leader.

	Your Answer	Computer's Answer
PRINT 4*40/5	_____	_____
PRINT 6+20/9	_____	_____

PRINT (40-7)/5 _____

PRINT 5+(4*3/2)/3 _____

PRINT 5+(4*(3/2))/3 _____

The Computer's "Math Power"

In the above exercises, you learned to write simple statements to perform math calculations, much like a calculator. The real power of the computer, however, lies in its ability to perform several operations very fast. The average person could take hours to perform several math calculations in the time it takes a computer seconds to do the same calculations.

The next two exercises show the computer's speed in performing calculations. Both exercises use special BASIC language statements called FOR-NEXT loops. "Loops" are common to most programming languages. Their purpose is to execute a series of instructions a specified number of times. Take a look at the program below and type it into the computer:

```
10 FOR I = 1 TO 1000
20 Y = 100 + I
30 PRINT "RESULT IS ";Y
40 NEXT I
50 END
```

Now run this program. What do you see? You see numbers scrolling up the screen and increasing very fast. This shows you how fast the computer can run. Statements 20 and 30 between the FOR and NEXT statements are executed 1000 times! This program adds the value of the loop counter (I) to

100 each time line 20 is executed. Line 30 prints out the result, Y. When 1000 is reached, the program stops. Look at your computer screen. What was the final result when the program stopped? It should have been 1100 (which is 100+1000).

Run the same program again. This time, use a stopwatch or watch with a second hand to time the computer. Record the time below:

The 1000 executions took __ secs on the screen.

Now we will change the program just a little. Type the program below:

```
10 FOR I = 1 TO 1000
20 Y = 100 + I
30 NEXT I
40 PRINT "RESULT IS ";Y
50 END
```

Notice what we did. We moved the PRINT statement outside the loop. When you run it, you will only see "RESULT IS 1100" printed. The only statement inside the loop is the equation which is still being calculated 1000 times as before. You just can't see each calculation. The program will run much faster, however. Prove this to yourself. Run this program and time it just as you did before. Record the time below:

The 1000 internal executions took __ secs.

Were you able to time it? Pretty fast, huh? Why is it so much faster? The reason is that, in the first program, the computer had to write each statement to the video screen 1000 times. The computer requires many more of the

same "byte-length" codes to do this. In the second example, much time was saved because the codes to write each statement to the video screen were not needed except at the very end.

Saving and Retrieving Programs

Procedures for saving and retrieving programs for later use are basically the same no matter what computer you use. Your leader can help you with specific commands for the version of BASIC you are using. The general procedure is outlined below:

1. In your BASIC programming environment, save the last program you wrote using the SAVE command. Call it any name you wish. Save it to any disk drive you wish. Ask your leader how to save the program to a particular disk drive.
2. Now that you have saved the program, leave the BASIC programming environment and return to the system. This will erase the program you ran from RAM memory. Do not worry, however, your program was saved on disk.
3. To retrieve your program and run it, first get back into BASIC as your leader showed you. Now, load the program from disk using the proper command. Remember to call it by exactly the same name you saved it.
4. Now re-run the program as before.

Additional Activities

You have now completed this project, but there are still many things you can learn about computers. Some suggested sources of information include:

1. Your computer's instruction manual. This is a good source of extra information.
2. Books about computers. Your library has lots of books about computer hardware and software. There are a lot of computer programs on the market that do mathematics, word processing, games, and data organization (to name a few applications). Many bookstores have books on how to use these programs. You may want to browse through some of these books in the bookstore to see what the programs are about. You load these programs into the computer in much the same way you loaded your BASIC program.
3. If possible, take a group tour of an electric, gas, telephone, or water company to see how computers are used to manage operations and keep records. You can call these companies to set up tours.
4. Check with a teacher, school counselor, or principal about how computers are used at your school and how you might start a career with computers. If your school teaches computers or uses computers in classes, ask the teacher of the class about potential career possibilities.

5. The State of Virginia has career information materials and a computerized information delivery system called the Virginia VIEW career search. These tools allow you to learn more about occupations related to computers or any 4-H project. Virginia VIEW materials are found in public schools, libraries, community colleges, and cooperative extension offices throughout Virginia.

One of the best ways to use Virginia VIEW would be to develop a personal profile first. You answer questions about your personal interests and area of work desired. The computer program will then provide occupations matching this profile.

Other states may have similar career search systems. You should contact your state's 4-H Youth Cooperative Extension Office for information on what your state has to offer.

Demonstrations and Talks

Give a demonstration at a 4-H meeting or in your county demonstration program. Some suggested topics include:

1. Hardware components of a computer and how they work.
2. How to use a computer and take proper care of floppy disks.
3. Uses of computers in daily life and innovative applications. (For example, you might research how the space program or the military uses computers).

4. Research careers in Engineering or Computer Science and present what you have learned.

5. Write a computer program for the 4-H competition and explain its operation.

Project Record Form

You need to fill out a project record form detailing what you accomplished and learned from this project. These forms are available from your local Extension office.

Virginia Cooperative Extension programs and employment are open to all, regardless of race, color, religion, sex, age, national origin, handicap, or political affiliation. An equal opportunity/affirmative action employer. Issued in furtherance of Cooperative Extension work, Virginia Polytechnic Institute and State University, Virginia State University, and the U.S. Department of Agriculture cooperating. William A. Allen, Interim Director, Virginia Cooperative Extension, Virginia Tech, Blacksburg; Lorenza W. Lyons, Interim Administrator, 1890 Extension Program, Virginia State, Petersburg.