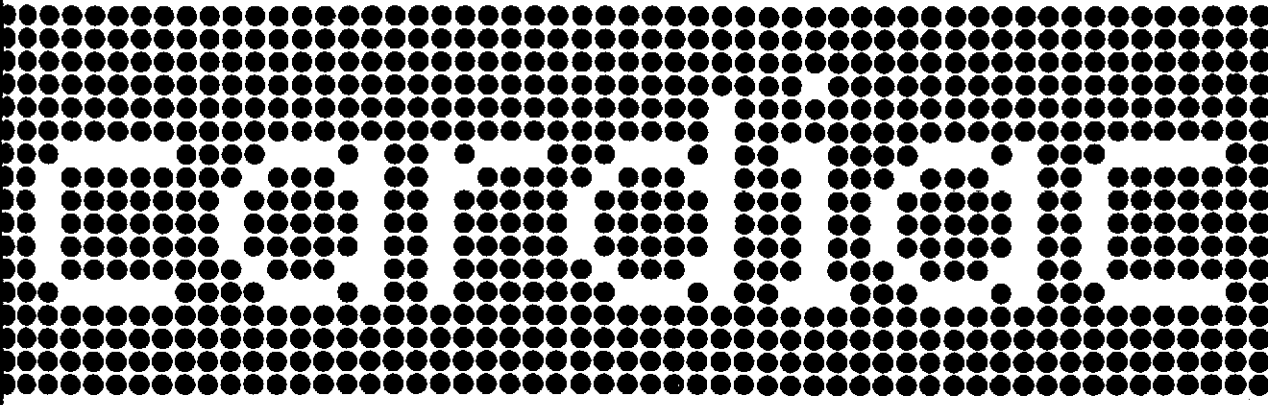


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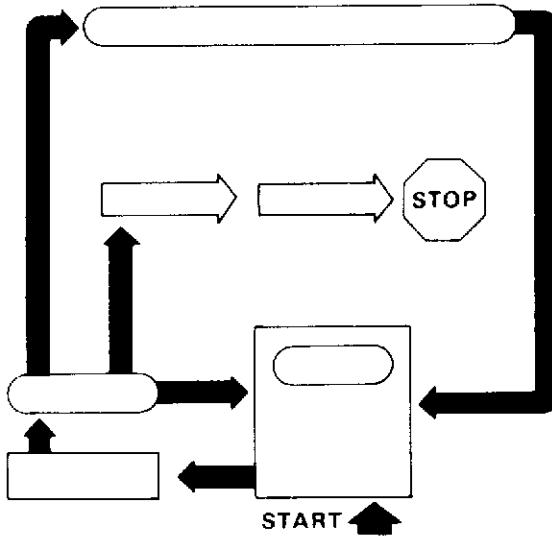


A cardboard illustrative aid to computation

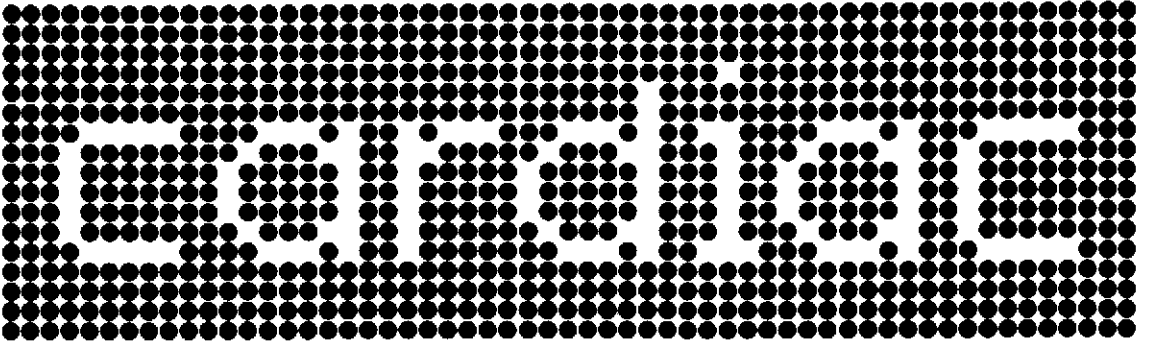
David Hagelbarger

Saul Fingerman

Bell Telephone Laboratories



An instructional manual for



**A cardboard illustrative aid
to computation**

by David Hagelbarger

Saul Fingerman

Bell Telephone Laboratories

Cartoon illustrations by A. Barthelson

Bell System Educational Aid

Developed by Bell Telephone Laboratories

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Preface

You may be surprised that CARDIAC, which is about computers, has been developed and made available by the Bell System. It is true that the Bell System's relationship with computers is not obvious but nevertheless it is very substantial.

To begin with, the Bell System is the nation's largest user of computers (with the exception of the federal government). Hundreds of computers are used for billing, record keeping and other internal operations. The Bell System also offers a number of services for interconnecting computers, or connecting with them.

In addition, the entire Bell System telephone network has often been compared to a gigantic computer: Digital information in the form of a called number is pulsed into a central office, switching equipment possessing computer-like features then solves the problem of establishing a connection between the called and calling telephones.

Out of the research and development that made this network possible, has blossomed much of the basic technology of modern computers.

But it is at Bell Telephone Laboratories—the research and development unit of the Bell System—that the System's most extensive involvement with computers is to be found.

The first electrical digital computers were conceived at Bell Laboratories (as well as at Harvard University, in an entirely independent effort), shortly before World War II. The inventor was George Stibitz, who later went on to develop several other computers that remained in productive service throughout the war. These were all relay machines—primitive by comparison to the incredibly efficient electronic computers that have become so much a part of contemporary life.

What made efficiency possible was the transistor. Invented at Bell Laboratories, the transistor not only cut size and power requirements, but also provided the speed and reliability that makes it possible for computers to perform millions of operations without errors.

Within a decade of its inception, the transistor was proved out with TRADIC, an airborne computer built by Bell Laboratories for the military. Since then, direct descendants of TRADIC have

played essential roles in other military programs, such as the SAGE communications network and the very complex Nike Zeus and Nike-X antiballistic-missile projects.

The computer is playing an increasingly important part in *all* areas of research at Bell Laboratories. Today, about 30 per cent of the technical personnel there spend more than half their time programming computers.

Currently, a Bell Laboratories task force is developing BIS (Business Information System) to supply Bell System management with the kind of up-to-the-minute information needed to reduce operating costs and provide better customer service. BIS will use new third generation computers—high-speed, on-line, real-time random-access machines with mass information storage and retrieval capabilities.

It is no exaggeration to say the story of Bell Laboratories and computers is a significant one. Information theory, error detection and correction codes, electronic switching, programs for visual computer displays such as BEFLIX, as well as for design, simulation and modeling—these and many others are only highlights in the long story. And as a by-product of this story, CARDIAC was developed, which we hope will help you to understand computers.

C. I. R.

SECTION

1.

WHAT CARDIAC IS ...AND ISN'T

CARDIAC is an acronym for CARDboard Illustrative Aid to Computation. The key word here is "illustrative." It means that CARDIAC *illustrates* the operation of a computer without actually *being* a computer. In fact, it is not even a practical *aid* to computing. On the other hand, it is a very practical aid to *understanding* computers and computer programming.

You'll need this kind of understanding to keep up with the Computer Age you are about to enter. These are fast-moving times, and those who make no effort to understand computers may very well get left behind.

