

The

E R A

Computation Center

*for
industry,
government
and
research*

Engineering Research Associates

DIVISION OF
Remington Rand



serving Industry, Government and Research with

ERA General-Purpose Computers

ERA Custom-Designed, Special-Purpose

Computers and Control Systems

and . . . **THE ERA COMPUTATION CENTER**

A new departure in computation

Today's giant general-purpose electronic computers are not merely wonders of science — they are practical working machines. In some cases they can solve problems that were formerly insoluble by any method.

In other cases they can provide solutions at far less cost than has hitherto been possible. Any problem whose solution can be reduced to a sequence of basic arithmetic and logical operations is a potential application for these machines. The tremendous power of such a machine is now made available by the ERA Computation Center at Arlington, Virginia.

Engineering Research Associates

ERA, a division of Remington Rand Inc., was organized in 1946 at St. Paul, Minnesota. During its rapid growth ERA has made contributions to nearly every phase of the practical development of large-scale electronic data-processing systems. Many of the computer industry's leading engineers and mathematicians are counted among the company's planners and designers.



*How you can use the **ERA** computation center*

A large-scale computer is needed for the rapid handling of enormous volumes of data, or for elaborate mathematical computations. It is equally true that a large-scale computer will often be very economical for quite simple problems. When a large-scale computer can be kept fully occupied, as is possible in a computing center, its operating cost for a particular computation is frequently far lower than that of a smaller machine.

The ERA Computation Center's facilities will be of particular value to you:

If you have well-defined problems and are in need of machine computation facilities.

If you desire assistance in formulating your problems for computer processing.

If you desire advice as to the applicability of large-scale computer methods to your problems.

ERA's Computation Center. . . Three phases

A Machine Solution of a problem is accomplished in three phases -

Problem Analysis:

The first phase, problem analysis, leads to a clear formulation of a method of solution that is suitable for mechanization.

Programming:

The second phase, programming, translates the already formulated method of solution into a detailed set of coded instructions for a particular computer.

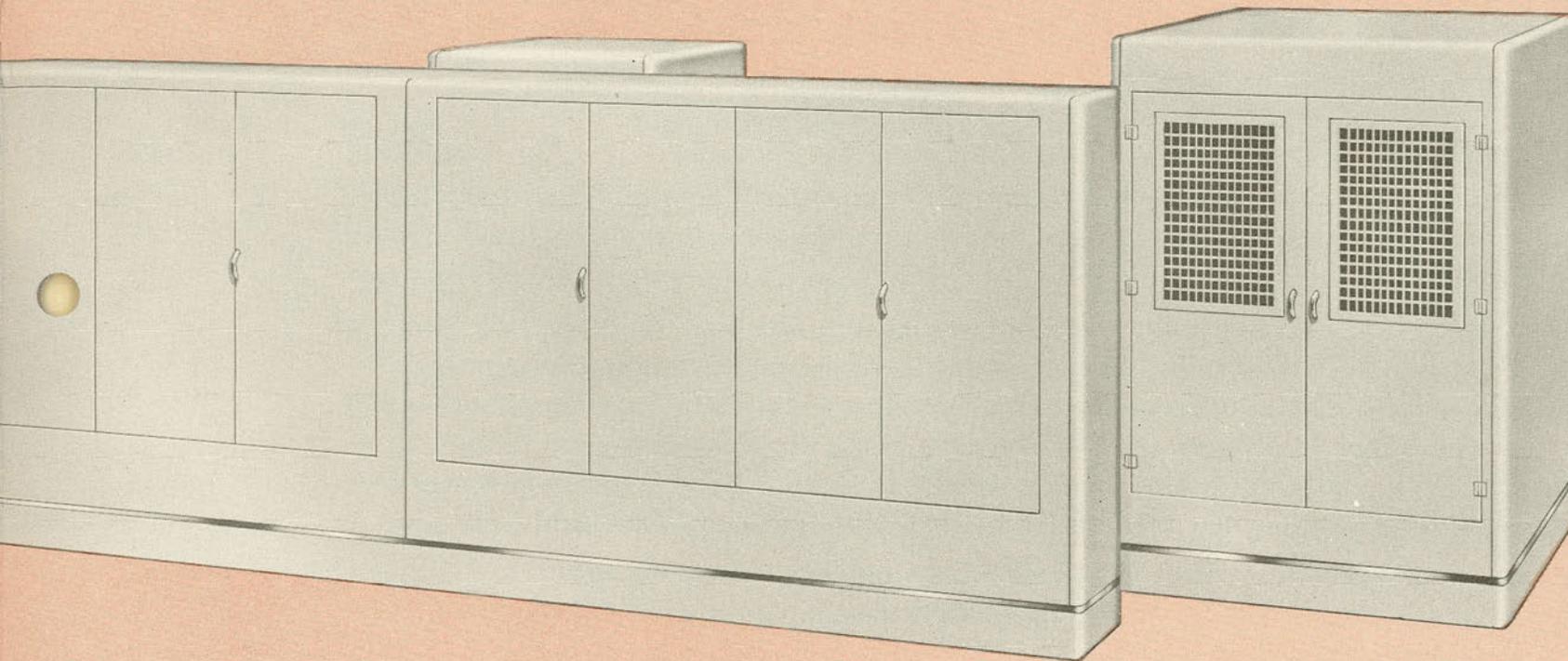
Machine Computation:

The third phase, machine computation, consists of putting the instructions into the computer, running the problem, and presenting the results.

Many users of the services of the ERA Computation Center will carry out the first phase themselves. Others, however, will wish to take advantage of the strong team of problem analysts and programmers who will be available to assist users of the computer both in the formulation of their problems for machine solution and also in the detailed preparation of computer programs. Manuals will be provided for those users who prefer to do the programming themselves.



The **ERA 1101** *General-Purpose
Computer System*



Basic equipment of ERA's Computation Center is the ERA 1101 Computer. This machine has set new standards in computer reliability and performance since its first installation in December 1950. The ERA 1101 Computer belongs to a class of machines that are popularly known as "Giant Brains". In technical parlance, it is a binary, parallel, large-scale, general-purpose electronic computer of the type usually associated with numerical analysis.

Computer output takes the form of paper tape, punched at the rate of 60 characters per second. Characters can be coded in any way necessary to operate such external equipment as typewriters or teletype printers. Punched paper tape is used for input also, where high speed is attained by photo-electric reading. The computer will accept tape that has been prepared at the Center or elsewhere on standard communications or office equipment.

ERA's 1101 Computer has a flexible logic similar to that of other digital computers designed for numerical analysis, and can perform the same type of computations. In addition, it has many unusual features not shared by other computers in the same class:

1101 Exclusive Features:

1 . . . the direct-access computing memory is unusually large, consisting of 16,384 words of 24 binary digits each.

2 . . . the computer has special provisions for operating on small groups of binary digits, as well as on words of standard size. This suits the computer to problems involving logical analysis of coded information, in addition to the mathematical analysis of numerical quantities.

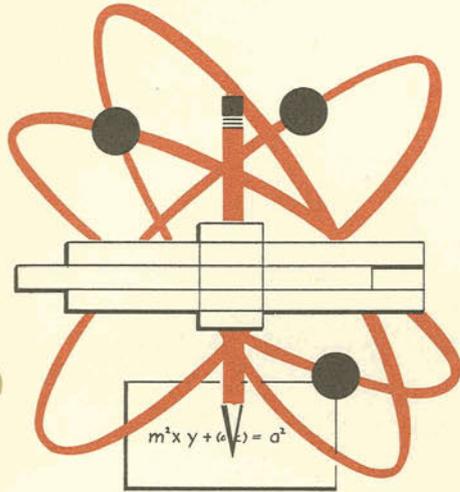
3 . . . in arithmetic operations, the machine's accumulator handles double-precision numbers composed of 48 bits (binary digits). When multiplying, it is possible in a single computer operation to add the 48-bit product of two 24-bit numbers to the 48-bit number initially in the accumulator. In division, the 48-bit number in the accumulator is used as the dividend. These special features help the programmer to obtain greater accuracy in numerical analysis, making the computer particularly well suited to linear problems involving matrices.

As an example of computing speed, ERA's 1101 Computer can extract the square root of a number in 14 milliseconds. Typical times for multiplication of two $n \times n$ square matrices are:

<i>n</i>	<i>times</i>
8	5 secs.
16	18 secs.
32	168 secs.
64	24 minutes
128	4.5 hours

Areas of Application

The field of application of high speed computers is continually expanding as experience is gained in the use of these machines. Several of these areas of application are outlined here—



Scientific and mathematical computation

The advent of large-scale computing machines has revolutionized the field of scientific and mathematical computations. Problems whose solutions would have been inconceivable a few years ago or which would have been too wasteful of time and money now are handled quickly and economically by this equipment.

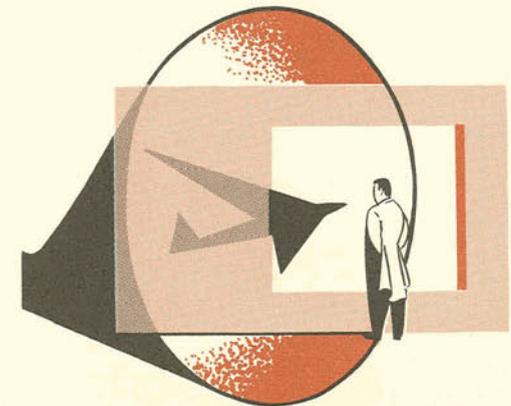
One vital result is a great increase in the use of scientific knowledge and mathematical computation to predict behavior, thus enabling designers in many fields to eliminate much costly "trial and error" development. Problems of heat flow, strain distribution, critical speeds and ray tracing are becoming less formidable as the big computers prove their worth.

Other examples in this general field are the computation of tables of functions, the solution of many types of differential equations, and problems involving matrix algebra. A pointer to the future is the recent use of a digital computer to calculate the instructions needed in an automatic milling machine operation, these instructions being recorded in suitably coded form on punched paper tape.

Automatic data reduction

Familiar examples in this field of problems admitting machine solution are the reduction of wind tunnel data, computation of correlation coefficients, curve fitting and flight path determination.

The ERA 1101 Computer belongs to a class of digital computers which is well suited to analysis of large quantities of experimental data.





Industrial and economic planning

The application of digital computers in the field of industrial and economic planning is in its infancy, with prospects of a brilliant future. Most applications, it appears, will concern optimization—the selection of numerical magnitudes of related quantities leading to the nearest approach to some desired result.

One type of application is the so-called “linear programming” technique developed by economists. Another is the optimum routing of traffic over a communications network.

A third example is the recent computation of an optimum procedure for handling a strip mining problem. Yet another, more extreme example is a computation to determine what changes are necessary in the shape of a river bed to obtain optimum flow.

System Simulation

System Simulation is a field of endeavor for digital computers that is still in a formative stage. Frequently the design of an automatic system will involve complex problems of behavior. The designer would like to know in advance what the behavior of a proposed system would be under a wide variety of possible situations. Lacking this knowledge he is faced with trial and error procedure in building equipment. Take Air Traffic Control as an example. An important aspect of this problem is the accurate determination of an aircraft's true position and velocity from intermittent measurements, subject to random errors. A designer, creating equipment to estimate these factors, is faced with considerable choice in such matters as selection of the best type of non-linear smoothing, and will need to determine in advance the response of his system to such unknowns as rapid turn of the aircraft, change in size of random errors in measurement, an isolated fault producing a large error in one measurement, and similar considerations. In problems of this nature the 1101 computer is of great service.



How to inquire . . .

All inquiries concerning use of the ERA Computation Center will be welcomed.

Engineering Research Associates
Division of Remington Rand Inc.
Computation Center—Department A
555 23rd Street So.,
Arlington, Va.

Engineering Research Associates



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pioneers in the development of digital computer techniques
digital computers . . . data-handling systems . . . magnetic storage systems . . .
instruments . . . analog magnetic recording systems . . . computing service

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COMPUTATION CENTER, 555 23rd STREET SOUTH, ARLINGTON, VIRGINIA