MATHEMATICS

Machines Speed Science

Mechanical "mathematicians" are being designed to solve problems too involved for the human brain. Men must be trained to staff machines.

➤ NEW PLANS for thinking with machines were made by 200 mathematicians and scientists who have been conferring at Harvard University. The "brain" machines that think with numbers will speed scientific investigations, doing some computations that are impractical for the human brain alone to do.

In the new, modernistic building of the computation laboratory of Harvard University, Prof. Howard H. Aiken demonstrated the latest Harvard-built computing machine, the Mark II automatic sequence control calculator.

Automatic digital computing machines think with numbers. Once set up to work a problem, the machine without human intervention can perform the thousands of lightning additions or multiplication to give answers to problems that were hitherto too long or involved for any practical method of solution.

Problems for Machine

How does the air flow around a projectile travelling faster than the velocity of sound? What is the relation between profits, wages and prices, given the hundreds of complicated interrelations between costs and productions? These are but two examples of the problems that are expected to be solvable by the many machines that are now built or being built.

By translating the principles involved in counting on your fingers into complex machines of wires, electron tubes, magnetic wire recorders, photographic films, relays, phosphorescent-coated discs, teletypewriters and printers, and even sound waves in tubes of mercury, the engineers expect to perform such computations.

The biggest problem in these machines is the finding of a good, cheap way of storing the hundreds of thousands of numbers involved in a big problem, and yet having this stored content available on a split second notice. In hand computation, simply writing the numbers on a piece of paper is sufficient. But for a machine which may generate millions of numbers in intermediate steps, and at a rate a thousand times faster than the speediest human calculating machine operator, the method would use up too much paper. Storage of numbers by the hundred thousand on miles of magnetized wire or on microscopic patterns on photographic film was discussed.

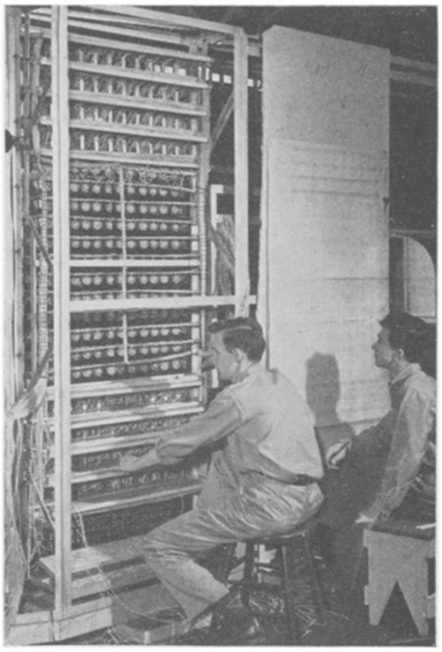
Rapid Memories

When you add or multiply, you temporarily hold one or two digits in your head. But these machines are designed to hold in their "rapid memories" as many as a thousand numbers, each ten or more digits long; and to be able to think of any one of these numbers, to do the next step of a problem in a thousandth of a second.

One suggested solution of these problems included the use of tiny patterns of electric charges on the insulating inner surface of electron beam tubes. Another was the use of a sort of telegraph code—at a million dots per second—which would be put as acoustic pips into a tube of mercury where a thousand pips can be stored before the first one emerges at the far end. When the pips come out, one at a time, they can be put back into the other end of the same tube for the next round of storage. They are always on the go, but they never get anywhere. Numbers have been stored in such a fashion for days, to take the load off the mathematician. This is the purpose of the new digital machines.

But then you cannot have the machine stopping every so often to ask questions of the mathematician. There are ways to make the machine think for itself, to size up the problem and the steps that it has just finished, and from this to make its own decisions on how to go ahead with the thousands of steps ahead of it. These were discussed by Dr. H. H. Goldstine of the Institute of Advanced Study.

With machines that can compress a lifetime of computation into a few days or weeks, the problem of handling the huge output of answers is acute. Harrison Fuller of Harvard University demonstrated the most unusual proposal for the solution of this problem. He showed that with a few dozen vacuum tubes he could actually write Arabic numerals on the face of a cathode ray tube. By pressing any one of 10 buttons, one of each of the ten digits appeared on the face of the tube, written as if by a pencil of electrons. Twenty of these tubes in a row could then display a number 20 digits long. With suitable equipment, these numbers could be recorded photographically on a sheet in a form suitable for immediate photo-printing processes.



MARK II—This picture shows the calculator under construction at Harvard University.

Demonstration of Mark II

The demonstration of the new Mark II calculator was a feature of the four-day meeting. With thousands of relays interconnected with a million feet of wire, it is one of the biggest computing machines in the world. This machine was built for use at the Naval Proving Grounds, Dahlgren, Va., where it will provide answers to the many problems of guided missile flight, bomb trajectories and shell characteristics. The machine is 12 times faster than the Mark I machine which was built at Harvard and presented to the University by the International Business Machines Corporation in 1944.

Prof. Charles C. Bramble of the Post Graduate School, Naval Academy, Annapolis, Md., sounded a call for the immediate training of young mathema-

(Turn to page 52)

AAAS WINNERS—Dr. Quentin M. Geiman and Dr. Ralph McKee (top), department of biochemistry, Harvard Medical School shared in $1,000 prize of the AAAS meeting with Prof. T. M. Sonneborn and Ruth V. Dippell, research associate, both of Indiana University. The winning papers were, respectively, "Cultural Studies on the Nutrition of Malarial Parasites" and "Paramecin 51." (See SNL, Jan. 11, 1947.) Chemical and Engineering News photographs.

From Page 51

ticians in the operation of the many new computing machines now building, lest the construction of the machines outrun the supply of operators trained to use them.

This call was seconded by Prof. Aiken, who stated that a university was for the building of men, not machines, and that the number of young men now trained in the field was far too small. He expressed his intent to initiate courses in the fall in applied mathematics with a strong flavor of computing machines.

The snowballing of interest in automatic digital computing machines is vividly demonstrated by their history. Before the war, only the Bell Laboratories Relay Computer was in existence. In 1944, the IBM-Harvard automatic sequence controlled calculator was put into operation. In 1945, the electronic numerical integrator and computer, called "Eniac," was unveiled at the University of Pennsylvania. Now there are about a dozen projects planned or underway.

The Navy, through the Office of Naval Research, plans to establish institutes for numerical analysis, one on the east and one on the west coast, it was announced by A. T. Waterman, speaking for ONR. These centers, which will use the latest machines, will be placed near large cooperating universities and will encourage outside scientists to become temporary staff members.

Science News Letter, January 25, 1947

SCIENCE NEWS LETTER

Vol. 51 JANUARY 25, 1947 *No. 4*

The weekly summary of Current Science, published every Saturday by SCIENCE SERVICE, Inc., 1719 N St., N. W., Washington 6, D. C. NOrth 2255. Edited by WATSON DAVIS.

Subscriptions—$5.00 a year; two years, $8.00; 15 cents a copy. Back numbers more than six months old, if still available, 25 cents.

Entered as second class matter at the post office at Washington, D. C., under the Act of March 3, 1879. Established in mimeographed form March 18, 1922. Title registered as trademark, U. S. and Canadian Patent Offices. Indexed in Readers' Guide to Periodical Literature, Abridged Guide, and the Engineering Index.

The New York Museum of Science and Industry has elected SCIENCE NEWS LETTER as its official publication to be received by its members.
Member Audit Bureau of Circulation. Advertising Representatives: Howland and Howland, Inc., 393 7th Ave., N.Y.C., PEnnsylvania 6-5566, and 360 N. Michigan Ave., Chicago, STate 4439.

SCIENCE SERVICE

The Institution for the Popularization of Science organized 1921 as a non-profit corporation.