COLUMBIA FOCUS

Trig Homework? Consult Watson Computing Labs

By ERIK ARCTANDER '49

If you have a flair for the fantastic, take a peek into the innocent-looking building at 612 West 116th Street. In the basement and on the first floor of this five story structure people are doing things with numbers that used to be impossible. Or more corectly, machines are doing the impossible.

It's Columbia's newest aid to science — The Watson Scientific Computing Laboratory. The name is exceedingly appropriate, since Mr. Thomas J. Watson is president of International Business Machines Corp., a Trustee of Columbia University, and the instigator of the whole idea.

In 1945, Mr. Watson called Dr. W. J. Eckert in Washington, D. C. where he was serving as Director of the U. S. Nautical Almanac Office. Dr. Eckert had been a Professor of Celestial Mechanics in Columbia University's Department of Astonomy before leaving for Washington in 1940. Now Mr. Watson invited Dr. Eckert to take charge of a new division within IBM—the Department of Pure Science. This department immediately established the Watson Scientific Computing Lab in cooperation with Columbia.

100 Answers Per Minute

It was Dr. Wallace Eckert who first saw the application of machine computing in pure science. During his early days as an instructor in the Astronomy Dept. of Columbia, he had used Prof. Ben Wood's IBM punched-card machines from the Columbia University Statistical Bureau. This was in 1928; by 1934 Dr. Eckert had progressed to the point of getting Columbia, the American Astronomical Society, and International Business Machines to jointly sponsor the Thomas J. Watson Astronomical Computing Bureau. Ever since the demonstration was made that computing machines were invaluable in pure science as well as commercial accounting, the use of them has multiplied.

What can these machines do that is so remarkable? The Electronic Multiplier can determine the product of two ten-digit numbers in 17-thousandths of a second. But this electronic part of the operation is so much faster than the mechanical one of reading the problem and printing the answer that only 100 answers per minute are recorded. One wonderful time-saver which is possible with this particular machine, is to "look-up" values in a table. For example, if the values of trigonometric functions are needed in the process of solving a long problem, a stack of punched cards representing the table are placed in one hopper of the machine. As a particular value is needed, the appropriate card runs through the machine. As many as 20,000 sines have been "looked up" in three or four hours.

The fundamental tools which comprise this new, almost unbelievable contribution to science are two: the punched card and the electronic or electric machines. The card used at Columbia measures about 3 x 4 inches and containes 80 vertical and 12 horizontal columns. This means that eighty 10 place digits can be punched on one card, since the other two places are to control the operation-as in the case of a minus sign. All the machines are thus designed to place data on a card, read the figures from them, or place the cards in order. They do this by having tiny wire "brushes" make circuits through the punched holes.

The Key Punch cuts smal holes in cards to record initial information, which can then be checked by the Verifier. Once cards are punched they may be distributed into any desired order by the Sorter; or two sets of similar cards may be merged into one by the elaborate Collator. Several other machines can reproduce cards already punched, multiply, divide, add, subtract, or print data from punched cards on regular rols of paper.

The involved problems are handled by the Computing Labs' two Automatic Relay Calculators, which can perform and record 24,000 6 x 6 multiplications per hour. Two are found to be desirable in case one breaks down, so that one can check the other, and so that two parts of a problem can be worked on simultaneously. These machines have 28 counters in which to store digits, and 2,000 connections can be made on the control panels in order to direct the working of a problem.

The twenty-odd machines used in the Watson Scientfic Computing Laboratory represent rentals totaling several thousand dollars per month, and they consume about 20 kilowatts of electricy per hour. Besides the 35 Columbia graduate students who may use the Lab, there are often visitors from other universities using these unique facilities. At present an Egyptian student of Astronomy at Harvard is one of those working there.

Trained Men Needed

Dr. Eckert, Mr. Seeber and their assistants give a one-year course in the use of the machine to qualified graduate students. But most of these men are engineers, chemists, or physicists and are not working toward the newly-created degrees of MA and PhD in Applied Mathematics. Directors Grosch and Thomas give advanced courses in mathematics.

Discussing the need for trained men in this new field, Dr. Grosch was disappointed: "The whole field of computing is definitely wide open and yet we hardly ever get any students interested in the machines for their own sake. Most of them are chemists, or engineers, or physicists who want to learn how to use them as an aid in their work. But we are still hoping.

The Laboratory also includes the use of the huge and stupendously complex Selective Sequence Electronic Calculator in IBM's World Headquarters Bldg., 590 Madison Avenue. This so-far unsurpassed monster can read 140,000 digits a minute from sixty-six tapereading units, and can print 24,000 digits a minute on record forms. And while working a problem this machine can "remember" 400,000 digits. To mention some figures which probably will be better understood, it can be disclosed that the cost of the Selective Sequence Electronic Calculator was about $750,000 and it rents for the neat sum of $300 per hour. However, if the machine is operating properly half of the time this is considered good—and the customer doesn't pay during a breakdown. By comparison, Harvard's Eniac operates only about one-quarter of the time.

Profile of Watson Computing Lab at Columbia. Includes discussion of SSEC, other lab machines and quote from Herb Grosch

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