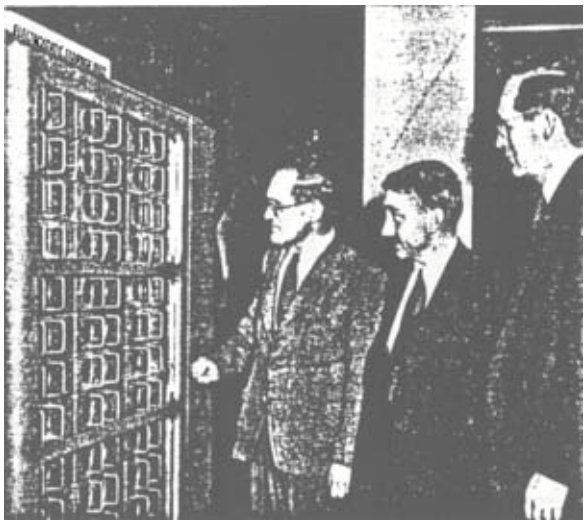
They put MEMORIES In a Tube!

Giant 701 Owes Speed to Cathode Ray Tube Memory Units, Produced by IBM'ers Without Previous Tube Manufacturing Experience

With yellow flame, James Ackerman, of Plant 2's Tube Manufacturing Dept., dries a coating on a memory tube for the 701.



Eying the memory unit of 701 calculator at WHQ are (L to R) English scientists F. C. Williams and H. J. Crawley with IBM Vice-president J. C. McPherson.

HOW good is your memory? If you're like most people, you often write little notes to remember things like names and dates. For instance, when you don't want to forget a telephone number you probably jot it down. If you took the time (as might a young man when a pretty miss gives him her phone number) you could memorize the number without the slip of paper.

Just how well you remember things has a great deal to do with your speed of thinking. When you try to solve even the simplest of arithmetic problems you discover that your speed depends on how well you remember rules of mathematics.

Engineers who build electronic calculators—such as IBM's giant 701—to help tackle complicated technical problems know how important it is to provide these calculators with some sort of memory unit. However, since electronic computers cannot be built to think as you do (they produce solutions only when told how), they cannot memorize. They must "make a note" of everything.

If you are to use the 701 to plot the path of a guided missile, you must tell the calculator ahead of time how to proceed, step by step. The machine "jots" down the steps and then carries them out.

Somewhere in the problem you might have to compare the missile's velocity to the speed of sound. So, beforehand, you must tell the computer that sound travels at 760 miles an hour (at sea level). The machine "writes" this down and stores it until it is ready to use the data.

IBM calculators—like all computers—always have had to "take notes" to remember things. One method of storing information is the punched card; another is the counter wheel in a mechanical calculator. Magnetic tapes and drums also are used to keep data in the form of magnetized spots.

Last year IBM's 701 introduced in its calculators a high-speed memory called "electrostatic storage," whereby information is "remembered" by means of electrical charges on the face of a cathode ray tube.

The heart of the 701's memory system is comprised of seventy-two of these tubes, similar to television picture tubes—only, instead of producing a picture of Jackie Gleason on its three-inch face, each tube stores 1,024 bits of data in the pattern of dots and dashes.

When the giant computer is told to "remember" something while doing a problem, electric impulses throw the data on the inside face of the tut.;, which is coated with a phosphorescent paste. When the information is needed, it is recalled by a scanning electronic beam. It is converted into an impulse and fed back into the calculations.

This writing and reading of information is done within a few millionths of a second. (The 701 also uses not-as-fast magnetic tapes and drums to

supplement the memory work of the cathode ray tubes.)

In 1947, IBM started a major effort to develop the cathode ray tube as a storage element, to devise a way of accurately directing an electronic beam to a particular spot on a tube and a means of operating a group of tubes as a complete storage unit. IBM's project was greatly aided by the published work of an English scientist, F. C. Williams, in 1948.

When IBM decided to use the cathode ray tube for the 701's memory unit, tubes then on the market could not handle the job. So the company engineers did just what they have done other times when pioneering in a new field—they designed their own tube. At the Poughkeepsie plant's Tube Laboratory, white-coated engineers, who transform ordinary glass into experimental electronic tubes, developed a new cathode ray tube.

At first, this IBM-designed tube was produced for the company by an outside concern. Then, to provide another source of supply, IBM folks decided to manufacture the tubes.

IBM had never produced tubes in quantity. Company engineers outlined a plan for an assembly-line process which, roughly, went like this:

(1) Phosphorescent paste would be coated on the inside face of a glass tube.

(2) The tube's internal parts—known as a "gun"—would be assembled.

(3) The "gun" would be vacuum-sealed into the tube.

(4) The tube base would be attached.

In addition to working out this manufacturing plan, the company had to train people to produce the tubes, and engineers had to design machines for the employees to use.

A small staff was selected from the plant and sent to the Tube Laboratory. These IBM'ers were enthusiastic about their new work. They became apt pupils of Tube Lab folks who taught them glass-working skills.

Meanwhile, a small but fully-equipped Tube Manufacturing Department was built at the plant.

The engineers realized that part of the department would have to be kept as spotless as a hospital. Even the tiniest piece of dirt on the face of a tube could cause a blemish impairing the storage of electrical charges. So, no dirt, not even the smallest particle of dust, could be allowed into the coating and assembling sections.

These rooms had to be sealed tight—even the window sashes were calked. An air-conditioning unit was installed which pumped air into the rooms only after it had passed through two special filters.

However, these laboratory-type precautions would mean little if the people who were to work there carried in dust on their clothes or hands.

As the engineers related it, "One way to be sure people would not bring in any dirt was to give them a hot shower—and scrub their clothes—every time they entered the area."

Of course, this wasn't practical.

So the engineers arranged for the coating and assembly folks to wear white orlon (lint-catching) coats over their clothes. Rubber gloves and rubber finger guards were provided for handling the tubes. A gelatin "welcome" mat was spread outside the department. When anyone stepped on it, all dirt from the soles of his shoes was absorbed.

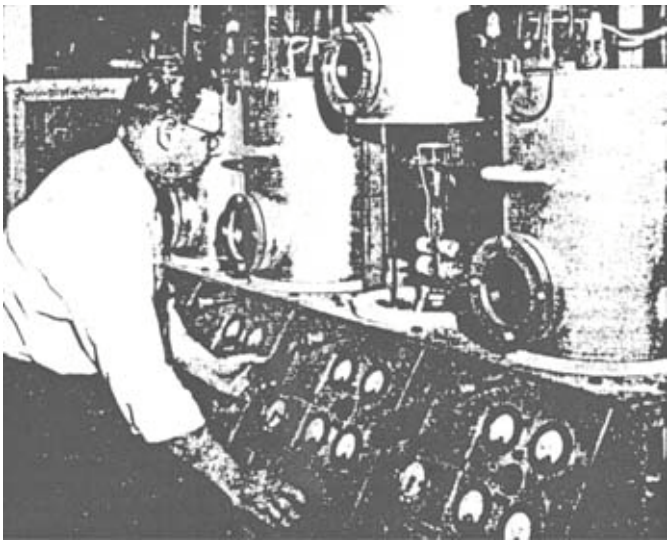
After almost a year's training in the Tube Lab, the employees moved into their newly created department at the plant. Even after production of the tubes started, improvements in the 701's design necessitated changes in the manufacture of the cathode ray tube. However, as a result of engineers' careful planning and employees' fine workmanship, 88 per cent of the tubes manufactured have met the specifications of final inspection.

The Tube Manufacturing Department proved it could produce a better quality product than any outside company—and at less cost. Now, IBM manufactures all the cathode ray tubes for 701's. (Also, setting up the new department provided the company with invaluable information for future development of memory tubes.)

Today, 701 calculators — working at a lightning pace—are helping to solve knotty problems such as the design of an aircraft wing or the complicated mixture of crude oils in auto gas refining. To a large extent, the 701 owes its speed to a group of IBM scientists, engineers and plant personnel. They teamed up to produce a glass tube memory for an electronic "brain" which can't remember a thing without "writing" it down!

Even a fleck of dust can impair the memory work of the tubes, so they are cleaned and assembled in rooms which are as spotless as a hospital. Shirley McPeck wears orlon lab coat and rubber finger guards while assembling parts.

Like a chemist mixing a potion, Ruth Wermuth pours hydrofluoric acid into an empty tube before the parts are sealed into



Looks as If he might be piloting a space ship, but actually Norman Berry is vacuum-sealing the tubes with this mechanism.

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