POPULAR SCIENCE
REG. U. S. PAT. OFF. Monthly

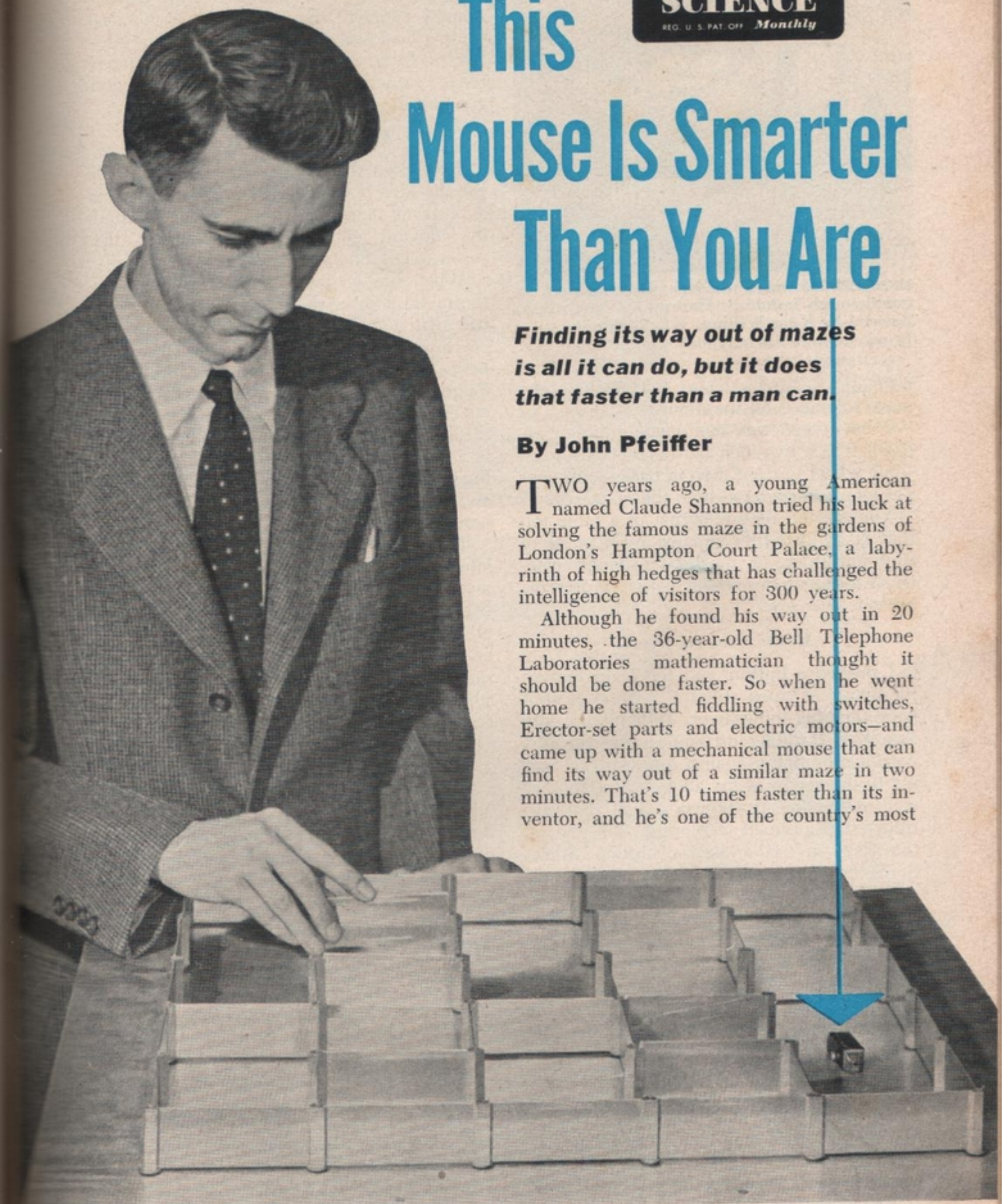
This Mouse Is Smarter Than You Are

Finding its way out of mazes is all it can do, but it does that faster than a man can.

By John Pfeiffer

TWO years ago, a young American named Claude Shannon tried his luck at solving the famous maze in the gardens of London's Hampton Court Palace, a labyrinth of high hedges that has challenged the intelligence of visitors for 300 years.

Although he found his way out in 20 minutes, the 36-year-old Bell Telephone Laboratories mathematician thought it should be done faster. So when he went home he started fiddling with switches, Erector-set parts and electric motors—and came up with a mechanical mouse that can find its way out of a similar maze in two minutes. That's 10 times faster than its inventor, and he's one of the country's most



Dr. Shannon with his maze-solving mechanical mouse. Maze can be arranged a million ways.

HIGH HEDGES make tourists twist and turn to get through London's Hampton Court maze, devised by King William III. Guide on stilts is nearby to rescue anybody who gets panicky.

brilliant mathematicians. Unfortunately, maze-solving is all the mouse can do.

I have seen this man-made mouse perform. It is a two-inch bar-magnet "tricycle" —one wheel in front, two in back—with copper whiskers soldered onto the nose end.

You place it on one corner of a table top that is divided into squares by a maze of tiny partitions. A mushroom-shaped electrical terminal in another corner represents a piece of cheese.

Mouse Uses Its Head

I pushed a button, and the make-believe mouse stood stock still for a while as if it were thinking things over. Then it went into action. It started scurrying around the first corridor, bumping against one wall, retreating to the center of the alley, trying another wall. After finding its way out of that corridor, it continued exploring the rest of the maze in trial-and-error fashion. Sometimes the mouse retraced its steps to "make sure."

When its whiskers brushed against the cheese at last, it stopped dead. Total elapsed time: two minutes, 10 seconds.

But the most remarkable feat was yet to come. When I put the mouse back at the starting point, there was no bumping into walls, no investigating of blind alleys. The mouse immediately headed in the correct direction, negotiated right-angle turns at the proper places and moved smoothly to the goal without a single slip-up. The second trip took just 13 seconds. The mighty mouse had remembered the maze perfectly!

Next I rearranged the maze. The mouse had to learn new pathways the hard way, but remembered the unchanged parts.

Finally, we gave the mouse an "experimental neurosis" by putting it in a completely enclosed square. After about a minute of futile wall-bumping, the frustrated maze explorer "cracked up" and began running around in circles.

Magnet Does the Trick

How does this strange toy work? "You'll get the idea if you've ever put a magnet on a piece of paper and made it dart around by moving another magnet under the paper," Dr. Shannon explained.

When the magnetic mouse is placed on the metal floor of the maze, it trips an electric switch to signal a strong, motor-driven electromagnet, which moves to the spot beneath the mouse and "grasps" it in a firm magnetic grip. Then the electric field changes so that the steel creature turns through a 90-degree angle, and the magnet moves toward one of the maze walls, pulling the mouse along with it. If that's a dead end, the magnet backs away, shifts the mouse another 90 degrees and tries again.

The electromagnet's movements are regulated by 40 airplane-control relays. The mouse's "memory" takes 50 more relays, two for each of the 25 squares. Each group of two relays can be arranged four ways—on-on, on-off, off-on, off-off—and each arrangement stands for one of the four possible ways out of the square. Thus they remember which directions are blocked off.

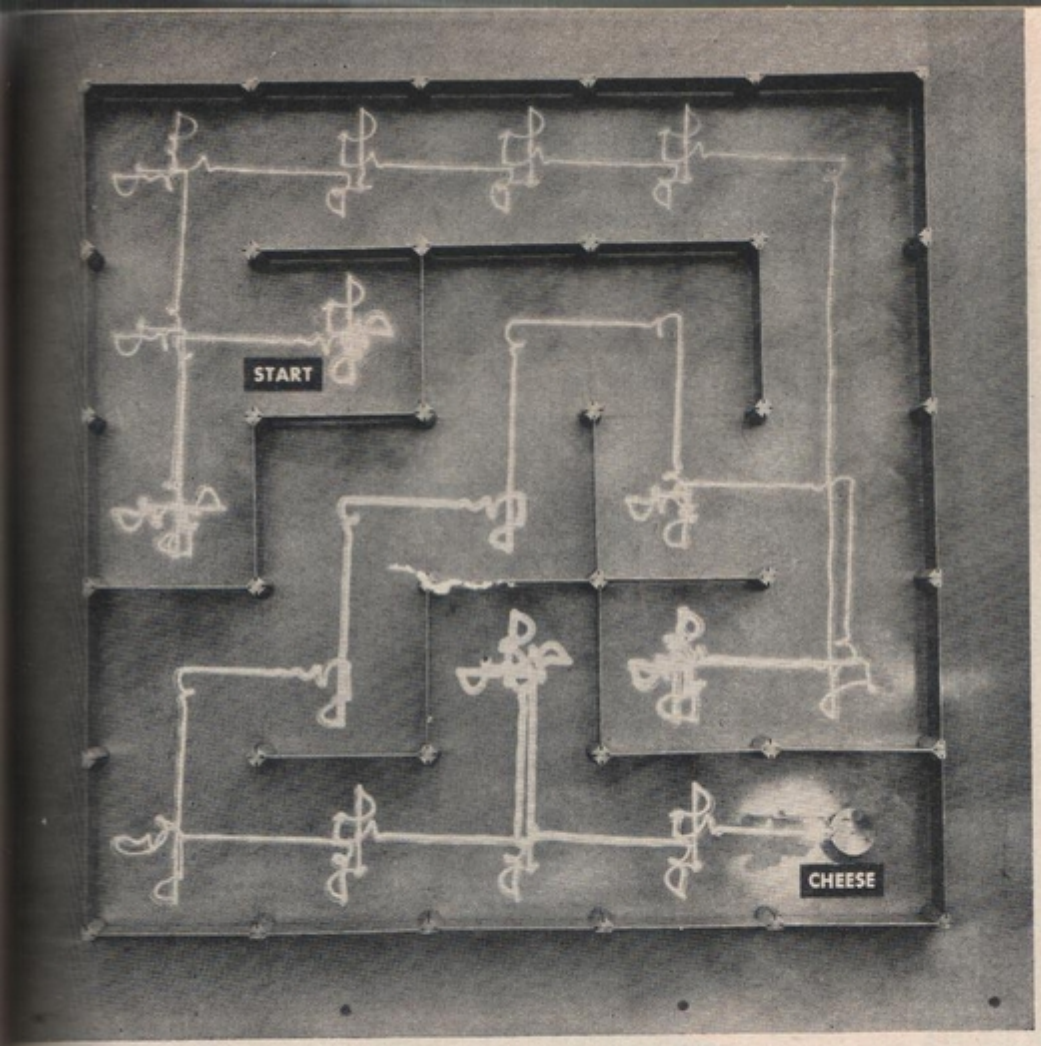
Chess Player Is Next

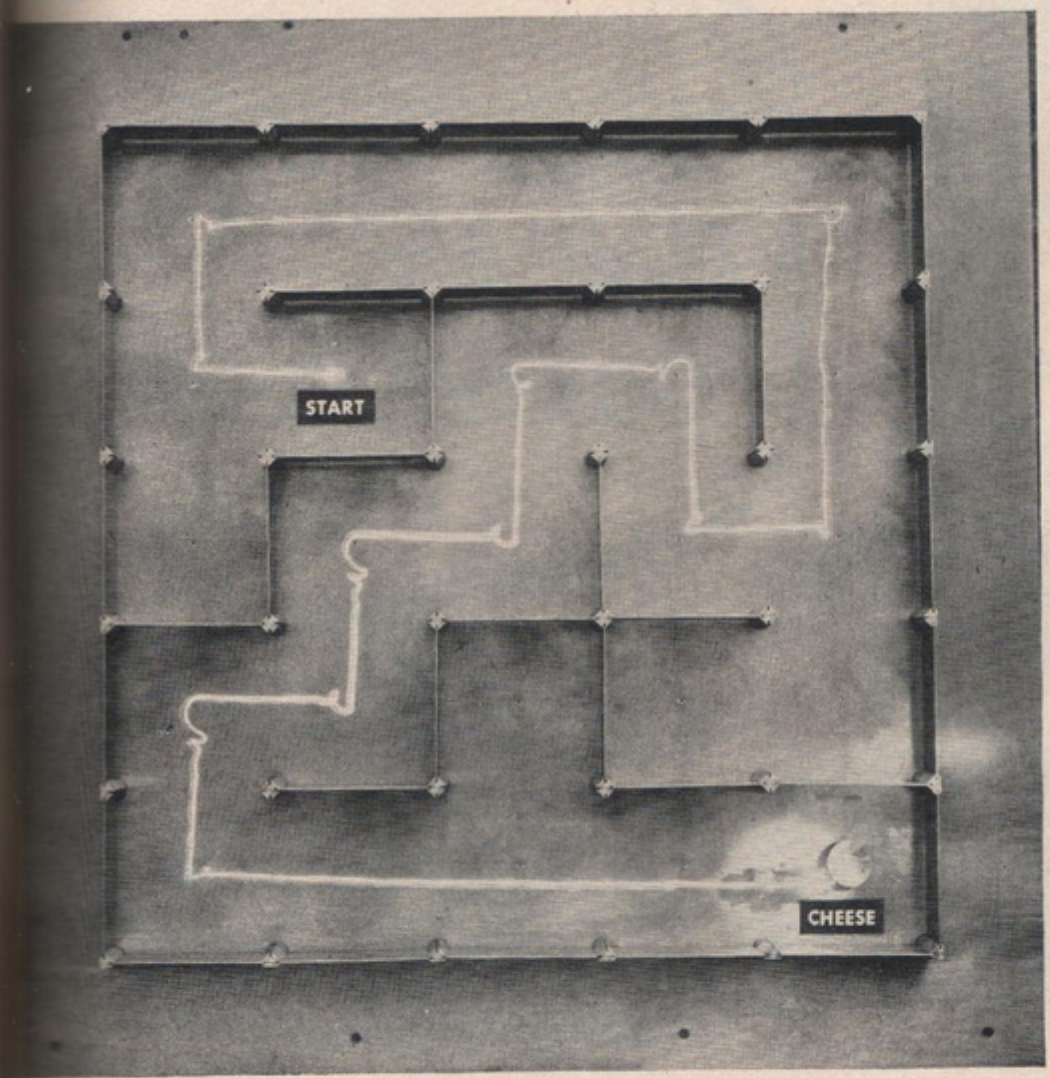
Shannon spent a lot of time building this mouse and a long array of other incredible devices. A robot that may some day play chess stands in his living room now.

If you ask the New Jersey scientist why he keeps building such devices, he'll admit that it's mainly curiosity: "You learn something about machines—maybe, a little about brains. And you never can tell what may turn up."

You never can. Shannon has made important contributions to communication theory, and is working now on a machine that may automatically simplify complex telephone circuits.

Bell Labs officials are also thinking seriously of having Dr. Shannon build another "thinking" mouse. Such mice would make wonderful playthings—but the price is liable to be several thousand dollars.





MOUSE SOLVES MAZE by trial and error on first attempt, as shown by route traced in top photo at left. On second try, mouse "remembers" correct route, avoids blind alleys, and heads straight for "cheese," as shown in bottom photo. First time through maze, mouse starts exploring each square by first trying to head south (toward bottom of photo). If this way is blocked, mouse then turns 90 degrees to the right, tries that side, then turns 90 degrees again until it finds path that is open. Note in top photo that mouse must repeat hunting procedure in each square, even though way may be open straight ahead—unless open direction is south. Then mouse can pass several squares without stopping. As mouse moves through maze, mechanism underneath sets relays that indicate which way it went. On second trip through maze, mechanism simply follows route established by relays, and mouse goes right to cheese.

TO MAKE PHOTOS shown here, the photographer taped a tiny bulb and battery to the mouse. Light then traced path during a time exposure.