When DNA is the new hard drive

Stuff of sci-fi:A representation of a human hand, encoded into and then recalled from the DNA of a living cell.NYT

It was one of the very first motion pictures ever made: a galloping mare filmed in 1878 by British photographer Eadweard Muybridge, who was trying to learn whether horses in motion ever become truly airborne.

More than a century later, that clip has rejoined the cutting edge. It is now the first movie ever to be encoded in the DNA of a living cell, where it can be retrieved at will and multiplied indefinitely as the host divides and grows.

The advance, reported on Wednesday in the journal *Nature* by researchers at Harvard Medical School, is the latest and perhaps most astonishing example of the genome's potential as a vast storage device.

Scientists already have managed to translate all of Shakespeare's sonnets into DNA. George Church, a geneticist at Harvard and one of the authors of the new study, recently encoded his own book, *Regenesis* , into bacterial DNA and made 90 billion copies of it.

"A record for publication," he said in an interview.

Even stranger

With the new research, he and other scientists have begun to wonder if it may be possible one day to do something even stranger: to program bacteria to snuggle up to cells in the human body and to record what they are doing, in essence making a "movie" of each cell's life.

When something goes wrong, when a person gets ill, doctors might extract the bacteria and play back the record. It would be, said Mr. Church, analogous to the black boxes carried by airplanes whose data is used in the event of a crash.

At the moment, all that is "the other side of science fiction," said Ewan Birney, director of the European Bioinformatics Institute and a member of the group that put Shakespeare's sonnets in DNA. "Storing information in DNA is this side of science fiction."

Mr. Church and Seth Shipman, a geneticist, and their colleagues began by assigning each pixel in the black-and-white film a DNA code based on its shade of gray. The vast chains of DNA in each cell are made of just four molecules — adenine, guanine, thymine and cytosine — arranged in enormously varied configurations.

Gene editing technique

The geneticists ended up with a sequence of DNA molecules that represented the entirety of the film. Then they used a powerful new gene editing technique, Crispr, to slip this sequence into the genome of a common gut bacteria, E. coli.

Despite the modification, the bacteria thrived and multiplied. The film stored in the genome was preserved intact with each new generation of progeny, the team found.

Andrew Odlyzko, a mathematics professor and expert on digital technology at the University of

Minnesota who was not involved in the new research, called it “fascinating.”

Molecular biology

Imagine, he said, “the impossibility of controlling secrets, when those secrets are encoded in the genomes of the bacteria in our guts or on our skins.”

The renowned physicist Richard Feynman proposed half a century ago that DNA could be used for storage in this way. That was long before the molecular biology revolution, and decades before anyone could sequence DNA — much less edit it.

“Biology is not simply writing information; it is doing something about it,” Mr. Feynman said in a 1959 lecture.

“Consider the possibility that we too can make a thing very small which does what we want!”NYT

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