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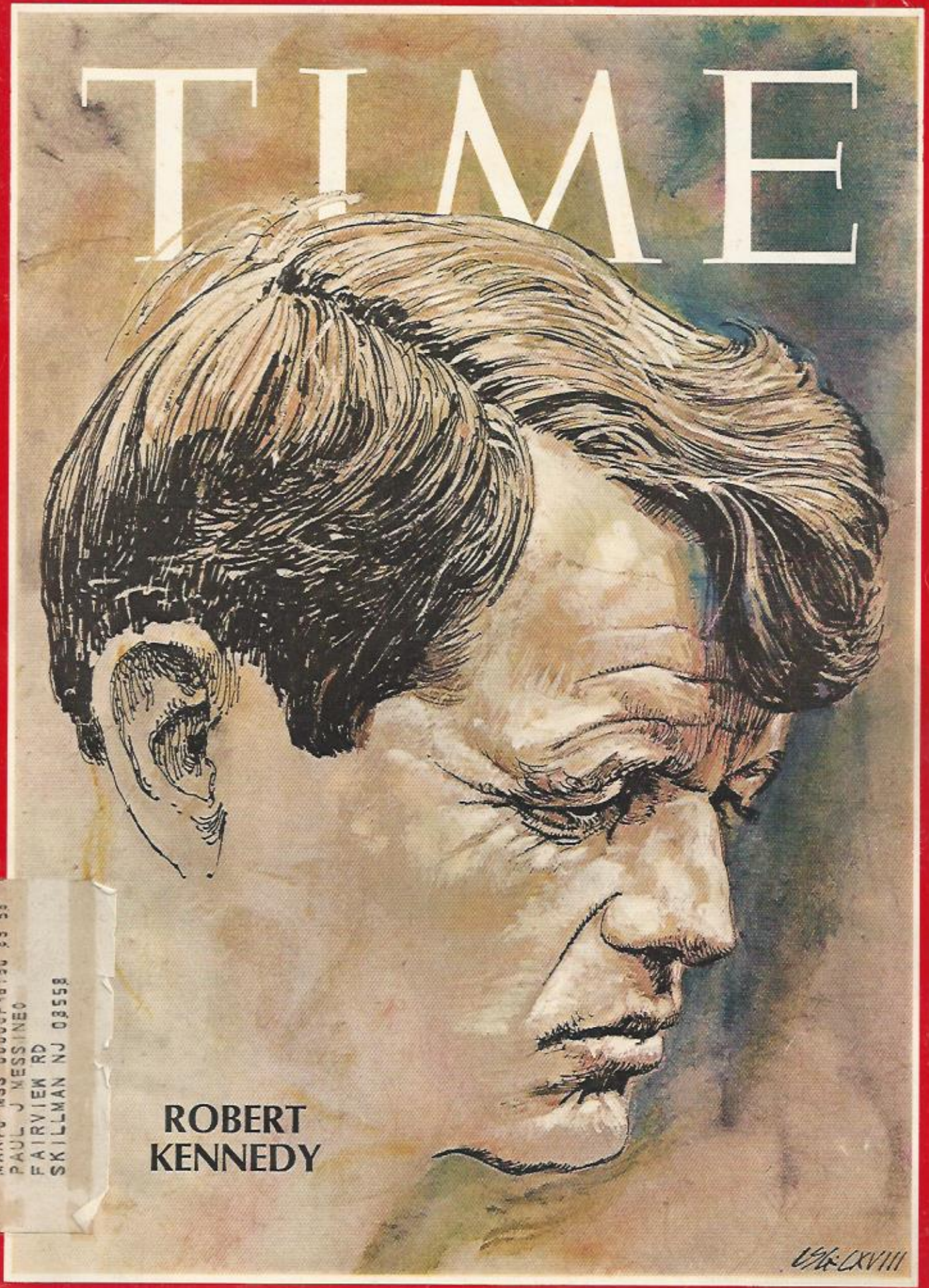
JUNE 14, 1968

TIME



ROBERT KENNEDY

SCIENCE

RELATIVITY

Clock in Outer Space

In the gloomy days of January, time seems to drag. According to the Einstein theory of relativity, it actually does —in a minute amount that means little to anyone except a scientist. During its annual elliptical trip through space, the earth reaches its maximum speed each January, when it makes its closest approach to the sun. According to Einstein, the earth's increased velocity, along with its passage through a more intense part of the sun's gravitational field, causes terrestrial time to slow down in relation to time outside the solar system.

A practical proof of January slow time has never been possible. How can the slowing of time be measured if all the available timing devices on earth are similarly affected by relativity? Last summer, when the regularly beeping signals of pulsars were first detected coming from outer space, Queens College Physicist Banesh Hoffmann figured that they might supply an answer. Though their source was unknown, the precisely spaced radio pulses coming from light-years away seemed to be the distant clock needed to measure earth time. In a letter to *Nature*, Hoffmann suggested that the pulse rate of pulsars be taken regularly from January through June, when the earth is farthest from the sun and slows to its minimum speed. Each time the pulse rate could be compared with an accurate timing device on earth.

Match with Cesium. If earth time does indeed slow down relative to the pulsar clock in January, and speed up correspondingly in June, the pulsar signals (which have blipped at a constant frequency since they were discovered) would appear to increase their repetition rates as earth clocks slowed down and decrease them as earth time speeded up. Hoffmann's plan was immediately snapped up by Dror Sadeh, a Tel Aviv University physicist currently attached to the U.S. Naval Research Laboratory at Washington, D.C.

Using the Navy's 150-ft. radio telescope at Sugar Grove, W. Va., Dr. Sadeh will attempt this month to establish the pulse rate of one or more of the pulsars to an accuracy of one part in 10 billion—the equivalent of a clock that would gain or lose only 1/300th of a second per year. Then, twice a month for the next half a year, he will match the rate of incoming pulses against a cesium clock, an atomic timer that is accurate to one part in 10 trillion.

Sadeh feels sure that by January he should be able to detect an apparent speedup in the pulsar clock when compared with its rate this month—a clear indication that earth time has slowed by the same amount. If Einstein was right, that observed slowdown will total about 1/100th of a second per year. "If our measurements are accurate and we don't get this result," says Hoffmann, "then we scientists—and the Einstein theory—are in trouble."

DICK SWANSON

EXPERIMENTAL PLANTING OF IR8 IN THE PHILIPPINES

Bugs in the miracle.

AGRONOMY

Rice of the Gods

To chronically starving Asia, reports of the new rice sounded like an invitation to a feast. It was tough and fast-growing, able to root almost anywhere and twice as bountiful as ordinary strains. Crossbred from a common tropical rice called *peta* (meaning seed) and an ancient Chinese variety known as *dee-geo-woo-gen* (brown-tipped, sharp-legged thing), IR8, as scientists tagged the hybrid, was promptly—and prematurely—labeled a miracle.

Then, as results came in from experimental plantings two years ago, the miracle proved highly vulnerable to such mundane enemies as bacteria, blight and insects. It required expensive nitrogen fertilization and often broke during milling. Many Asians, who prefer their rice sticky and manageable in the bowl, found IR8 too starchy and dry. Indonesians, in particular, complained because the stubby IR8 stalks had to be cut with a larger blade than could be concealed in the hand. That, they felt, offended their rice goddess.

Back to the potting shed went IR8's developers at the U.S.-sponsored International Rice Research Institute in the Philippines. By slow, painstaking cross-breeding with other varieties of rice, they gradually enhanced IR8's strong qualities and got rid of its weaknesses. As a result, IR8 is now beginning to live up to its potential. A few months ago, it was joined by IR5-47-2, a related variety that requires less fertilizer and is less susceptible to disease. Delighted with their new hybrids, the researchers are convinced that some biological kin of IR8 will eventually become Asia's basic rice source.

Widely planted under President Ferdinand Marcos' "Rice, Roads and Schoolhouses" program, improved IR8 has already helped make the Philippines a rice exporter for the first time in this century. In the paddies of India, Pakistan and Malaysia, farmers are sowing thousands of acres of IR8. Even the Indonesians have been persuaded to shuck their fears of divine indignation; last week they received 600 tons of harvested IR8 from the Philippines in the first international deal involving the new rice. The Filipinos have also been sending hundreds of tons of IR8 and IR5 seed to South Viet Nam. Much of it has gone into 10,000 "miracle rice" kits recently handed out by U.S. agricultural advisers. Yielding four or five tons per hectare (2.5 acres), or twice the national average, the rice has already shown such promise that South Vietnamese peasants have taken to calling it *than nong*, or "rice of the agricultural god."

CHEMISTRY

Crystal Versatility

A big picture window that turns opaque at the flick of a switch, giving those inside instant shade and absolute privacy. A wall clock, no thicker than a pane of safety glass, that flashes the hour without any tick or hum. A small screen that records the face of a telephone caller even when no one is home to pick up the receiver. Such items may seem like excerpts from a catalogue of 21st century technology, but RCA scientists say that they are already within reach. And they are only a small sampling of the practical new uses that are promised by the chemical phenomenon known as liquid crystals.

These organic compounds made of carbon, nitrogen, hydrogen and oxygen resemble ordinary liquids. Yet their orderly molecular structure is similar to that of solid crystals such as diamonds, mica and quartz. The crystals themselves are not new, but it was only recently that scientists discovered that an electrical charge makes them light-reflecting; the higher the voltage, the

greater the reflecting power. At first, this "electro-optical effect" could be shown only in the laboratory, since the crystals reacted to electricity only at certain temperatures. Now, after trying more than 100 compounds, RCA scientists have produced a crystal that responds to even small amounts of electricity throughout a temperature range from 20° F. to more than 200° F.

Animated Display. To demonstrate their compound's wide capability, RCA researchers sandwiched a thin film of the liquid crystals between two sheets of glass. The inner surface of each sheet was coated with a transparent electrical conducting material. When a small negative charge was applied to one sheet and a positive charge to the other, so much turbulence was caused inside the

RESEARCHER WITH LIQUID CRYSTALS
Potential in the turbulence.

liquid crystals' molecular structure that the film turned instantly opaque. Next, in a more complicated display, the conducting surfaces were divided into a mosaic of squares, each separately linked to the external power source; this enabled the scientists to send the electrical current into selected areas of the liquid-crystal film. By directing the electrical charges into the proper combination of squares at just the right moment, the RCA men were able to form a rapid succession of numbers—in much the manner of an animated outdoor advertising sign.

Such uses of liquid crystals' electro-optical potential could be applied soon to a whole new generation of sports scoreboards, traffic-control signs, stock-market tickers, and instrument panels in cars and aircraft. Besides drawing very little power, the devices would work perfectly well in ordinary daylight, since liquid crystals reflect external light rather than produce their own. In the more distant future is a liquid-crystal TV screen. The entire television set, say the RCA researchers, not only would be as thin as a book, but could be watched even in the glaring light of a sun-drenched beach.