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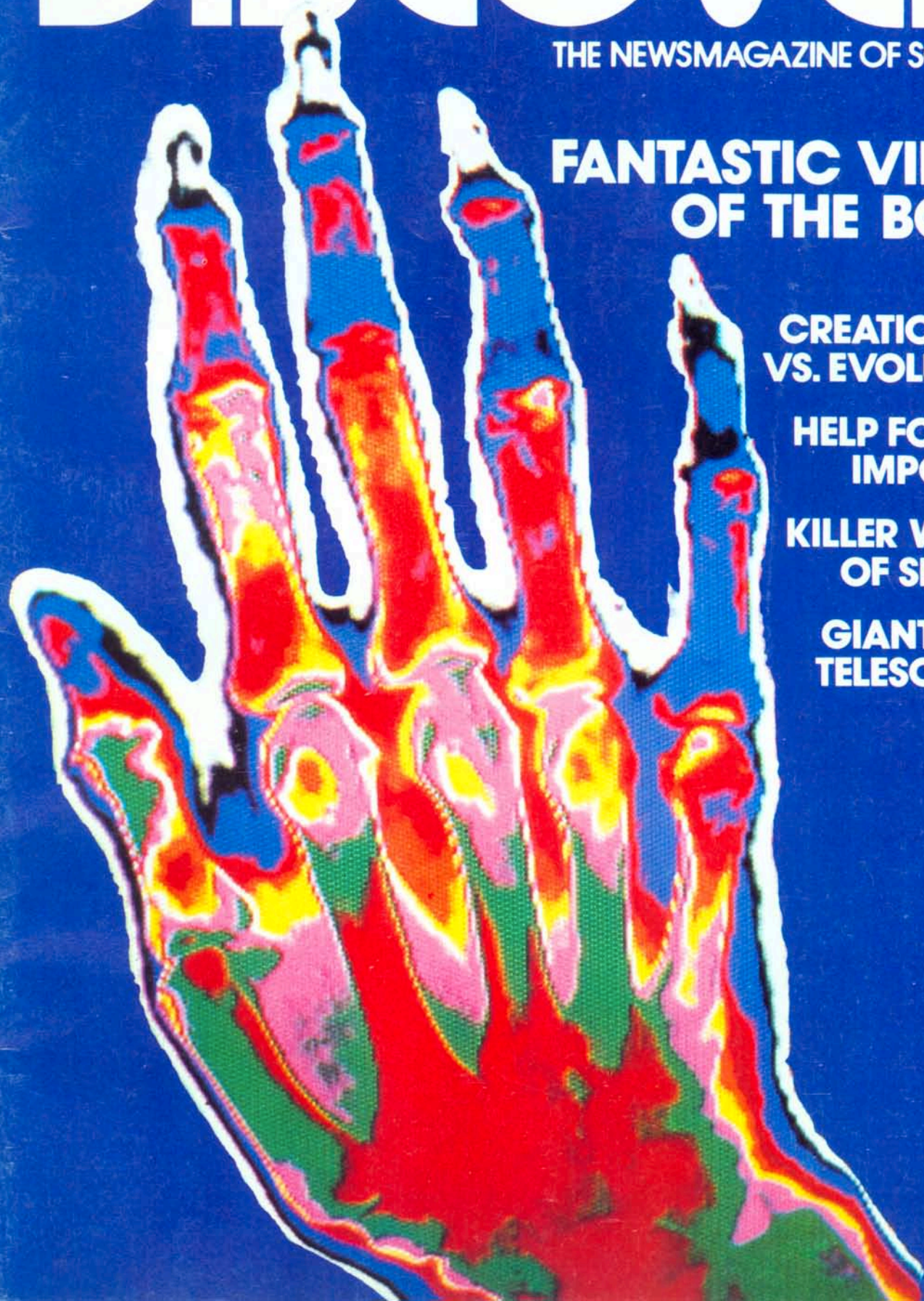
FANTASTIC VIEWS OF THE BODY

CREATIONISTS
VS. EVOLUTION

HELP FOR THE
IMPOTENT

KILLER WINDS
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GIANT NEW
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PERSONALITY



THE MAN WHO BELIEVES IN FOREVER

At 65, astronomer Fred Hoyle has retired to the mountains of northern England, but it is too soon to say that he is over the hill

by DENNIS OVERBYE

The clouds suddenly parted and Sir Fred Hoyle, 65, his glasses fogged with mist and sweat, his face red from slogging up a 2,000-foot mountain, found himself on the brink of a dizzying cliff. Far below, a silver thread of river wound its way through the green hills toward England's wild Lake District, where Hoyle has lived for the past nine years almost in exile from the world's scientific community. He peered over the windswept edge and grinned. "Shall we go down this way?"

For Hoyle, one of the century's most creative and controversial astronomers, such directness has been both a virtue and a vice. As an outspoken author of the "steady state" theory of an infinite, eternal universe, he once held center stage in the dramatic debate on the origin of the cosmos. Hoyle probed the chemistry of outer space, showed how stars transmute the elements—and made most of his money writing science fiction. He founded a major research institute at Cambridge University in 1967, only to abandon it five years later in a rage. Today he roams the green hills of the English northland happily munching sausage rolls, with only the sheep and the wind for companions, while his mind ponders the origin of life. Not long ago, he caused a stir by proposing that life originated in space and migrated to earth aboard comets.

To his friends and admirers, Hoyle is a renaissance man, a cosmic underdog yet to be vindicated. To others, he is a rude eccentric, a brilliant mind tragically isolated from the mainstream of science; his best work, they hint, sniff-

Fred Hoyle on a mountaintop near his home in England's Lake District



A sampling of Hoyle's books

ing at his new theories, is behind him. Hoyle is unruffled and unapologetic. Says he, "I never waste time seeking the solution to a problem along conventional lines, because if the solution were to be found in that way, somebody would have done it already."

Hoyle has always been proud of his independence—a trait prized in Yorkshire, in the industrial north of England, where he grew up as the eldest child of a struggling textile merchant. He remembers his father and his father's friends trying to decipher a book about optics. "These people who were denied an education were very keen to try to acquire it. It wasn't a bad environment to grow up in." When Hoyle was ten, his father gave him a small telescope, and he began to stay up all night watching the stars.

Hoyle won two scholarships to Cambridge University, where his more priv-

ileged classmates made fun of his provincial working-class accent. "When I got there," he recalls, "I had about a twenty-pound margin between what I had to pay in fees and my scholarships. I felt infinitely rich." After graduation, Hoyle stayed on to study nuclear physics under the famed theorist Paul Dirac, then drifted into astronomy. He and Raymond Lyttleton investigated the birth and evolution of stars, and upset old ideas by contending that the dark dust clouds in space were also vast seas of molecular hydrogen—from which stars condense. "It was thought that the stars were like billiards, the balls were on the table and that's all there was," says Lyttleton. "Fred and I said there had to be something in between."

In 1937 one of Hoyle's undergraduate roommates, then teaching up north, brought one of his students, a 16-year-old girl named Barbara Clark, down for a visit. Two years later she and Fred were married. They set up housekeeping in Cambridge, but had to move when the war broke out and Hoyle went to work for the British Admiralty, directing a team of radar scientists.

After the war, Hoyle, along with two of those team members, Hermann Bondi and Thomas Gold, found himself back in Cambridge, where he began to worry about the cosmos. In the 1920s, astronomers had discovered that the universe seemed to be flying apart. The galaxies were receding from each other as if they had all been shot outward in a giant explosion, since nicknamed the Big Bang. According to Einstein's theory of general relativity, the bang was also a birth, in which matter, energy, space, time, and the laws of physics themselves had sprung into being,

like a party girl popping out of a cake. Hoyle found this version of genesis unappealing: "It seemed absurd to have all the matter created as if by magic."

A way out of this cosmic dilemma suggested itself one evening in 1946, when the three friends saw a movie called *Dead of Night*. It consisted of four stories woven together in circular fashion so that the end came back to the beginning. "What if the universe were constructed like that?" asked Gold. Hoyle and Bondi scoffed at first, but could not prove the notion wrong. "One thinks of unchanging situations as being static," explains Hoyle. "What the ghost story did sharply for us was to remove this wrong notion. One can have unchanging situations that are dynamic—for instance, a smoothly flowing river." The result was the steady-state theory. Hoyle did not deny that the galaxies were flying apart, but in his theory, new matter is being continuously created to fill the void that would otherwise be left behind. Thus the universe always remains about the same.

When the theory was announced, in 1948, the young astronomers found themselves at the center of a hot debate. "Astronomers were pretty hostile to the theory," says Hoyle.

Did the universe have an explosive beginning, or has it existed forever? Nowhere was the debate more intense than in Cambridge, where it was even the subject of church sermons. The principal debaters were Hoyle and a young Cambridge radio astronomer named Martin Ryle. Ryle thought he could disprove the steady-state idea by

showing that the universe had evolved and changed with time. Radio astronomers had found that many galaxies were emitting powerful radio waves. Ryle argued that there were more cosmic radio sources at great distance than near by. Because the signals from distant galaxies had left their sources billions of years ago, this meant that more radio galaxies existed when the universe was younger than now. Thus, he said, the universe was evolving.

More than science was colliding. Ryle, tall, tweedy, and reserved, an Oxford professor's son, is the quintessential Cambridge academic. He is brilliant but intense, a high-strung scientist who has been known to cry when a theory of his was disputed. Hoyle, ruffled and verbally flamboyant, with his working-class accent, did not fit the Cambridge mold. He relished the give-and-take. "The south of England is soft," he used to say. Hoyle's group challenged Ryle's results in debates that ended in shouting matches. When Hoyle once suggested doing a particular radio observation, Ryle invited Hoyle to go lay cable in the grass and build his own radio telescope.

As Hoyle and Ryle rose in the scientific establishment, the debate blossomed into a feud. Hoyle still complains of Ryle's habit of springing new objections to the steady-state theory on him while he was in the middle of a lecture. Also, Hoyle resented the radio astronomer's secrecy. "Ryle would never tell you anything. Although I was a fellow professor, I did not know about

their discovery of pulsars* until two days before it appeared in *Nature*."

In 1974 Ryle and his colleague Antony Hewish won the Nobel Prize, and a year later the feud flared publicly. Speaking, unknowingly, to a reporter, Hoyle criticized the omission from the award of Hewish's former graduate student Jocelyn Bell Burnell, who had first discovered the pulsars' regular beeps. Ryle and Hewish nearly sued Hoyle before they were persuaded that he had not intended a public personal attack.

Ryle and company found Hoyle abrasive and impetuous. Says Ryle, "I think it is fair to say that Hoyle is rather an awkward and difficult person to deal with." Even Hoyle's opponents admire his originality and the elegance of the steady-state theory. Sighs Hewish, "It is a pity the universe is not like that."

"I won that controversy with Ryle," Hoyle maintains today. "His position was disgraceful because his experiments and measurements were wrong." But, most astronomers would say, if Hoyle won the battle, he lost the cosmic war. In 1965 astronomers found a faint radio noise filling the sky and recognized it as the tired echo of the Big Bang itself. The cosmic background radiation hissing through radio antennas around the world sounded the death knell for the steady-state theory.

But Hoyle's defense of his theory had produced something even more important than the theory itself—an explanation of the origin of the chemical ele-

*Objects, now believed to be neutron stars, that emit precisely spaced radio beeps

Hoyle through the ages

Little Fred with his parents, Ben and Mabel Hoyle



Fred at two or three



With his baby sister, Joan

ments in the universe. Both the Big Bang and the steady-state theories faced the problem of explaining how matter—presumably created in the form of hydrogen, the simplest atom—could evolve into the complex variety of chemical elements that make up the universe today. George Gamow and Ralph Alpher had suggested that a frenzy of nucleosynthesis during the Big Bang had created the elements, but Hoyle and others showed that the reactions could not have produced anything more complex than helium.

Hoyle decided that the answer must lie in the stars, in the same thermonuclear processes that burn hydrogen into helium and generate the energy that makes stars shine. In his view, a star was a recycling plant for atoms, condensing raw hydrogen and helium out of space, cooking them, and then spewing heavy elements back into space in supernova explosions. By the late 1940s he was ready to work out the details. Hoyle joined forces with Caltech nuclear physicist Willy Fowler. The catch turned out to be the 10 per cent of the atoms in the universe that are helium. Hoyle calculated that forming helium in stars would have released ten times as much energy as all the galaxies have radiated since their birth. Thus he reluctantly concluded, in 1964, that most of the helium must have been formed in the putative Big Bang. He thereby exploded his own cherished steady-state universe.

Hoyle's imagination spilled beyond science. Starting with *The Black Cloud*, in 1957, he wrote dozens of science fic-

tion novels—most recently with his son, Geoffrey. He also dabbled in drama, with a successful children's play, *Rockets in Ursa Major*, and the libretto for the opera *The Alchemy of Love*. In his classic first novel, life on earth is threatened by an intelligent interstellar cloud that comes to feed on the energies of the sun. Scientists persuade the cloud to move on, but not before it has done a lot of damage. At the book's climax, the Hoyle-like protagonist dons a headset to communicate with the cloud and absorb its cosmic knowledge, but the experience fries his brain. To the psychiatrist Carl Jung, that passage symbolized the rational mind's fear of a devastating collision with the subconscious.

Hoyle's own collisions with Britain's science bureaucracy and his Cambridge rivals were becoming more frequent. Incidents ranging from being dropped from an exclusive dinner club within the Royal Astronomical Society to difficulties in finding money for his research left him raging. Says radio astronomer Sir Bernard Lovell, "Hoyle is extremely sensitive; a lot of his difficulties are because people haven't realized that." In 1961, a proposal by Hoyle to establish an Institute for Theoretical Astronomy at Cambridge was killed by back-room politics; reduced from the original proposal, the institute finally opened its doors in 1967 after rumors that Hoyle might go to the United States.

Says his old friend Sir Hermann Bondi, "Fred's trouble is he has never been interested in management or politics.

He feels that once he has pointed out to people that two plus two is four, they should all jump to attention. Given what an intrigue-ridden place Cambridge is, I am only surprised how long he managed to tolerate working there."

To Hoyle, a self-described "blue conservative," there was a political element in all this. "The Cambridge clique were all fanatical extreme leftists or Marxists, and they couldn't stand having a conservative professor in their midst," he told DISCOVER reporter Robert Temple. He remembers a meeting with philosopher Bertrand Russell. "I got the feeling that Russell thought, 'This chap is just a damned outsider.'"

Hoyle's research was also making him an outsider, as it veered in a speculative direction off the beaten astronomical track. "I got fed up with solving problems in a straightforward way. I began to say, 'Well, there must be aspects of physics that we don't know right now that affect the things we're looking at.'" Gradually he has tried to resuscitate the steady-state theory.

The foundation for this new steady state is a theory of gravity that Hoyle and his graduate student Jayant Narlikar began developing in the 1960s. It is based on a philosophical principle enunciated by the Austrian Ernst Mach, who speculated that particles somehow derive properties like momentum or mass from the universe around them, the way a leaf has color only when there is light to illuminate it. Einstein had tried to incorporate Mach's principle into the general theory of relativity but failed.



The astronomer as a young boy

Hoyle with his children, Elizabeth and Geoffrey, in 1950



Hoyle in his Cambridge office, 1966

According to Hoyle and Narlikar, newborn particles pop into being with no mass at all, and then get heavier as they learn about the universe around them. "Suppose," explains Hoyle, "that by some magic half the distant parts of the universe were taken away. The earth would move much closer to the sun than it is at present. The sun would grow a hundred times as bright, and you would find yourself twice as heavy."

Where does the new matter come from? Hoyle thinks it comes out of quasars. According to conventional cosmologists, quasars are the most distant and energetic objects in the universe, perhaps the cores of young galaxies powered by matter falling toward oblivion in massive black holes. But Hoyle and a small minority of other astronomers believe there is evidence that some quasars are closer and are shot out of nearby galaxies. He thinks that quasars are white holes—fountains of energy and matter that are the opposites of black holes—from which the new stuff of creation explodes. As it cools, the new matter condenses into stars and a galaxy around the hole. The Big Bang itself, says Hoyle, was a white hole. It may have been just one of many bangs spread out in an infinite and approximately steady universe.

For Hoyle and Cambridge, the last local bang came in 1972, ironically, the year he was knighted. Hoyle's theoretical institute was being merged with Cambridge's observational facilities to form a new Institute of Astronomy

(Ryle's radio astronomers would remain separate). On a flight to Australia, Hoyle learned that he was being passed over for director of the new institute in favor of a Ryle protégé, who had been elected professor by, Hoyle thought, a packed committee.

He never really liked Cambridge, anyway," says Fowler. The Hoyles briefly considered moving to the Scottish Highlands, where Hoyle had long enjoyed mountain climbing. But they wanted to be close to their children and grandchildren. So they settled in the Lake District in Cumbria in the north of England, where they built a large isolated house on a windswept hill. The house is stacked with firewood and bottles of natural gas, and stocked with food for the long periods when winter storms cut them off. They rarely leave, but Geoffrey and Elizabeth and the grandchildren come to visit. Hoyle carries on his scientific work in a giant picture-windowed study. "I feel infinitely sharper," he says. "I wish I had left Cambridge when I was forty. I would have achieved so much more." He maintains an association with University College, Cardiff, in Wales, where his former student Chandra Wickramasinghe and he are taking a new radical look at interstellar clouds.

They think that organic molecules—like water, alcohol, and ammonia—floating in space could easily combine on dust grains to make amino acids, the building blocks of life, and then life it-

self in the form of bacteria. At first dormant, the bacteria are encapsulated and incubated in warm watery comets that carry them to earth in a rain of new genetic material and perhaps diseases. "Life," says Hoyle, "can spread itself through the universe. I suspect that the cosmic quality of microbiology will seem as obvious to future generations as the sun being the center of our solar system is to our own."

It is not yet obvious. "I don't think anybody in British astronomy takes the work seriously," says Cambridge professor Martin Rees. Others describe the theory as "bizarre."

Hoyle is unperturbed. "I am completely insensitive to public pressure." But the response has made life difficult. Last winter an application for \$7,500 to buy a computer to help him do calculations was rejected by Britain's Science Research Council, on which Hoyle used to sit. Later, at an astronomers' dinner, some of his colleagues began to boast about the \$75 million a year that British astronomers spend. Driving home on a rain-slicked, leaf-covered road, Hoyle crashed into a tree. The next morning, he explained: "It was the rage."

Hoyle's experiences have made him sympathetic to the plight of scientific dissenters. "Heavy government funding of science is the mainspring of the degeneration of science into conformity," he says. "The system has a natural evolution towards killing minds."

"In many ways, Fred has always been on the fringe of science," says Cardiff astronomer Mike Disney. Even Hoyle concedes that few astronomers have paid any attention to his new steady-state theory. Fewer, however, deny the importance of his influence. Says Dennis Sciama, Oxford cosmologist and onetime steady-state champion, "It is healthy that a small number of scientists provide plenty of provocative ideas. That has certainly been Fred Hoyle's role over his career."

Scattered through the astronomy community, like dormant bacteria in space, are a small core of astronomers, like Gold or Caltech's Halton Arp, who believe that the cosmic debate is not over, that the Big Bang theory may seem naive some day. That day is not yet, but, says Lovell, "I don't really think there have ever been any victories against Hoyle."

The Chinese have a saying, which in their wisdom they interpret as a curse: "May you live in interesting times." No one has made the times more interesting for astronomers than Fred Hoyle. □

Sir Fred ponders a chess problem in his Lake District study

