BEYOND THE VISIBLE

The Story of Fred Gillett, a Private Man Who Lived His Life in the Heat of the Night

Ed Kennedy

One bright October morning two years ago, two men were talking as they made their way up Sabino Canyon.

Sabino Canyon is a popular recreation area outside of Tucson, Arizona. It's a good place to get lost in the mountain quiet of the foothills and think things out. Or talk things out. And since the desert clouds had chosen to be generous to the Santa Catalina Mountains that Fall, the burbling of Sabino Creek added a meditative footnote to their conversation.

This was more than just an ordinary conversation. It was also a conversation held in metaphor. For what was actually being discussed that morning could not yet be faced. And so the leaves were spoken aloud. The sunlight was spoken. No doubt the stars were spoken aloud, too. For both men were astronomers. And though neither could yet admit it they'd come up here to say the long goodbye.

Fred and Wayne Stein (background) doing a field experiment as part of their work at the University of Minnesota in the early 1960's.

One of the men was Frank Low. Low had worked all his life at the University of Arizona. The other, a man named Fred Gillett, was more of a peripatetic in academia. But he, too, had spent a lifetime in astronomy.

Low and Gillett were famous – at least among the observatories that sprinkled the mountaintops of northern Arizona and southern California. Out of their work had come some of the seminal developments of infrared astronomy. They were, in fact, two of the founders of the field. Low had produced the first-ever cryogenic bolometer, an infrared eye that led the way to modern infrared astronomy.

Gillett had been a leader in developing infrared spectrometers and a leavener of infrared observatories. Sharing a small University of Arizona telescope that Low had helped build himself, and located on a peak not far from where they were now walking, Low and Gillett had managed to take one of the world's first-ever peeks at the incredibly rich panoply of the infrared sky. Before men like Low and Gillett, the infrared sky was an unknown. What they had first seen as young men back in those heady days of the early 1960's through their rudimentary instruments – a sky glowingly alive with the radiated heat of the universe – had dominated the rest of their professional lives.

But it was not astronomy these two men talked of that warm October day. It was life. And it was about the ending of life, and miracles. As the two old friends walked up the canyon amidst the first signs of the coming winter, they talked of how it is that everything a man has made of his life, his family, what he has

given, all the triumphs and trials of one of the most productive careers in science, how everything of meaning can suddenly be cut short. In their rather guarded, careful, metaphorical way of talking about other things that morning, they were actually talking about death. How do you face such a thing? How do you actually go about dying? And what are the chances of a miracle?

Telescopic Sight

Everything about this story revolves around telescopes. Everything about the men and women involved in this story concerns telescopes. And ultimately, two telescopes in particular. Two new telescopes that ushered in a new paradigm about how astronomers do science. Gemini North, the first 8-meter telescope specifically optimized for infrared research, was dedicated atop Mauna Kea on the Big Island of Hawai'i, June 25, 1999. Gemini South, its twin in Chile, was dedicated on January 18, 2002. Together, the identical telescopes with two of the largest single mirrors in the world make up what is formally known as the Gemini Observatory. The Gemini Project, which was one of the most successful major observatory construction programs in the latter part of the 20th century, had been in part initiated by Frank Low's visionary enterprise. Gemini Observatory had also been Fred's crowning achievement and it is why the Gemini telescope on Mauna Kea, Hawai'i was renamed in his honor on November 13, 2002.

Getting the News

Six weeks after the Hawai'i dedication ceremonies for Gemini North, crowded with lei-bedecked dignitaries from throughout the worldwide astrophysical community, Fred learned the worst. Following a routine physical, the caring and careful Dr. Alice Adee in Hilo, Hawai'i, had to tell Fred that he was suffering from Myelodysplastic Syndrome and fibrosis of the bone marrow. This seemed at the time nonsensical. Fred was at the peak of his health, athletic, contentedly married for almost 40 years, a dedicated family man with a son and two daughters, a brood of beloved grandchildren, his name in the scientific annals of astronomy, and plenty of creative and challenging work ahead of him. For the careful, caring and logical man that Fred was, a fatal disease was impossible to assimilate. But death is nothing if not nonsensical.

Myelodysplastic Syndrome, or MDS as it is commonly known, is an extremely rare disease of the bone marrow. Only about 20,000 people each year are diagnosed with it. It is the same disease that killed celebrity scientist Carl Sagan in 1996. What happens is that the bone marrow loses its ability to make new blood cells. Transfusions and bone marrow transplants can sometimes postpone the worst, or in rare cases, even halt it. More often than not, it is fatal.

When Fred found out he had MDS that August in 1999, he told only a handful of people. Anyone who ever knew him knew first of all that he was an extremely private man. Except for a few colleagues and his family, for months no one knew that he was even ill. He exhibited no symptoms of illness. He continued to take long bicycle rides around the Big Island (one of his favorite activities). He hiked up in Volcano National Park, going to see the lava pouring down to the ocean from Pu'u O'o vent. "As far as any of us knew, he was in top shape," recalled Jean-René Roy, a fellow hiking enthusiast and the French-Canadian Associate Director of Gemini North.

But in private, in the thorough, scientifically exhaustive and precise way that was so typical of anything that Fred undertook, he began to research the debilitating disease. He began to spend a lot of time trying to find out everything he could about MDS. He poured over statistics and medical tomes.

Even with his wife Marian, a registered nurse, he shared very little. Certainly not fear. It wasn't Fred's way.

"This was just one more thing we had to go through," Marian said. "Our basic attitude was, well, let's get through it and get on with our lives. Everything will be all right."

What else could they do? Marian continued with the couple's plans for her to go back to Tucson to wind up things with their house, in preparation for their anticipated move to Chile. The diagnosis had come precisely on the cusp of the next phase of the couple's life together. As Gemini Project Scientist, Fred was scheduled to help oversee the completion of Gemini South. MDS was not going to interrupt their lives. Marian went back to Tucson. Fred stayed on in Hawai'i.

It must always be remembered that Fred was a scientist, first, last, and always. Fred had a disciplined, achromatic mind that was famous among his colleagues for the ability to intuitively grasp the nub. Faced with some experimental quandary, armed only with his habitual paper and pencil, he was unrelenting. In his typical way, quiet, low-key, out of the limelight, he worked until he got it. This was his great professional strength, and he was highly respected for it. He'd been a scientist all his life. Every empirical nut would crack if you hit it hard enough. Everything had a logical solution. Everything.

What else could he do? Fred didn't – couldn't – allow anyone else to know. He would deal with it in his own way. He and Marian went quietly about their preparations for moving to Chile. Somewhere in there they'd decided to sell their house. This in itself was indicative of their emotional plight. Fred never loved any place like he loved Tucson. He'd been all over the world, and rented houses in Hawai'i and England. But Tucson was home.

In the midst of all these preparations, Fred disappeared. "We had a meeting in Tucson," Low remembered. "Some meeting that Fred would never have missed. He wasn't there. Suddenly he'd dropped off the radar. Everybody was saying, 'Where's Fred?'"

Fred and Marian had gone to Indianapolis, where their children lived. A lot of things had to be talked over. There were certain medical procedures that could be undertaken. Fred's age was approaching the cutoff line for a stem cell transplant. But even so, he was still in rigorous, glowing health. Now Fred had to decide if he would undergo the agony of a stem cell transplant with little hope of success. MDS had brought him all the way down to a cliché: a life-and-death decision. Infrared meetings in Tucson somehow seemed not so important any more.

During this trip, Fred and his son Michael took what was to be their last bicycle ride together. Mike recalls, "This was the first time that I noticed that this thing was really affecting my Dad. Things just didn't bother him, so it was shocking for me to see it get to him like this."

When Fred had gotten the news about his illness, he was just 63 years old. He'd been born February 7, 1937 in Minot, North Dakota. He was a product of the forward-looking optimism of post-war America. Infrared astronomy was the perfect choice for a scholar of his bent. Infrared is the newest major field of observational research in astronomy. The entire discipline is only 40 years old. Fred's career almost exactly spanned the time from the field's birth until the time of the Gemini North dedication. His entire professional life had been spent in the infrared.

A Budding Astronomer

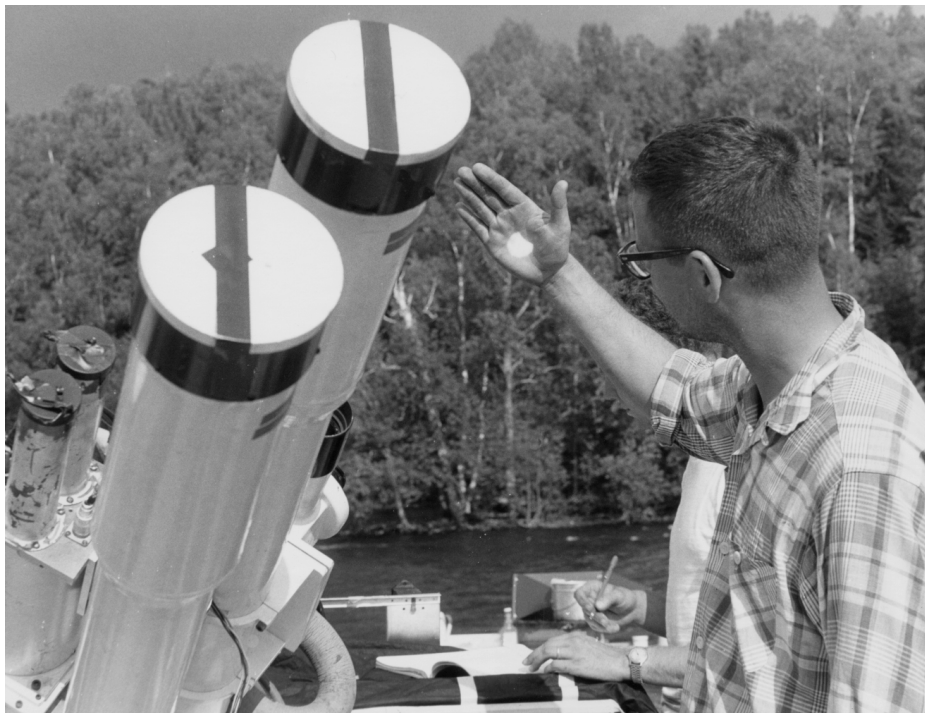
Fred was from what would for years only half-jokingly be called the "Ed Ney School of Science." Ney was a staple at the University of Minnesota for almost 50 years. Ney was a lovable, idiosyncratic character. And because of his penchant for emerging fields of science, was another genuine pioneer of infrared astronomy. Originally a physicist, he drifted into the infrared via consulting with the military and looking at the sky through high-altitude balloons.

Ney, however, was fated to be known more as an artificer of new ideas and nurturer of famous students than a discoverer. As one of his biographies says, "Twice, the position of NASA Chief Scientist was filled by former students of Ney. Another student helped establish the Stratoscope Program at Princeton, and two students constructed one of the world's largest infrared telescopes at Jelm Mountain, Wyoming. One former student is a member of the National Academy of Sciences." Ney once remarked that Fred Gillett was the best graduate student he'd ever had.

Infrared Progress

The field of infrared astronomy emerged at an ideal time for Fred. The discipline was just in its formative stages when Fred was working on his post-graduate degree in physics. Infrared astronomy, which had seen slight development in the early 20th century, had been hindered by

Fred performing a field experiment as part of his work at the University of Minnesota in the early 1960's.



A projection of the partially eclipsed image of the sun on Fred's hand during the same field experiment as the image on page 3.

the lack of proper instrumentation for imaging the incredibly rich infrared sky. It wasn't until 1961 when infrared astronomy really began to take off. It was in that year that Frank Low at the University of Arizona published his first paper on germanium doped bolometers. This instrument increased by hundreds of times the infrared sensing capability for astronomers, and even lengthened their range of seeing into the far infrared. Because of his bolometer, many have called Low the father of infrared astronomy. True or not, there is no disputing that Low's instrument put infrared research solidly and forever on the astronomical map.

Fred showed up in the late 60's just as Low was taking off – literally. Exploiting the possibilities of his new bolometer, Low was busy flying Learjets into the Earth's stratosphere to reach above the heaviest atmosphere. Meanwhile, a gentleman named Gerry Neugebauer was getting ready to do his famous 2.2 micron survey atop Mount Wilson on the 62-inch reflector. Neugebauer entered the field, as many of those early pioneers, through the military. "I was a lieutenant. They ordered me to go to JPL and work on infrared," was how he put it. He was using lead sulfide detectors. Both types of instruments were analogous to a sort of crude camera which could record a very rudimentary smear of heat.

By the time Fred came along, Ney, Low and Neugebaur were already established and a definite infrared nexus was forming.

Low recalls that Ney urged Fred to visit him in Tucson. "Fred built our first liquid helium cooled spectrometer." Together, the pair took off into the infrared, Low's bolometer hooked up to Fred's helium-cooled spectrometer.

Fred's infrared commute between Minnesota and Arizona went on for a couple of years. And then following a brush with Ney's high-altitude balloon experiments on the East Coast, Fred landed his first real job. He'd been hired as the junior-most assistant research physicist at the University of California at San Diego. In 1966, the brand-new astrophysicist left the snow-choked climes of Minnesota for sunny California. He never went back. Along with him came his family.

Fred and Marian had been married in 1960 the same year he got his B.S. in physics. He'd met her through her cousin.

While in San Diego, Fred traveled to Mount Lemmon to observe, as pictured here in this April 1972 image.

When they moved, the couple already had their two young children, Nancy and Michael. The job at UCSD paid a good deal more than the $200 a month he had earned as Ney's research assistant. "Thank goodness I was a nurse," Marian said. While Fred had been in school, she'd supported the family.

In 1967 Fred published his first paper with Low. It was called "Infrared Observations of the Planetary Nebula NGC 7027." It was only the fourth paper he'd ever published. The first three had been with Ney. Eventually he'd publish more than 120 scholarly pieces, the last one in 2000 on Gemini instrumentation, in collaboration with Gemini Director Matt Mountain, then Gemini Project Manager Jim Oschmann, and Robert Nolan, then Gemini Instrumentation Manager.

Right from the beginning, Fred worked in the infrared. "Between 1965 and 1970 there were 14 papers with his name on them," says Gemini Senior Astronomer Tom Geballe, who first came across Fred's work when he joined the new Berkeley infrared astronomy group in 1969. "I suspect that that number represents far more than half of all the papers published in infrared spectroscopy during the first half-decade of infrared astronomy. Fred was not only a pioneer, he probably was the most active pioneer."

The Vega Phenomenon

Like the radiation that Fred studied, most of his work was beyond the visible, but the early 70's brought the beginning of Fred's claim to true public visibility – his share in discovering the Vega Phenomenon. Many people know about this discovery, but few outside astronomy are aware it has a name or who discovered it. The Vega Phenomenon is the first solid scientific evidence that stars other than the Sun might have their own planets. It launched myriads of speculations about extraterrestrial life. Two men started this - one of them was Fred.

Here's how it happened: In 1975, Low, Neugebauer and Fred were three of nine infrared scientists chosen by NASA to propose an infrared survey mission in space. Their recommendations resulted in the Infrared Astronomy Satellite, or IRAS for short. IRAS eventually became a joint project of the U.S., the Netherlands and the United Kingdom. It consisted of a 24-inch telescope and four different kinds of IR detectors, all cooled to 1.4 degrees above absolute zero by 127 gallons of liquid helium. In 1977 when the project officially got under way, it was pioneering work. Fred was in it from the beginning helping to design and maintain the instrumentation.

The marriage of Fred to Marian Ruth DeGriselles on December 17, 1960 at the Lake Wilson United Methodist Church in Minnesota.

IRAS benefited greatly by being a child of NASA. In the 1970's, infrared detector technology was still highly classified military information. Since NASA was backing the project, however, the designers were able to get access to detectors which were unavailable to civilian astronomers.

"It was funny," said George Aumann who discovered the Vega Phenomenon with Fred. "NASA went to bat for us in getting access to those detectors," he says. "The military wasn't going to let us have them until they learned we were going to cool them with liquid helium. When they heard that, they said sure, go ahead. They figured the helium would explode in space anyway, since nobody had ever tried to put liquid helium in space before. They figured their detectors would blow to pieces with everything else."

They were wrong. IRAS, which was finally launched in January of 1983, would be an extremely successful NASA project and one of the most important landmark experiments in the history of infrared astronomy.

Dr. James Houck, Professor of Astronomy at Cornell University, recalls Fred's meticulous attention to those 62 detectors in IRAS. "He knew those detectors personally," Houck remembers. "He could tell you the characteristics of each one. Like they had personalities."

As a member of the IRAS team, Houck had insisted on extending the IRAS "seeing" capabilities into the longer infrared wavelengths where the Vega Phenomenon was eventually confirmed. It was Aumann and Fred who made the actual discovery. They were in England in 1983 overseeing the orbit-by-orbit calibration of the satellite when Fred

NASA press conference in November of 1983 that focused on the achievements of the IRAS project. In the front row, Fred is second from left and Frank Low is second from the right.

noticed an anomaly in the data on Vega. Eventually they figured out the data meant they had discovered a disk of particles around Vega.

Astronomers had long speculated that planets are formed from such disks, but could only speculate until this discovery. "This should give the modelers something to think about," was Fred's characteristically understated comment when Aumann showed him his conclusions on what they had stumbled upon. It certainly did.

"I remember when the word got out, within 24 hours the BBC was interviewing us. The next day we got an excited call from NASA saying, 'Why do we have to learn about this in the newspapers?'" Aumann laughed. "There wasn't anything we could have done about it. Reporters were calling from all over the world."

As many scientists have learned, bright lights and cameras are often more exciting than the slow progression of hard research. But Fred's brush with public acclaim had little effect on him. Both he and Aumann turned down an invitation from Carl Sagan to lecture at Cornell on what he and Aumann had discovered. They were too busy analyzing the data, he told Sagan. And they were. Fred never much cottoned to the limelight anyway. For him, it was the science that mattered, not the publicity. In private, with his family, he always expressed a droll sense of humor about the ephemerality of "celebrity science."

"But he never really criticized anybody," said his daughter Nancy Richardson, who studied at the University of Arizona while the family was living in Tucson. "Dad would talk at home sometimes about people in the business in a sort of general way," she said.

"But when we were discussing someone, you could tell by the tone of his voice what he really thought about them. At least I could. He had strong feelings about who he admired, and who he thought didn't have it. He never said anything outright. But you could tell by the tone of his voice. Anyway, I could."

At the height of the Vega Phenomenon publicity glare, Fred found himself as a celebrity guest on Ted Koppel's nationally televised "Nightline" television show. His fellow guests were Sally Ride, the first woman in space, and Carl Sagan. It was "Space Night" on "Nightline." First Ms. Ride was interviewed, and talked about the thrill of going into space. Turning to Fred and Sagan, the interviewer remarked that as astronomers, they must be envious of Ms. Ride's opportunity. Sagan confessed being somewhat jealous of her.

The interviewer then turned to Fred. "Wouldn't you like to go, too?"

"Oh," said Fred, "I'm so tired I'd be happy to retire to my desk with all my information and try to understand what IRAS has told us over this past year."

Later in the interview he said, "I'm enjoying myself a great deal right now and I don't think I'd change places with anyone."

"That was just like dad," Nancy said.

"When the movie 'Contact,' came out, I got a call from my daughter," recalled Aumann.

"She said, 'Dad, go see 'Contact'."

"I asked her what for?"

"She said, 'Never mind. Trust me. You'll get a kick out of it.'"

"We went" said Aumann. "That part in there about how the alien message from Vega was discovered was based on our work," he laughed.

Fred in his NASA office in Washington, DC, Summer 1988.

Soon after the papers had been written and the roar in the media over the phenomenon had died down, Fred went back to building spectrometers and raising his family. It was his 15 minutes of fame. "That was a good time for us," remembers Marian.

NASA Interlude

Fred rode the success of IRAS all the way to Washington. In 1987, he took a two-year sabbatical to become NASA's Visiting Senior Scientist for the Infrared and Radio Astrophysics Branch.

"He didn't want to do it," says Larry Caroff, who worked with Fred at NASA, managing several of the space agency's IR programs. "They kept talking to him until his ears fell off," said Caroff. "Finally he did it."

The fact that Fred was hired to help establish an IR presence for NASA speaks for itself about what the experts thought of him and his work. Fred had arrived at the top of his field. He didn't like being there in Washington, dealing with the endless administrative minutia that such top-level jobs entail. But he learned a lot about how such projects get done, the pitfalls, the politics, the necessities of so-called Big Science.

"Fred had a natural talent for teamwork," Caroff said who became a dear friend and biking buddy.

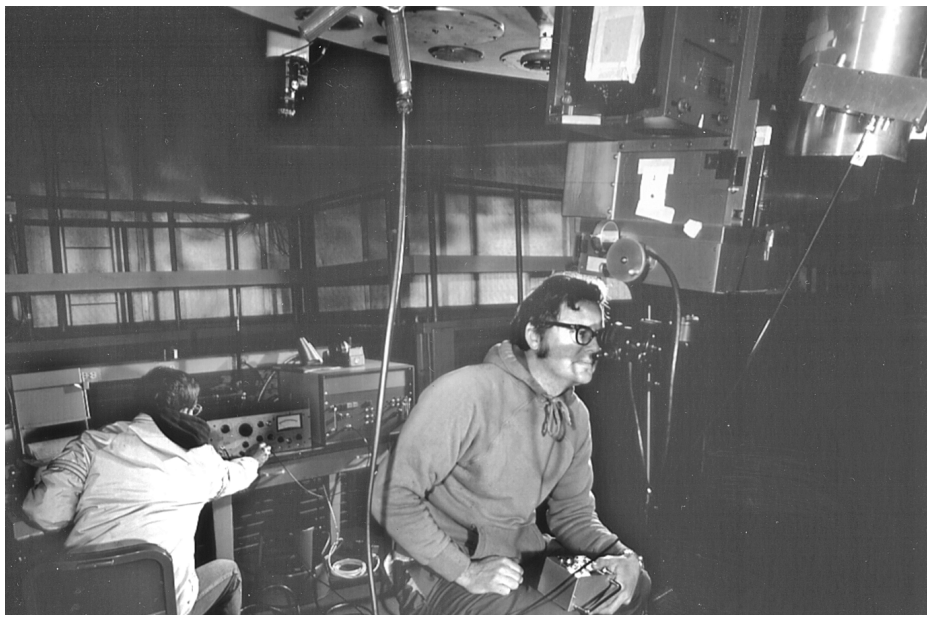
During his two years at NASA, Fred was the logistical point man for getting three major projects off the ground. Two of these projects were basically in-depth extensions of the two most significant IR projects to date, IRAS (1983) and Neugebauer and Leighton's 2.2 micron survey (2MSS) in 1969. SIRTF, or the Space Infrared Telescope Facility, is basically a follow-up of IRAS and 2MASS is an extension of 2MSS. Fred also played a key role in the initial stages of SOFIA, the Stratosphere Observatory for Infrared Astronomy.

"A lot of the people at SOFIA don't understand what an important role Fred played on SOFIA," Caroff said. "Fred forced us to crystallize the science arguments for the project. He's the one who focused it."

"That was Fred," Caroff said. "What he brought to any project was the ability to grasp and then to conceptualize the whole. Then he did the analysis – you could never catch Fred out on a limb. He had a natural talent for convincing other people how it should be. And he never gave up, either. Ever!"

Over to NOAO

The great success of IRAS, which catalogued between 250,000 to 350,000 infrared astronomical sources (depending on which celestial camp is doing the counting), kept Fred busy for a long time. He was also getting more and more involved at Kitt Peak National Observatory, outside of Tucson. Fred eventually had his hands in just about every Kitt Peak infrared project in some way or another. He kept on plugging away at his infrared instrumentation until he climbed all the way to the top. For a few months in 1978, he even served as Kitt Peak's Acting Director. Though he didn't much care for the politics of observatory administration. Fred was proud of his association with Kitt Peak and he's still famous enough



Fred using the infrared photometer on the 2.1 meter telescope at Kitt Peak in the mid-70's.

with Kitt Peak personnel that an anonymous picture of him is posted on a "Guess Who?" web page of important instruments and well-known scientists who have worked at the facility.

Working for Kitt Peak inevitably pulled Fred into the administration of the National Optical Astronomy Observatory. Formed in 1982, NOAO serves as the umbrella organization for many of the largest observatories funded with U.S. tax money. It is one of the institutional arms of the Association of Universities for Research in Astronomy (AURA), which operates Gemini, Kitt Peak, the Cerro Tololo Inter-American Observatory in Chile, the Space Telescope Science Institute and the National Solar Observatory, with facilities in Arizona and New Mexico.

Fred's reputation as a solid researcher more interested in good data than politics was inexorably pulling him into the realm of Big Science. "Fred kept us honest," former NOAO director Sidney Wolff told one interviewer. By the time Fred left NASA in 1989 to come home to Tucson, he was recognized by his peers as one of the unquestioned leaders in infrared astronomy. It was Fred's science and his quiet, behind-the-scenes tenaciousness that would see him through the looming uproar in the United States over the Gemini mirror. Beneath his unassuming façade lay real strength.

The Decadal Survey

Every ten years the U.S. science community takes a deep breath and considers its priorities for future research. This process is called the Decadal Survey, and is sponsored by the National Academy of Sciences. In 1989, the Academy appointed John Bahcall, with the Institute of Advanced Astronomy at Princeton, as survey chairman for astronomy and astrophysics. Bahcall gathered together more than 300 of the top astronomers in the country to decide the direction astronomy should take in the 1990's. Twenty-five of these experts were assigned to consider what should be done about the infrared. Fred Gillett was appointed committee chair.

One of Fred's great talents was that he always grasped the overview. If it could ever be said that he wore blinders, it was because of his uncompromising focus on doing something right.

Thanks to Fred's vision, when "The Decade of Discovery in Astronomy and Astrophysics" was published in 1991, Bahcall's report cited an 8-meter infrared telescope atop Mauna Kea as its number 1 priority for American astronomy in the upcoming decade. The committee went so far as to label the 90's the "Decade of the Infrared."

The Decadal Survey placed an 8-meter infrared telescope on the fast-track for development within the American astronomical community. There was a good deal of residual resistance to a major infrared telescope, however, since the great majority of American astronomers observed in the optical

Fred in front of what is now the Frederick C. Gillett Gemini Telescope on December 26th, 1998.

part of the spectrum. The unique funding arrangements by Congress also added to the difficulties of getting the Gemini Project off the ground, since Congress had mandated that half the Gemini budget must come from foreign sources – which meant Gemini must move outward from its exclusively American interests and become a truly international project.

Resistance to Gemini's "new paradigm" of both design and international cooperation came to a head with a controversy that erupted in the early 1990's over Gemini's mirror design and manufacture. The traditional way of viewing a telescope was that the heart of any telescope is its mirror. Gemini visionaries, however, had taken a quantum leap in design priorities and adopted the view that the heart of a telescope is simply its "delivered image quality."

This view involved much more than just the mirror. It was also difficult to get the idea across to a great many in the astronomical community, who remained focused on the telescope's mirror as primary issue in design. Even Fred, who was a member of the Gemini team responsible for choosing the Gemini mirror design, had to go through his own assessment of how he saw telescopes.

The mirror controversy was a painful one for Gemini, but it could be argued that it was one of the best things that happened to the project. Because it helped focus the entire Gemini team, including Fred, on the new paradigm of "delivered image quality" as the designers' overriding goal in creating Gemini. Fred embraced this approach wholeheartedly and in fact became one of its primary advocates.

Why Fred?

When Matt Mountain was asked why the Gemini Observatory Board of Directors, at his urging, had unanimously chosen to name the Gemini North telescope after Fred Gillett, he didn't immediately answer. He mumbled around for a moment, obviously not getting to what he really wanted to say, and then stood up from his chair and walked over to the large blackboard that dominates his office. The board was already crammed to overflowing with supernumerary squiggles and scrawls – the symbolic effluvia of the interminable discussions on science and technology that go on day after day in that office. He reached up and wiped off a big, clean space on one corner of the board, and then he wrote down this formula:

$$S/N \propto (D/\theta) \times (\eta^{1/2}/B^{1/2})$$

"This is why," he said looking around. "This is why."

For a scientist such as Mountain, this

The Frederick C. Gillett Gemini Telescope with the vents and observing slit open at sunset on Mauna Kea.

tells it all. It does this so eloquently because it so lucidly, so gloriously speaks truth in the form of number. All great formulae do this. There is no "muddle of humanity" in them, only ratiocination. In their pristine symbology, they are the poetry of science. And for those who are immersed in their language, they sing as sublimely as a Shakespearean sonnet. Any real scientist can tell you this.

As for the formula above, translated into English, it says: "The quality of the data is dependent upon the quality of the telescope." This formula has another very interesting aspect to it. It is this: Anything you manipulate within the formula affects everything else. It is a scientific expression of integrity.

It is customary to apply the word, "integrity," to describe the human condition. Many people mistake "integrity" for moral excellence, for honesty, or rectitude and uprightness. It is not. This is probity. Integrity means wholeness. Like love, it encompasses these other things. In Webster's Unabridged Dictionary, integrity is defined as "the state or quality of being entire or complete." Integrity is wholeness.

Fred Gillett

Fred had always been an excellent scientist. But it is not for his science that the telescope is being named for him. It is not even for his leadership – at least in the traditional sense of the word. Though Fred chaired many committees, led projects and was in the very thick of the Gemini design, anyone who knew Fred will quickly tell you his type of leadership was not based on charisma, or haranguing the crowds and "bringing the team together."

Fred was in fact so low-key it is interesting to note that most of his long-time colleagues, those men and women who heartily approve of the telescope honor, when asked how they first came to know Fred, will pause for a moment, mentally scratch their heads, and pensively reply they never gave it much thought. As a matter of fact, the great majority have no recollection at all of their first meeting with Fred.

"Damned if I know," said Gerry Neugebauer in a typical reply when asked how he met Fred. "He was always around."

So if it wasn't for his science or his leadership, why, then, is Fred being awarded this singular honor?

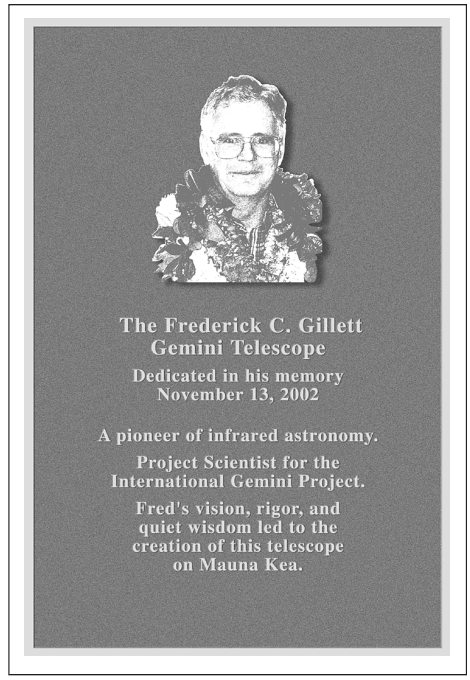
The key to that answer lies not in what Fred did, but in who he was. Especially who he was for Gemini.

No matter who you talk to about Fred, no matter what scientist or instrumentation engineer, or astronomer or physicist, or neighbor or friend – and his colleagues were legion and included some of the best minds in the world – no matter who they are, they all answer the same. One way or the other, often in explanations dense with formulae and jargon they try to describe Fred for you. In a desire to sincerely explain their feelings about Fred, they always work down to one word. They always come down to integrity.

Integrity was the key to Fred's life. It is the reason behind the telescope's naming. No matter what else that could be said about Fred – and many could say a great deal since he had his unassuming, scientific fingers in so many empirical porridges – no one ever questioned his integrity.

The Fred Gillett Telescope

"The post of honor is a private station," Cato once said. So the telescope will get only one man's name upon it. What is to be understood, however, is that by choosing this one man for this singular honor, all who have played a part are honored. The naming of the telescope is public acknowledgement of what Fred fought for in the rigor of his calculations, his meticulousness, his one-pointed, uncompromising insistence on quality as he unhesitatingly urged everyone on



The plaque that was placed overlooking the Frederick C. Gillett Gemini Telescope on November 13, 2002.

with a kind of uncompromising focus incessantly repeating the refrain that Gemini was going to be the best possible infrared telescope that he possibly could make it. That everyone could make it. And he meant it. In the end, this is what he was about. It is this legacy that remains at the heart of the telescope. That's why his name is on the plaque that overlooks the Gemini telescope on Mauna Kea.

What Fred bequeathed to Gemini was a lasting, inner core of integrity. This is not to say, however, there was any conscious intent by anyone – least of all by Fred himself – to place "integrity" at Gemini's core. It was just one of those fortunate, half-intuitive, things in life that sometimes just happen.

Fred was not Gemini's arm, or even voice, but he was certainly Gemini's conscience. In renaming the Gemini telescope on Mauna Kea the Frederick C. Gillett Gemini Telescope, this is what is being honored.

Aloha to Everything

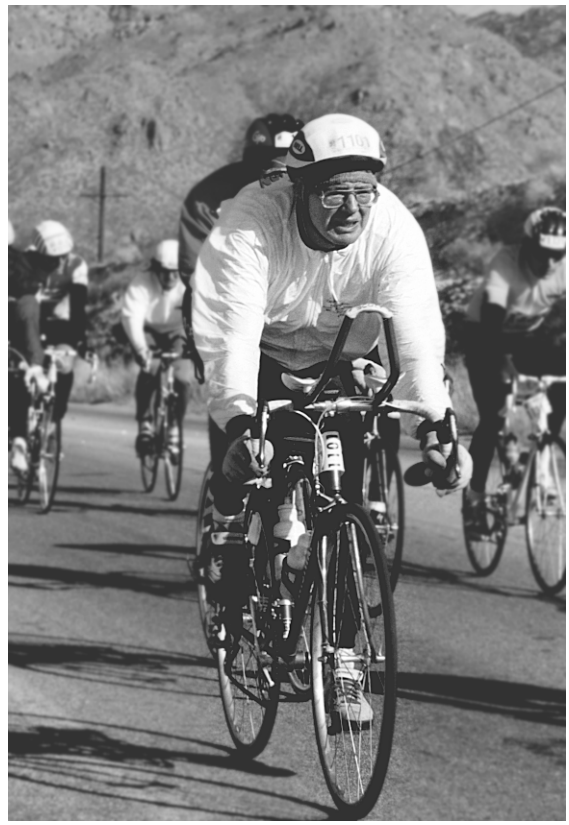
In early October of 2000, Fred and Marian returned to Tucson. They'd talked it out with their kids in

Indianapolis. Now they were passing back through Tucson on their way to Seattle. People invited them out. The Sierka's, their closest friends in Tucson, held a very special party for them. Here Fred and Frank planned their hike.

So there they were, two hard-core scientists, two old friends, walking and talking as autumn was coming on and the leaves were dying. Edging ever so softly towards the ineffable.

"How do you go about this?" Low remembers Fred asking that fateful autumn morning in the canyon. "Wouldn't it be easier on everyone if I just got on my bicycle and rode away?"

"I don't doubt something like that happened," says Marian.



Fred riding in the tenth annual "El Tour De Tucson" on November 21st, 1992. The route travels around Tucson and totals about 100 miles in one day.

Either there in the canyon, or perhaps even later as he and Marian made their slow way up to Seattle, Fred made his final decision to go through with the bone marrow transplant. Ultimately his decision had nothing to do with logic, or even fear. "I really do honestly believe that if Fred had been on his own, he wouldn't have gone through with it," said Marian. "He knew perfectly well what his chances were. Without us, I think he would have just let nature take its course. He had to try for his family."

After Tucson, they went on to San Diego, where they visited with friends and old colleagues. They stopped by Neugebauer's office. They spent a week just before Halloween at the home of their hanai (unofficially adopted) daughter, Danuta Gessner and her husband Rick. "Fred had a wonderful time playing with our two-year-old Megan," Danuta said. "We all went on a hayride together." Danuta had come into their lives back in 1980 when Fred and Marian had hosted her as a young woman performing in the international singing group, "Up With People." "Our paths were just meant to cross, I guess," Danuta said. Danuta became part of the Gillett family. (Altogether, the Gillett's hosted 95 young people through the years in the "Up With People" program.) They spent a couple of days at the Caroffs' home in Sunnyvale, still visiting, winding up business, still preparing. The friends went for one last, long bicycle ride together.

Fred with brother Jim (left) who donated bone marrow for the transplant.

And then on Oct. 22, 2000, they checked in at the Fred Hutchinson Cancer Research Center in Seattle, and settled into an apartment furnished by the center for families undergoing bone marrow transplants. Everybody staying in the apartments was in the same boat. It was a place rife with fear and hope. And thus, it was an intensely caring group of people. Marian has good memories of it. It was to be Fred's last home.

"It didn't really matter, though," said Marian. "No place was ever home for Fred except Tucson."

The bone marrow transplant towards the end of November went well. They were lucky. They'd found a good match. Fred's older brother Jim donated the life-giving marrow.

Fred felt well enough by Christmas to spend the day at the home of family friends. January was looking even better, until the end of the month when Fred started to have back pain.

By the end of February he was diagnosed with spinal compression fractures and by mid-March the graft cells were beginning to cause major problems with his kidneys, liver and other organs. He was battling painful infections, he was full of IVs, taking all kinds of medicines, in and out of the hospital, full of pain killers, and in severe pain from a series of compression fractures in his spine (brought on by steroid treatments). His organs were failing and his bones were collapsing.

"Those were some bad times. There were so many specialists, so many tests. There was just nothing else

we could do," said Marian. "We couldn't deal with it any more." On March 19th, 2001, Fred checked back into the hospital for what would be his last time.

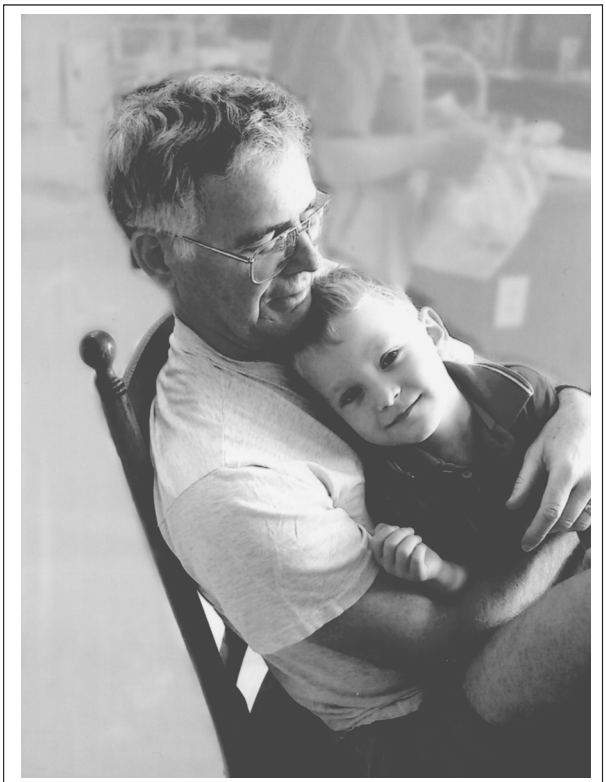
"They haven't got a model, Matt," a very sick man fretted to Mountain when he called to check on him a few days before his death. "They're just trying things."

"Through all of this," said his son Mike, "Dad never gave up." "He realized that with all of his systems failing however, that there was a bigger issue. I'd like to think that because of the way Dad thought everything through, that he was a step ahead of the rest of us."

It was about that time that his old NASA friend Larry Caroff took off work and drove up to Seattle to see him. It would be the last time the two biking buddies talked. And like so many in such situations heavy with implications of mortality, they talked only of mundane things, known equations. But they were both aware finality was hanging in the air between them, in the sterile, antiseptic air of an impersonal hospital room.

On April 20th, the couple's children arrived in Seattle to spend the weekend with Fred and Marian. Early Sunday afternoon daughter Nancy with her husband Ed and three year-old Alexandra returned to Indianapolis and Danuta and husband Rick to San Diego. Son Michael with his wife Susan and seven year-old Elizabeth remained. The family's good friends and longtime neighbors Ray and Jeanne Sierka arrived with their daughter at about 3:00 pm from Tucson. With family and friends at his bedside Fred died peacefully at 4:45 pm on Sunday the 22nd of April 2001.

The great mythologist Joseph Campbell used to tell a famous story about Schopenhauer, which he felt shed light on how a man's life is lived.



Fred with grandson Eric Gillett in August 2000.

"Schopenhauer," he said, "points out that when you reach an advanced age and look back over your lifetime, it can seem to have had a consistent order and plan, as though composed by a novelist. Events that when they occurred had seemed accidental and of little moment turn out to have been indispensable factors in the composition of a consistent plot. So who composed the plot? Schopenhauer suggests that just as dreams are composed by an aspect of yourself of which consciousness is unaware, so, too, your whole life is composed by the will within you. And just as people whom you will have met apparently by mere chance became leading agents in the structuring of your life, so, too, will you have served unknowingly as an agent, giving meaning to the lives of others."

It is all interwoven, intermeshed. Cold Minnesota winters, emissivity, bicycles, stark hospital corridors, stars, paper notebooks dense with penciled calculations, the snow atop Mauna Kea, science, family, love, laughter.

"All nature is but art, unknown to thee;
All chance, direction, which thou canst not see;
All discord, harmony, not understood;
All partial evil, universal good;
And, spite of pride, in erring reason's spite,
One truth is clear, Whatever is, is right."
- Alexander Pope