vested and the interest is used to support your research. It will be like a permanent endowment." I shot a rubber band across my office. "So how much money are we talking about and why are these people giving it up?" I queried.

"I think we can raise $30 million easy in an initial sale of shares of your future career. These would represent a total of 49% of your future career proceeds. Forty-nine percent of any awards, honoraria, or patent proceeds would be distributed to your shareholders. In return, they give you complete academic freedom for the rest of your career. You will have about $1 million to $3 million a year for research to do what you want with, depending on how it's invested." Ed continued: "With the success of your jet pack, aside from a few unfortunate outstanding law suits, I think it will be easy to convince folks that you will be generating more money-making ideas in the future."

I countered, "Look, Ed, we've had this discussion before; 'money-making ideas' is not what I'm about. I don't mind commercializing my ideas; heck, I think it's a good idea even, but I don't think I can sell myself as a money-making fund for investors."

Ed considered this for a minute and responded, "You are not selling yourself as anything like that. These investors are savvy enough to know that every once in a while, what you happen to find interesting and study because of purely intellectual curiosity may in fact be the basis for an incredibly lucrative entity. You don't have to misrepresent yourself in any way, shape, or form."

I wasn't convinced, and we decided to call it a day. I still had misgivings about the idea, but eventually the lure of a constant source of funding and the freedom from grant writing won me over. On July 18, 2016, we had an initial public offering of shares of my future career. Thanks to some well-organized hype, these sold fast and brought in more than Ed had envisioned originally: a total of about $50 million.

Since that day, I've never had to worry about funding my lab, and in the end, Ed was right: Although most of my research was of purely academic interest and had no commercial spin-offs, I managed to hit on a few more lucrative ideas that paid off my shareholders many times over. And now, here it is 50 years after I started my career. If I am honest with myself, I have to say that I will probably be remembered more for the revolution I helped start and not for my scientific accomplishments. The use of academic agents and academic IPOs forever changed the face of science and were even more revolutionary than the use of ultralight personal jet packs.

The author was a freewheeling and care-free postdoc in the chemistry department at Caltech when he wrote this essay; now he is a harried and stressed starting faculty member at the University of Missouri in Kansas City with not nearly as much time for such philosophical musings. Simon H. Friedman, Division of Pharmaceutical Sciences, University of Missouri, Kansas City, MO 64110, USA. E-mail: FriedmanS@umkc.edu

This essay is a work of fiction. Names, characters, places, and incidents either are the product of the author's imagination or are used fictitiously. Any resemblance to actual persons, living or dead, events, or locales is entirely coincidental.

In Touch at

by SETH SHOSTAK

It may be the biggest science discovery of the millennium, but somehow that's hard for me to swallow.

Sure, I've got a closet stuffed with awards and offers from two dozen publishers to write the whole thing up. But the awards don't mean much (although my wife enjoyed the trip to Stockholm), and as for the book—well, I'll leave that to the science historians. They'll be better at injecting drama even when there wasn't any. As it is, most of the Web sites already embellish my little result with florid hyperbole such as "the triumph of one man's vision," or describe it with metaphorical chutzpah as "how a lone science prospector hit the mother lode."

I didn't hit the mother lode. Sure, I found something that was important and reactivated a moribund field of research. But mother lode? I just stumbled on a loose nugget.

There is one thing the Web texts get right, though. I managed this discovery on my own. And that's unusual these days. Two centuries ago, an individual researcher could do something significant. Isaac Newton didn't need a lot of pals to puzzle out mechanics. Maxwell wasn't juggling a small coterie of co-workers as he wrote his four equations. But times change. If I log onto the *Astrophysical News*, I'm hard pressed to find a single submission involving fewer people than signed the Constitution. The physics journals are worse: They've resorted to an "authors" link, rather than crowd the first two pages of each paper with the names of academics in 8-point type. Modern science may have begun in the 15th century, but a half-millennium later, it's running out of steam. New results, at least in the physical sciences, are harder to come by, and one brain is not enough.

Personally, I figure the decline and fall began when Bernstein's Theory of Everything deprived theoreticians of something to live for. Astronomy has been on the skids for years. Sure, researchers try to keep themselves busy populating odd nooks and crannies of the cosmic bestiary, but there's a limit to Nature's inventiveness.

Last

Most astronomers go through the motions, collecting more parallaxes, mapping pulsars in nearby galaxies, or making interminable N-body simulations to understand how everything from solar systems to galaxies eventually evaporates, thereby ensuring a thoroughly dull universe.

I had never been keen to join this lackluster crowd, so I opted for SETI, the search for extraterrestrial intelligence. SETI is a niche area, and the niche seemed to be shrinking—a fact I found comforting, probably thinking it meant more for me. A backburner project that had moved up to the front of the stove when arthropods were found on Europa, SETI was now stalled thanks to its failure to find any intelligent aliens. It's not that people doubted the existence of the extraterrestrials. After the news from Europa and the discovery of a fecund Mars deep under the polar caps, it was clear to anyone with a warm cerebellum that biology was universal. As for smart biology—intelligence—it might not be common, but let's face it: The galaxy's a mighty poor place if *Homo sapiens* is its smartest inhabitant.

Sadly, the conventional scheme for finding the aliens wasn't working, and maybe it never would. Traditional SETI, now nearly four-score years old, hoped to detect cosmic company in situ, by eavesdropping on radio-wave or light broadcasts. Aliens might not come here, but they would presumably spit the evidence of their presence into space as a hail of photons. But the sobering truth was that no radio whine, no faint infrared pulse, had ever been found.

The pundits explained this disappointing result with tautological simplicity: The aliens were not broadcasting. After all, why should they? We don't. Our planet signed off the air less than two centuries after Heinrich Hertz concocted radio. Communications on this planet are now effected by optical fibers, and tightly focused infrared and microwave links. The spindly red-and-white towers on the hills at the outskirts of town are history. So are the energy-wasting broadcasts they would spew over the landscape and over the horizon, to leak into space and inadvertently mark our position. We aren't broadcasting, so why would the extraterrestrials?

Sure, the aliens could invest in deliberate, interstellar beacons to get our attention, but SETI hadn't found them. Perhaps beacons were too altruistic, or too dangerous, for E.T. Despite nearly a century of thinking about this problem, no one had figured out how to beat this transmission rap. No one had fashioned an alternative scheme for tracking down celestial beings whose communications were either highly directional or in pipes. Consequently, many of the large radio and optical arrays built in the first two decades of the century were abandoned and donated to amateur astronomy groups who, while grateful, inevitably groused about the cost of maintenance.

But there was one SETI instrument that was still collecting bits: the GRAV craft. GRAV, the General Relativity Amplification Viewer, had been launched in 2028 and reached its orbit, 520 astronomical units from the Sun, a decade later. The idea behind GRAV was simple: It would aim its 500-meter, thin-film antenna at the Sun, which, at this distance, would act as an enormous gravitational lens, amplifying signals from distant stars by thousands of times. It was a simple scheme for building the most sensitive receiving system ever conceived. In the early decades of the 21st century, it had been the Holy Grail of SETI research.

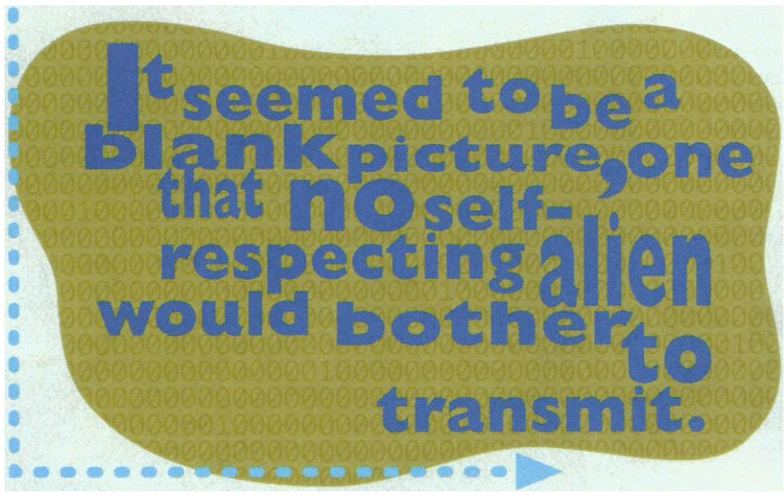
ILLUSTRATION BY ADAM MCCAULEY

Now the Grail was largely uncoveted. For 10 years, the small GRAV team had assiduously sifted through the ceaseless stream of data beamed back to Earth from the craft, looking for signals. In 2044, there was even a bit of excitement when a signal and success seemed at hand. But euphoria yielded to embarrassment when someone realized that the putative extraterrestrial transmis-

sion was from the forgotten Pioneer 6 spacecraft, still mindlessly belching worthless telemetry as it continued to orbit the Sun seven decades after launch. I think the false alarm dulled a lot of the excitement for the search team. In 2048, when GRAV's beam passed over the galactic center without finding any alien beacons, the money ran out. I saw my chance and took it. I pitched a small grant for a 5-year, one-man operation to do rudimentary analysis on the GRAV data. My proposal was modest, and it slipped through without waking a single referee. The International Science Foundation views small science as quaint. It's like tiny spiders in the kitchen corners; not important enough to bother.

My setup was pretty simple, just a couple of computers and some off-the-shelf software. Most of the work was in getting it all lashed together. Then I just let it run. For the first year, I must have checked the outputs a dozen times each day. Then I got jaded and relied on the automatic detection algorithms. My wife wondered if I still had a day job. I don't know whether I really expected to find anything or not; one gets so engrossed in the technical details, it's easy to forget what the original idea was.

July 20 was the big day, of course. I remember, because the kids were watching a syrupy documentary on the first moon landing. When I got to the office, I saw that the display on the data logger had gone bonkers. GRAV had found a signal—a steady carrier, remarkably strong. I thought it was a practical joke.



The rest is history, in every sense. Verification is always tricky for SETI, and for GRAV, which is 70 light-hours from Earth and can't be pointed, it's even trickier. So GRAV had an outrigger, a trailing craft with its own antenna—even larger than GRAV itself—following 200 hours behind the main instrument. The sibling could be activated to collect a second scan of any interesting signals at high temporal resolution and to relay them to Earth via the main craft, but not in real time. Of course, for a confirmation, that didn't matter. Needless to say, I gave the outrigger a nudge. You wouldn't be reading this otherwise.

The modulation, now so obvious to everyone, was a bit puzzling at first. I guess that's because experts expected that the aliens would be sending us pictures, or maybe simple mathematics. I always found the idea amusing: The aliens will send us the value of π, as if we didn't already know! Well, what was coming in was clearly a raster: There was a lone "on" bit every 10,330 bits, an obvious retrace signal, making a never-ending scroll. And it was all just binary. There was no compression, no color, no gray scale; it was the lowest common denominator of imagery possible.

But the rows were empty, or nearly so. Typically, there would be 10,330 "offs," and then an "on." It seemed to be just a blank picture, one that no self-respecting alien would bother to transmit. For a while, I considered the possibility that the alien transmitter was on the fritz. Maybe this was a crippled machine, a relic from a civilization that had built a transmitter and then died, leaving it without maintenance. The carrier was still operational, but the modulator was toast. Frankly, though, I didn't consider this theory for very long. Within hours, I made a startling observation: not all the rows were empty. Every 74th row had some bits that were set. The bits came in groups of four. They were simple characters, for sure, sixteen in total. Many people have said this proves that the aliens who built this machine have eight fingers on each hand. Sure, if they have two hands. But maybe they have four hands each with four fingers, or perhaps just a single, sixteen-fingered hand. It's all speculation if you ask me, probably prompted by the glove industry.

But the simplicity of the message was staggering. Empty strings of bits, marching down the screen in regular formation, like a huge military parade. Everyone wore a white hat, except a few in every 74th row. On July 22nd, just for the heck of it, I connected the bit stream to the audio channel of my porta-computer. The result was no surprise: regular clicks every 10,330 bits, and then a bit of a "buzz" every 74th row. That's when my wife walked in. "What are you listening to?" she asked. "Sounds like WWV."

Indeed, it did. It sounded very much like WWV, the Bureau of Standard's time-keeping service. I had found an alien signal, and it was, well, ... a clock. A clock! My first thought was, "Who needs a clock?" But of course, societies with fast rockets could use some sort of universal, or at least galactic, time. Special relativity guarantees that the timepieces aboard their ships will lose synch with one another. This alien transmitter supplied the equivalent of the "star date" of old science fiction: a calendar that everyone could use. Sure, not everyone would agree on the length of the ticks—it would depend on their speed—but none of that matters. This clock would serve to log events. At least it would help the historians.

There's been a lot of uproar since those early days. SETI is back in business, and in a big way. The philosophical impact of knowing that we're not alone has still not been felt, but that's coming. For myself, I guess I'm both elated and disappointed. For decades researchers had speculated on E.T.'s message: how the extraterrestrials would impart to us the wisdom of the ages, and perhaps offer us a free copy of the *Encyclopaedia Galactica*. I was a bit more cynical, figuring that we wouldn't be very important to the aliens. I didn't expect them to give us the time of day.

But they did.

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