



Riccardo Giacconi – Memorial Symposium, May 30, 2019

(Ken Sembach)

Life is full of opportunities. When opportunity knocks, answer the door. We all know this. We've heard this adage a thousand times. So why is it that we don't always answer the door?

Maybe we don't hear the knock. We are rather busy, aren't we(?), and easily distracted. Could the knock really be that important?

Maybe we think it's someone or something else knocking, perhaps chance, and we're really not feeling all that lucky.

Or maybe we're afraid of opportunity because we equate it with change. Change – that dreaded word. Everything is changing – the weather, not to mention the climate, our kids, the news, the fake news, who's in, who's out, our jobs. But opportunity shouldn't be equated with change, or at least not with change just for the sake of change. Change is a means to an end and may be necessary to realize opportunities that are worth pursuing. But it's knowing opportunity when it knocks, or when it is created, that makes change worthwhile.

When I think of Riccardo Giacconi the word that comes to mind is opportunity. Riccardo's model of leadership embraced opportunity. He knew how to open doors. Carpe diem. Seize the day. What we really mean is seize the opportunity. Riccardo recognized that to make Hubble successful, he would need to seize the opportunity to make it so. Upon becoming the STScI director, he found an array of problems related to operational planning. We heard about some of those yesterday from Joe Rothenberg. Riccardo characterized the ground system as “**a disaster**”. The guide star system wasn't working; there was an inadequate data system to deal with all of the observations that Hubble would make; the system for commanding Hubble to acquire and send data from the instruments to the ground wasn't up to snuff; there was no capability to track objects in the solar system; and so forth. What did Riccardo do? I'll quote him

directly: **“We took responsibility for Hubble beyond the construction of glass and metal to turn it into an outstanding scientific tool.”** In other words, he created an opportunity – some might even say a visionary opportunity – to make it inevitable that astronomers would unlock secrets of the universe. That isn’t to say there were no bumps along the way – there were – but there would be no leaving Hubble’s fate to chance.

Riccardo built up a core group of people with diverse talents to confront this opportunity. He surrounded himself with people whom he trusted and knew would be up to the task at hand. He gave them the opportunity (some might say, the mandate) to do something great. This was the group, some of whom are here with us at this symposium, who defined the Institute in its early days and set the foundation for how STScI would operate and serve the astronomical community even to this day.

Riccardo saw an opportunity to maximize Hubble’s scientific legacy by focusing decision making around science and using science in designing the systems needed to realize Hubble’s potential, a process he called “science systems engineering”, the seeds of which were planted years earlier in his X-ray work.

He writes in his book *Secrets of the Hoary Deep: A Personal History of Modern Astronomy* that science systems engineering **“signifies the analysis of a scientific research problem in all its dimensions, even before developing instrumentation. Starting with a clear definition of the problem, we would design instruments capable of obtaining the necessary data, then plan how these data would be analyzed, determine what errors might occur because of the intrinsic limitations of the instruments, and define the expected statistical weights of the observations. Only when it was clear that crucial results could be obtained would we proceed with the project. The principles of science systems engineering would be applied throughout the lifetime of the project to ensure that no changes occurred that would jeopardize its scientific success.”**

This change in mindset is something that Safi Bahcall, son of Neta and John Bahcall, calls an “S-type” or “strategy-type” loonshot in his new book *Loonshots: How to Nurture the Crazy Ideas that Win Wars, Cure Diseases, and Transform Industries*. The “strategy-type” loonshot is a breakthrough in strategy, a new way of doing business which involves few or no new technologies; it radically changes the chances of success or the direction of a project or industry. And the idea is often dismissed or deemed infeasible by others. Riccardo and his team brought experience and technological knowledge from previous projects, like the Einstein X-ray Observatory mission, to solve Hubble’s myriad ground system problems. What was needed wasn’t so much new technology as it was a new approach or mindset - a system mindset focused on outcomes to drive the engineering and management decisions of the project. This was not widely practiced at the time, and there was skepticism outside his team that it was even possible to make science-ready data products for the archive so useful that even non-experts could use them. A classic loonshot. The change that was required was an end-to-end approach that started even before the observations were planned.

[As a side note, the history of Hubble is littered with loonshots, but that’s a talk for another day.]

Make no mistake about it – the problems facing Hubble’s woefully inadequate ground system were potentially just as devastating to the mission’s success as the spherical aberration of the primary mirror. The possibility of failure was real. Riccardo and his team recognized that. But the need to revamp that unusable ground system provided an opportunity to recast Hubble as a mission that would not only be an outstanding scientific tool that rewrote textbooks, but would also transform the way astronomers do their work. Opportunity knocked. Riccardo insisted on opening the door.

In looking back on this, he wrote: **“We also developed a software pipeline capable of analyzing data in real time and constructed an archive of calibrated data suitable for reuse by scientists other than those who built the instruments or used the Hubble through the competitive research program. We instituted, with NASA’s consent, data analysis grants and the Hubble**

Fellowship program. We developed an outstanding outreach program to reach the general public as well as colleagues and students.”

We heard about these things yesterday, but think about that statement for a moment and those opportunities mentioned therein that we take for granted today. Science-ready data in an archive that is available to all. Observations that come with data analysis funding to ensure that great ideas enhance the knowledge of humankind. A fellowship program to set the gold standard for all others and to create leaders for the future. A model outreach program that has made Hubble a household word.

7769 different named Hubble investigators and more than 15,000 registered archive users

16,000 publications in peer reviewed journals with 3/4 million citations

> 600 PhD theses

> \$600M in grant funding

410 past and present Hubble Fellows (of which I am one)

Hubble press releases that typically reach hundreds of millions of viewers

Riccardo’s vision and leadership transcended the success of Hubble or the Institute. His mission was to make the field of astronomy successful. And I think one could reasonably argue that his list of accomplishments in this regard has few peers.

Just as important as acting upon opportunities is the ability to create opportunities for others. Riccardo gave those who worked for him opportunities, who in turn paid this forward to those who worked for them. Rodger Doxsey, one of Riccardo’s early recruits and head of the Hubble operations at STScI until he passed away in 2009, was an outstanding example of this. Like Riccardo, he cultivated opportunity. Rodger knew that in order for his team to be successful they had to have opportunities to grow and make the mission better. I will forever be grateful to him for the opportunity doors he opened for me – to be the Institute’s Hubble project scientist and eventually the Hubble mission head following in his footsteps. When Rodger passed, we

established the Rodger Doxsey Science Systems Engineering award at STScI to annually recognize an employee who makes outstanding contributions to our missions and upholds the principles of science systems engineering.

I'd like to comment briefly on the Hubble Fellowship program, in part because I think it is an example of opportunity at its finest, and in part because the program shaped my career. I won't go into the history of how it came about, but Riccardo had a desire to develop science leaders. He saw it as a way to grow talent without adherence to the practice of the day - a chance to explore, to be creative, to experiment, and to take risk in striking out in new directions. He said **"Its creation was for me a statement of principle for the pursuit of excellence and against conformism and mediocrity."** In short, it was a force multiplier for creating leaders. Give them opportunity and the field of astronomy will benefit.

As I was finishing my PhD thesis at the University of Wisconsin in Madison, opportunity knocked in the form of a fedex letter from STScI. I picked up the letter in the front office of the apartment complex where my wife and I lived at the time. I remember shaking as I read that Hubble Fellowship offer letter while running at top speed across the apartment complex grounds. Here was a gift of a lifetime that I could not pass up. That fellowship opened the door to opportunities that I had not imagined possible. I thank Claude Canizares in the audience today for agreeing to sponsor me on short notice when I chose to use the fellowship at MIT. Those years were wonderful. I learned a lot about X-ray astronomy since the first year there I was embedded in Claude's group in the Center for Space Research.

[Slight detour:

George Clark's talk yesterday and his comments about Bruno Rossi jogged my memory and brought back some wonderful memories for me of my time at MIT. When I arrived there, there was no office for me. So, Claude put me in the emeritus office on the 6th floor. I was sure at the time it was the best office I would ever have – a beautiful wooden desk (Bruno's), a wall of

wooden bookshelves filled with Bruno Rossi's and Herb Bridge's books. For me it was an almost surreal experience. I found I could lose myself for hours in those books or sitting at Bruno's desk, just thinking. When I heard George's talk yesterday, the thought that I have now occupied the offices of two of the giants of X-ray astronomy dawned on me. Pretty cool. And humbling to say the least.]

I am sure it is no exaggeration to say that most of the people in the room today knew Riccardo as well or better than I. I only met him a few times. I remember the first time – it was in the hallway outside the STScI auditorium. I thanked him for establishing the HF program and for the opportunity to be a fellow. I don't recall his exact words but it was something stated casually along the lines of "You're welcome but now I expecting you to go do great things" or something like that. Never did I expect that I would become director of the Institute he helped create. If I had, oh the questions I would have asked him!

STScI is a different organization today than it was when Riccardo was director, but the foundation he and others built is solid as a rock. That's good, because it is considerably larger than it was when Riccardo was director, and we're working on three Great Observatories not just one as Hubble approaches its 30th anniversary in space. The challenges we face now are both the same and different, all at the same time. The Institute has evolved in ways that Riccardo probably didn't imagine, but probably wouldn't surprise him. Opportunity abounds. STScI is looked at as a creator of leaders and a creator of opportunities for others. (We even have a fellowship named in his honor.) The democratization of science continues with the double-blind proposal review process, the expansion of opportunities to perform analyses in minutes that used to take months or even years, and the opening of new frontiers with ambitious observing initiatives.

Each director of the Institute is a product of their time. There are three of us in the audience today. Bob Williams, Matt Mountain, I'm honored to be following in your footsteps as well as Riccardo's. We've all faced challenges in shaping the Institute's future. Riccardo set a standard for meeting challenges that have served us well. While each STScI Director has made the job their

own, all have stood on his shoulders to see opportunities that might have remained hidden. Believe me, I still hear about how Riccardo said this or handled that, or what he would do now. It always makes me smile – I can picture him saying “That’s fine but don’t look back, push forward.” His spirit is alive and well at STScI.

Around the time of Hubble’s 25th anniversary, Riccardo said: **“If I had a different life, I’d like to have a result like Mozart, which made so many people happy.”** That quote strikes me as odd, because it sounds like Riccardo didn’t fully appreciate all that he had done to make so many people happy. Astronomy is so much better, and we as scientists and human beings are so much better, for Riccardo having lived exactly the life he led. It is good that we are gathered at this symposium to remember him and celebrate his life because it solidifies the friendships and experiences that we hold dear. To Mirella and Riccardo’s family, I say thank you for sharing Riccardo with us. I am sure that was difficult at times. To all of you here today, I say let’s make sure that others remember him as well, and that we honor him by creating opportunities for others.