

The Uhuru Spirit and the Search for Secrets of the Hoary Deep

Before their eyes in sudden view appear
The secrets of the hoary deep, a dark
Illimitable ocean without bound, ...

J. Milton *Paradise Lost*

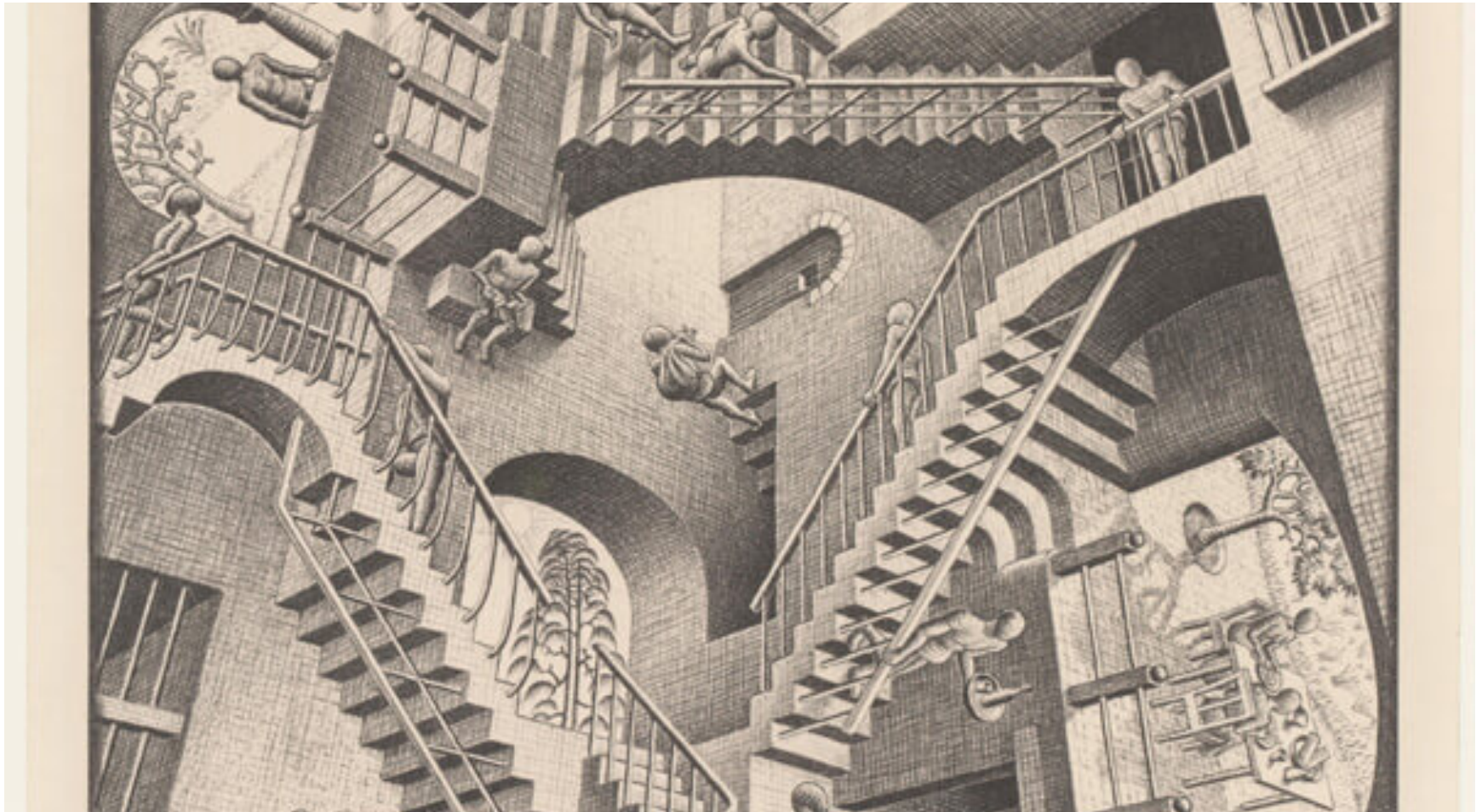
American Science & Engineering (AS&E)

- Started in 1958 with Martin Annis as President and Bruno Rossi as chairman of the Board
- Doing space research, mostly classified in a converted milk truck garage

AS&E started as a converted milk truck garage
(not really this one)



AS&E the way I remember it in 1969



The X-ray Sky Before *Uhuru*

- From proposal for a Large Orbiting X-ray Telescope (LOXT), May 1970
- ~ 50- 60 X-ray sources known ($J > 0.1 \text{ photon cm}^{-2} \text{ s}^{-1}$)
- Blue varying stars X-ray stars, e.g. Sco X-1, Cyg X-2
- Flaring X-ray objects, e.g. Cen X-2, Cyg X-1?
- Crab pulsar
- Crab, Tycho, Cas A SNR
- LMC,
- M 87
- 3C273
- And the X-ray Background Radiation

Ref: J. Dolan, 1970, AJ 73, 223

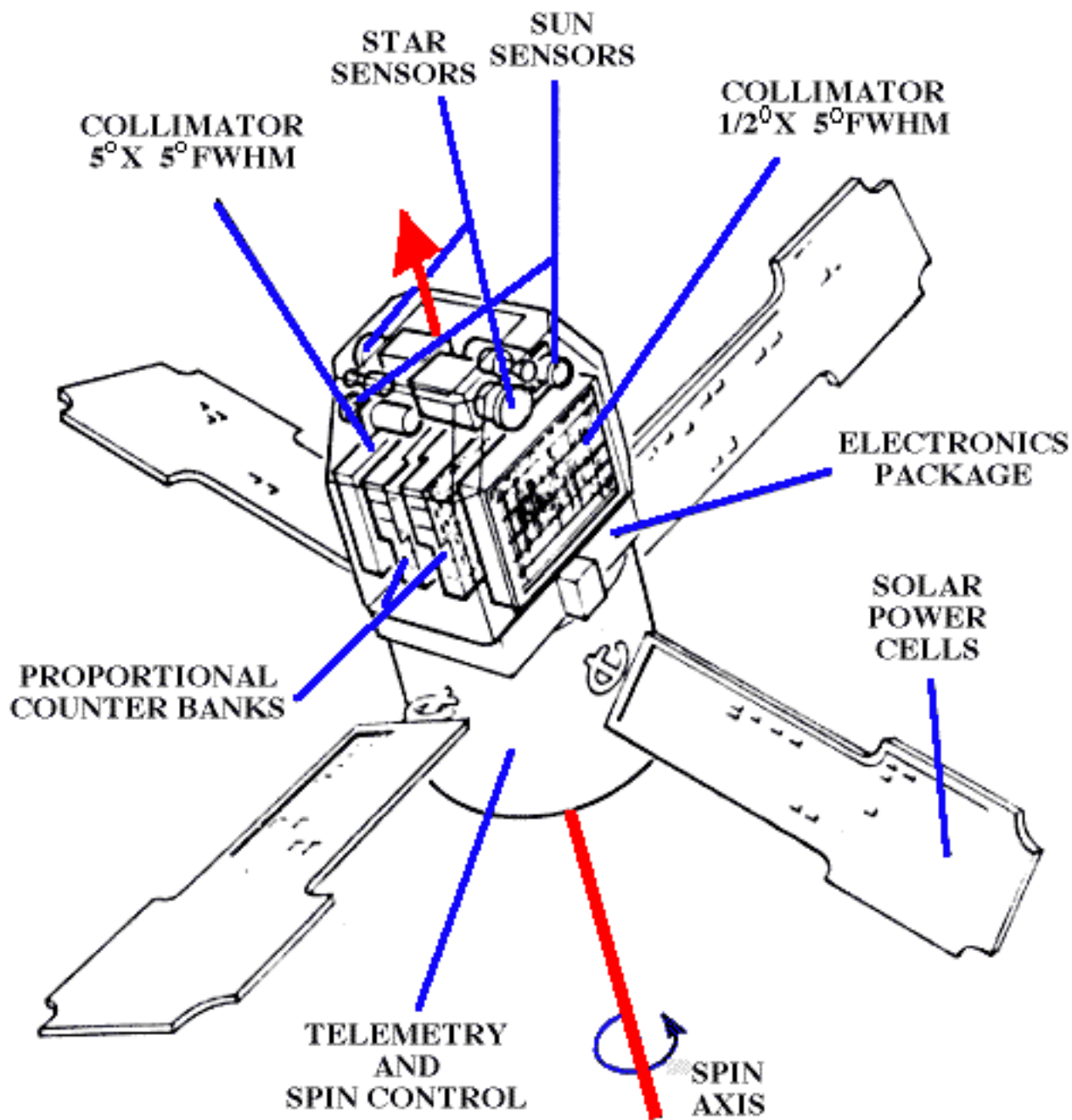
Activity at AS&E 1969-70

- Preparing the instrumentation for *Uhuru*
- Working on X-ray telescopes for solar research on Skylab (2 arcsec resolution)
- Working on the proposal for the Large Orbiting X-ray Telescope (a 1.2 m mirror with <5 arcsec resolution)

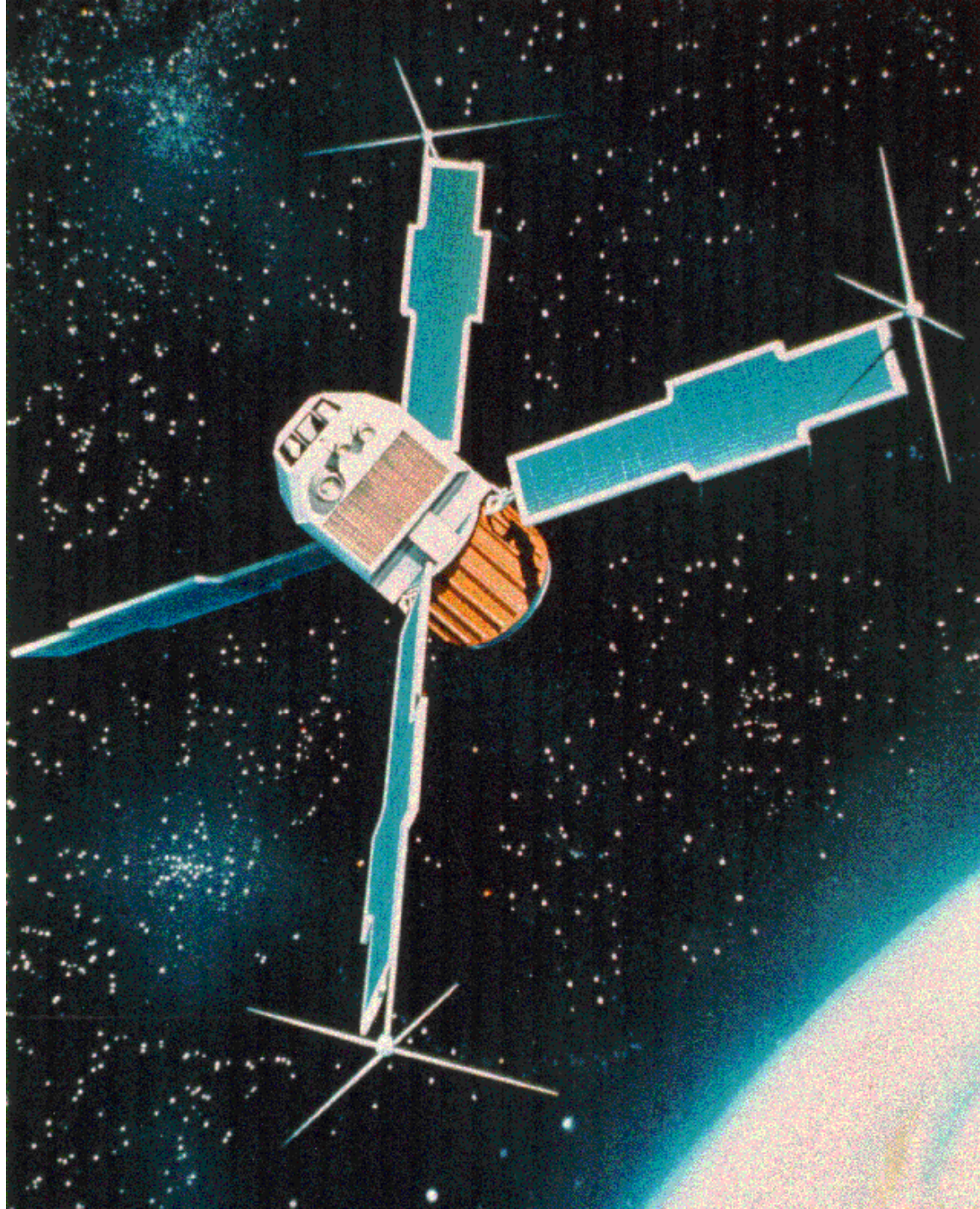


“We are not barbarians from the north, coming to sack Rome. It is our intent to operate the observatory as a national facility available to all astronomers.” R. G. 1970









The Uhuru Spirit

“We created what we called the Uhuru spirit. With the Uhuru spirit you absolutely let the other guy have it, Each of the scientists had prejudices and feelings about what was most important to do next and defended his point of view as vigorously as he could. “ R. Giacconi, *Secrets of the Hoary Deep*



The Uhuru Spirit -2

“These tough, no-holds-barred debates were most often resolved by consensus, and ...ultimately did not separate us, but rather united us in a shared learning experience.”

R. Giacconi, *Secrets of the Hoary Deep*

Dr Simon Mitton



Left to right:
Ethan Schreier,
Riccardo Giacconi,
Terry Matilsei,
Harvey Tannanbaum,
Edwin Kellog

“Looking back on that time, I recognize that those intense interactions were a rather unorthodox way of doing science we were young, enthusiastic, intoxicated by our daily glimpses into a mysterious new universe.”

R. Giacconi, *Secrets of the Hoary Deep*

Before -> After Uhuru

- 30 -> 339 sources known
- X-ray stars -> binary star systems containing a neutron star or possibly a black hole
- Maybe 1 -> ~ 10 AGN
- Sources associated with Virgo and Coma galaxy clusters shown to be extended and ~ 50 additional clusters detected.

“ . . . it was beautiful, almost mystical to the data coming in. Suddenly we have our own channel of communication with nature. ”

“We had truly started to probe “the hoary deep” in a new light”

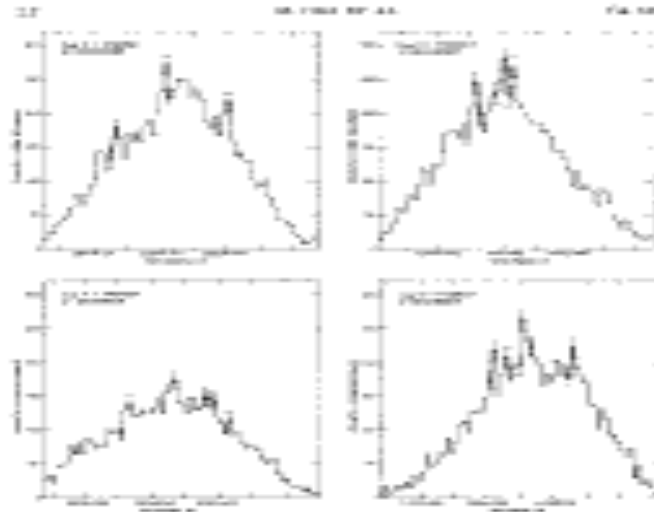


Figure 1. Counts recorded on the Apollo 11 lunar surface. The top two graphs show the data for the first 1000 seconds of the mission, and the bottom two graphs show the data for the next 1000 seconds. The data shows a clear peak in the counts, which is interpreted as the signal from the lunar surface.

X-Ray Pulsar Cen X-3

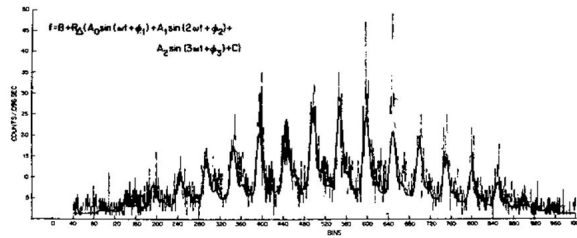


Figure 5. X-ray pulsations of Cen X-3. From Giacconi, 1974.

Pulses occur at intervals of 4.84 seconds

- The two-year period after the launch of Uhuru, was, “the scientific highlight of my career. It was the most mystical moment, when we suddenly understood.”



“our discourses should be about the real world, not a world on paper.” Galileo

“We should use modern technology for the construction of instruments powerful enough to solve physical problems by direct observation rather than by inference or speculation.” RG



“I am grateful to live in this heroic era of astronomy and to have been able to participate and contribute to its evolution.”

R. Giacconi, *Secrets of the Hoary Deep*