3. Adam Sturman

Extending the Sensorium

So now you're ancient man, staring at the nighttime sky, thousands of years ago. These little points of light—what are they? Where did they come from? How far away are they? Today, when we look to the heavens, we do *not* see paradoxes, but we see—explanations! A little kid stares at the sky, and asks his father, "Daddy, what are those little dots in the sky?" "Oh, those are stars, like our Sun, far away." Living in this so-called "modern world," we have the luxury of scientific popular opinion. And, it appears that the world has lost its desire and passion for new discovery.

But ancient man did look to the sky, and saw paradoxes. They meticulously, over a period of many years, took measurements of these points of light, and one of the first things they must have noticed, are the "Wanderers," today known as "planets." Secondly, future generations of astronomers must have realized, that the measurements of the past were beginning to lose accuracy. The older the observations, the less accurate they were. This paradox, today, is known as the "precession of the equinoxes." And, you will notice about a 1°, change, over a period of 72 years.

Now, some paradoxes are clearly visible to the senses and naked eye, like the refraction of light into water, or the planetary orbits of the sky. But other paradoxes are not visible to the senses. Increasingly, as we begin to break out of the shadow of appearances, our discoveries will come from both the domain of microphysics and astrophysics, which both require the help of various forms of technology.

Take, for instance, telescope technology: In astrophysics, the phenomena we observe do not directly come from our senses. Instead, we receive data and information, from our telescopes and instruments. What your telescope shows you, is not the phenomena that you're looking to in the sky.

Instead, what you see is an intersection between universal physical principles, and the telescope. Some of the principles that are acting on the telescope, are understood and known. What appears to be anomalous or paradoxical, in the data, represents a set of unknown principles, that have yet to be discovered.

So, what are we doing with these instruments? We are extending the senses: For instance, can we detect X-rays with our eyes? Can you feel the temperature of plasma? Would that hurt? Let's look at the difference between man and an animal. Take, for instance, bats: Now, bats have sonar. So do we! Without sonar, a submarine, sitting at the bottom of an ocean would be pretty helpless. Now, take a look at dogs: Dogs have an amazing sense of smell. Well—we do, too, now! Anyone that's been to an airport in the past couple of years, has noticed that we have these bomb-sniffing devices that can smell just one molecule of explosive.

Now, humans don't have these sense organs built in, so to speak; these extended sense organs are not hard-wired into our genetic code. Human nature is not genetically fixed. Take for instance a honey bee: A honey bee will instinctively make a honeycomb for its young, and will do so, in the same, exact way, forever and ever. Take a look at a beaver: Beavers build dams. Are beavers building dams out of concrete and steel yet? Animals are forced to wait for physical evolution, to see a fundamental change in their behavior. Humans are different, of course. Humans evolve, every time we make a discovery, and assimilate that discovery into our culture. Therefore, in a sense, the evolution of humans is dependent on the level of culture. The more developed a culture is, the greater its rate of evolution.

Now, let's compare man to an animal, again: To an animal, the sense organs represents a cage; it is such a cage, that the animal will never be able to see the paradoxes in its sense-perception, like the orbits of the planets. Now, for instance, a bat will always use its built-in sonar. It has no real free will to develop new modes of sensing. But, how about human beings? Are we stuck in that same cage of sense-perception? No! Our special quality of mind, allows us to break out of the box, and see beyond the shadow-world of sense-perception, and in fact, our humanity gives us a continuous development of sense organs. These extended sense organs, in this case, various forms of telescope technology, embody a set of understood scientific principles. If we didn't know what X-rays were, would we be able to detect them or control them?

These new sense organs open up a whole new realm, an extended Sensorium, and extended Sensorium that opens the doors for new paradoxes and anomalies.

Now, economics: This process of extending the Sensorium has direct implications into economics. We use this extended Sensorium to open the door for new paradoxes. It is the application, the principle of Platonic reason, that allows the human species to survive. Take, for instance, X-rays and nuclear processes: Did Mme. Curie understand the full implications of the discovery of X-ray radiation? Years later, we now have the ability to battle cancer; we have the ability to see broken bones, and to look at many types of funny things in the universe. How about nuclear power? What did that do for economics? It revolutionized the possibilities for the generation of electricity, and raised the living standards for people across the world.

Take another example, one of the most basic scientific instruments—an instrument that allows one to measure the two angles required to determine the position of a star in the celestial sphere. Through the journey of all human history, all serious scientific cultures devised devices, that will allow that society to take accurate measurements of the stars. This seemingly simple instrument allowed man to make incredible breakthroughs in the organization of society, and in the arts.

FIGURE 3.1
Chandra X-Ray Telescope

FIGURE 3.2
Chandra's Orbit

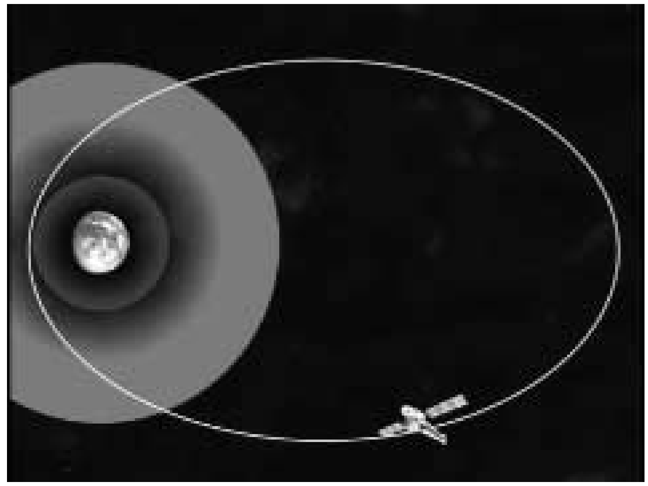
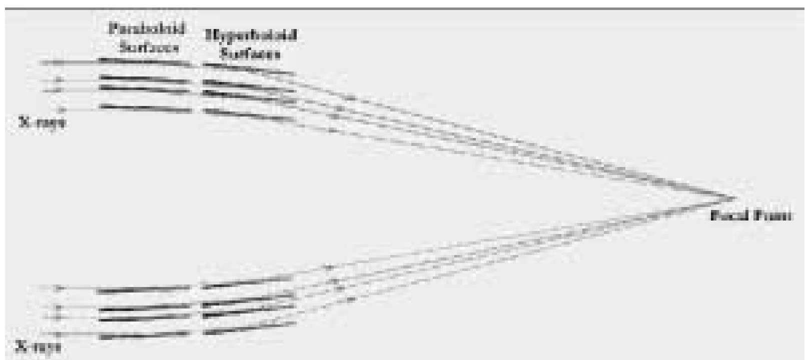


FIGURE 3.3
How the X-Ray Telescope Focusses High-Energy Electromagnetic Waves



Understanding the movement of the stars may seem like a pretty useless discovery, at first; however, it was just this discovery, that allowed for the creation of a calendar—and modern agriculture. Without understanding how long a year was, you would not be able to have modern agriculture. And, in fact, that was just the beginning, because one of the most fun things you can do, with an understanding of the movement of the stars, is, the navigation of the oceans and seas.

So, all great discoveries required the help of technology. And, how is this technology created? Man first must realize that his senses do not tell him the truth. And, this is evident, in both the nighttime sky and the behavior of light under refraction. The human mind must hypothesize the existence of the real universe lying outside the cage of simple sense-perception. Once these thought-objects are discovered, they are now put into the willful control of humanity, and we can therefore build new technologies that harness these newly discovered principles, detectors included.

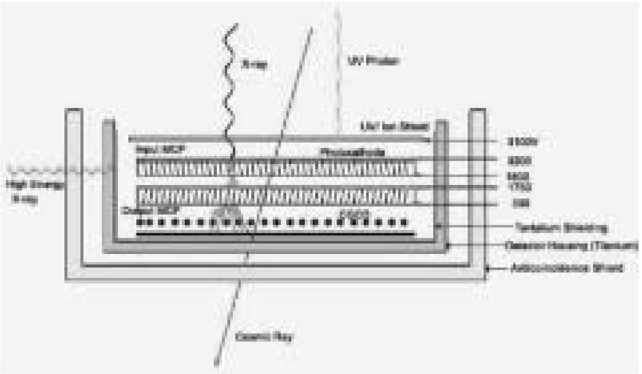
So, I want to investigate two of these detectors, that we actually use to look at astronomical phenomena. And these telescopes do represent the cutting edge of technology. I wanted to look at two interesting ways, two generalized sense organs, that we currently use to observe the heavens. Our telescopes pick up anomalies that are represented in the electromagnetic spectrum, and I'll briefly describe an X-ray telescope, which represents the higher-energy register of the spectrum, and a radio telescope, which represents the lower end of the spectrum.

This telescope (**Figure 3.1**) is named Chandra and it is an X-ray telescope. It launched July 23, 1999, so this thing's been in use for about four years now. Now, as you can get a sense, this telescope is not based on the planet, but it actually orbits the Earth, which is very important. **Figure 3.2** shows the orbit of Chandra. You can see the Earth; those two rings represent the Radiation Belts. Now, the farthest part of the orbit, is actually a third the distance to the Moon, and the closest represents about 10,000 miles to the planet. Because of this highly elliptical orbit, it allows for about 85% of its time outside the Radiation Belt, and the reason why this is so important, is because when this telescope is inside the Radiation Belt, it receives quite a bit of X-ray interference. This telescope can take about 55 hours of uninterrupted observations at a time.

Now, the challenge of building an X-ray telescope is hav-

FIGURE 3.4

The X-Ray Telescope's Main Detector



ing the ability to focus X-rays (**Figure 3.3**). What they had to do, in order to focus these higher-energy electromagnetic waves, is they have to bounce the X-ray off a very low angle of incidence, almost in a ricochet angle. The first set of mirrors, on your left, are parabolic surfaces. The next set is a set of hyperbolic surfaces, and it will focus the X-rays onto a focal point. This was one of the main breakthroughs needed to have an X-ray telescope.

Now, there's something very interesting with these mirrors that they use to reflect these X-rays. These mirrors are actually the world's most smooth and cleanest mirrors every produced. And to get a sense of how smooth these mirrors are—it's actually a set of four parabolic and four hyperbolic surfaces. Now, these mirrors are so smooth, it would be like, if you took the Earth and smoothed out the Earth so that the highest mountain was only 78 inches high. So, pretty much these mirrors are smooth to within just a few atoms, which it took them a couple of years to produce.

Now, this telescope (**Figure 3.4**) has four detectors. The one we're going to look at, very quickly, is its main detector. You see that squiggly line on the left—that represents an X-ray: What happens is, that X-ray strikes that first plate. Each plate has 69 million, tiny lead-oxide glass tubes. What makes these tubes amazing, is that they are about 10 micrometers in diameter, which is about one-eighth the thickness of a human hair. So, they had to figure out a manufacturing process, to actually make tiny little glass tubes one-eighth the thickness of a human hair. There are 69 million of them, per plate—see it strikes two plates. Now, when an X-ray hits one of these little tubes, it gives off a burst of electrons—and the electrons can be detected, and the direction of the X-ray can be determined quite precisely.

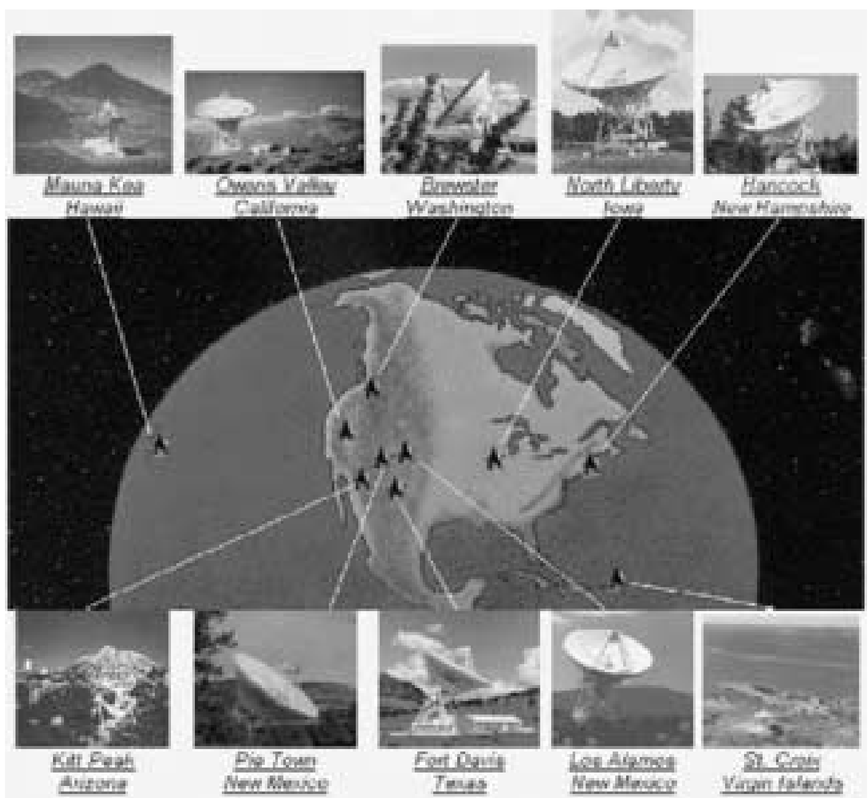
The next instrument I want to look at, is the Very Long Baseline Array [VLBA] (**Figure 3.5**). What the Very Long Baseline Array is, is it's actually not one telescope, it's a group of ten telescopes, from Hawaii to the Virgin Islands. The other eight are located in the United States; they're all identical; the dish is about 82 feet high when it points up.

What's pretty amazing about this array of telescopes, is that, altogether, these telescopes can see an object giving off radio waves thousands of times more accurately than an optical telescope could observe an object giving off visible light.

What makes this array impressive—because radiotelescopes have been around for quite a while—is that they have to combine all ten signals, and that's called "interferometry," which means using several instruments in which you compare the measurements between the instruments. This is where this

FIGURE 3.5

The Very-Long Baseline Array Telescope



array of telescopes gets kind of interesting: They record the observations simultaneously onto magnetic tape; the tapes are then brought to a central location. Now, the tapes have to be synchronized *within one-millionth of a second*. That means, that you have to take ten magnetic tapes, and align them within one-millionth of a second. Now, if you do this—if you have this ability to line up these tapes within one-millionth of a second—you will have the VLBA with a maximum highest resolution of less than 1 milliarc-second—that's about one-thousandth of a second of an arc. If you don't understand what that means, it would be like reading a newspaper in Los Angeles standing in New York City. That's the resolution of this array of telescopes.

So, the exploration of space is now necessary. And we must increase the density of paradoxes and discoveries, if the human race is to survive. It is a project which could show all cultures, that we really are all human. Imagine: A Moon observatory on the dark side of the Moon. That would mean almost no interference from the Sun or the Earth, and our observations of these phenomena would be increased by the order of many magnitudes—therefore, increasing our power to make creative discoveries.

Animals are caged by their senses, and we are not. Let's just have some fun. Thank you.