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To Eta Cas and Back — Howard L. Cohen

October 20, 2007 marks an approximate date when a radio signal sent from the University of Florida campus will reach a distant sun. Will a returning signal reveal the presence of extraterrestrial life in early 2027?

In the northeast corner of the third floor lobby of Weimer Hall, home of the College of Journalism and Communication on the University of Florida campus in Gainesville, is a small glass case. Few have seen this inconspicuous display that contains a bit of space history that began nearly twenty years ago and will end in 2027. Then, some hope a returning signal from outer space will display the presence of extraterrestrial intelligence living on a distant world.

This radio signal began its light speed journey Tuesday, 1988 May 24, at the groundbreaking ceremony of the Flanagan Telecommunication Wing of Weimer Hall. Dr. Ralph L. Lowenstein, Dean of the College from 1976–94, and known for his visionary goals and unconventional methods that helped put his college at the forefront of modern journalistic technology, proposed that the college broadcast the dedication ceremony into outer space. In fact, Dr. Lowenstein wanted the live signals of the groundbreaking ceremony directed at a specific spot in the heavens where potentially "someone" on a distant planet might receive the transmission and even respond!

Consequently, Dean Lowenstein asked my help finding a suitable "target" for his live broadcast. We decided the target star should not be too distant lest the signals be too weak and take too long to reach their destination. The star also needed to harbor potential planets where other world beings might reside. And, of course, the target star must be visible to the broadcasting dish that would send the live signals on its way.

I suggested we look for a "sunlike" star within a few dozen light years. Such a star might have a higher probability of bearing an "earthlike" planet with potential creatures that could communicate within a reasonable time span! One of the most sunlike stars in our neighborhood is Alpha Centauri A, a member of the closest known star system to Earth and only 4.4 light years away. But, this nearby star lies in southern skies not visible from North Florida.

(A *light year* is the *distance* light, including radio waves and all other types electromagnetic radiation, travel in a vacuum during one year. Thus, light requires 4.4 years to travel from Alpha Centauri to Earth.)

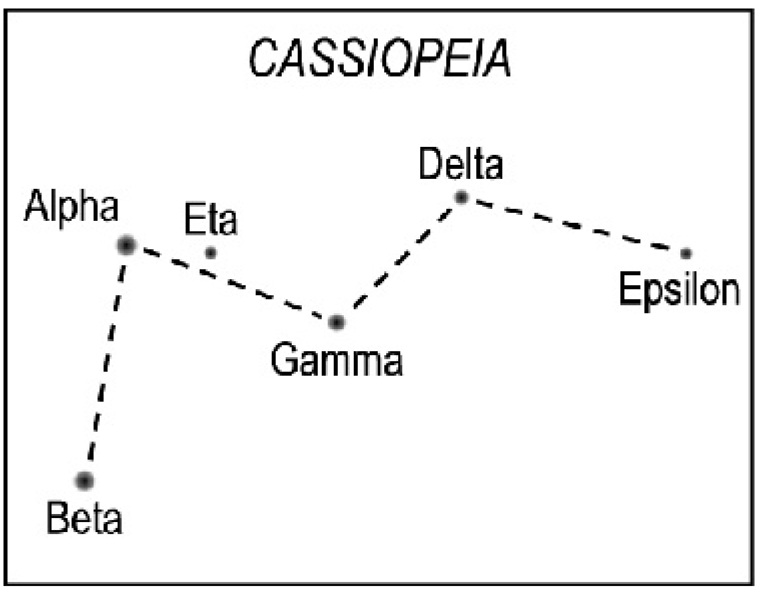
Unfortunately, most remaining known stars within about 25 light years are cool, faint, dwarf-like stars. Sirius and Procyon are among the rare exceptions. Sirius is only 8.6 light years away but approximately 25 times as luminous as the Sun and attended by a very hot, earth size white dwarf. Procyon, 11.4 light years distant, is about seven times the solar luminosity and also bound with a small, hot white dwarf. Both stars are also much younger than the Sun by perhaps several billion years, which might be a limiting factor in developing intelligent life.

Among our remaining "neighboring stars" within a few dozen light years, the Sun literally shines! It is larger, hotter and more luminous than most others in our vicinity. Therefore, contrary to popular belief, our Sun is far from typical or ordinary in our part of space. While some of our neighbors might be older than the Sun, many astronomers thought the low luminosities of most nearby stars might lessen chances for habitable planets. (In recent times, we have detected non earthlike planets orbiting some cool, small stars.)

Still, one star stood out as a potential candidate, Eta Cassiopeiae (abbrev. Cas), occasionally known as *Achird* according to A. Becvar. (Probably a modern recent designation as R.H. Allen's *Star Names* lists the star as unnamed.) Various other names include 24 Cas, h Cas, HR 219, HD 4614, GC 962, SAO 21732, BD +57 150, ADS 671, WDS 00491+5749A, Σ60, TYC 3663-2669-1 and HIP 3821! (From now on, we will refer to this star by its standard abbreviation, Eta Cas.)

This somewhat inconspicuous star does *not* make up part of the well-known "W" or "M" shape of Cassiopeia but lies less than two degrees from second magnitude *Schedar* (Alpha Cas). Shining at only visual magnitude +3.45, Eta Cas is thus a "naked eye object" but sometimes difficult to spot in lighted, suburban skies. (See sky map.)

Nevertheless, Eta Cas is more sunlike than most of our other stellar neighbors and relatively close, lying only 19.4 light years from Earth. Technically, Eta Cas is a G0 V star compared with the Sun's G2 V spectral class. Its temperature and mass are like the Sun although both this star's radius and luminosity appear about 20% larger compared with the Sun. This makes Eta Cas a whitish-yellow, hydrogen-fusing star not unlike the Sun.



Still, several characteristics of Eta Cas may reduce its chance of having habitable planets and therefore the probability that "someone" could respond to our beamed transmission! These factors include both its binary nature and chemical composition.

Eta Cas has been known for several centuries to be a visual binary star. Although Eta Cas shines only at fourth magnitude, small telescopes easily reveal its glorious nature—an eighth magnitude, yellowish-orange companion (visual magnitude +7.51) shines only 11 arc seconds away! So, small telescopes easily resolve this "double star" with the two slightly different star colors easily noticeable. The companion star (K7 V) appears much dimmer than its brighter component since it emits only 7 percent of the Sun's luminosity due to a smaller radius (half the Sun) and lower temperature (about 4,100K compared with 5,800K for the Sun).

Note: Six dimmer optical components lie near Eta Cas but seem unrelated to the Eta Cas System and are probably more distant stars.

From a planetary prospective, the binary nature of Eta Cas may limit possible stable orbits for habitable planets due to gravitational interactions from the two stellar components (A and B). Although their stellar orbit period is long, 480 years, observations over more than two centuries have produced reliable data. Orbit analysis shows Eta Cas A has a mass very similar to our Sun with Eta Cas B having a mass of about one-half a solar mass. In addition, the two stars move in an eccentric path (eccentricity 0.50) with an average separation of approximately 71 astronomical units (AU), or about 1.75 times the distance of Pluto from the Sun. (An *astronomical unit* is the mean Earth-Sun distance, about 93 million miles or 150 million kilometers.)

Since their eccentric orbit brings the two components within about 36 AU of each other at closest approach and 107 AU at farthest approach, one might suspect that inner planets in a “habitable zone” (liquid water possible) might not have sufficiently gravitationally stable orbits for development of life. Still, some studies (for example, SolStation.com) show habitable planets might exist about one AU from Eta Cas A.

Note: At one time Eta Cas A has itself been reported to be a spectroscopic binary (binary nature detected through analysis of spectra). This would put even more stringent limits on a stable orbit. However, the multiplicity of Eta Cas A has never been confirmed.

The astronomer James Kaler writes that, “Except for the much-longer period, Eta Cas is something of a northern-hemisphere version of Alpha Centauri.” (Alpha Centauri AB has an orbit period of 79 years.)

Interestingly, the Eta Cas System is also an *RS Canum Venaticorum* type variable star with a brightness variation of about 0.05 magnitudes (about 5%). This type of variation in luminosity results from active chromospheres (thin atmospheric layers) in close binary systems with possible variations due to mutual eclipses.

Unfortunately, besides its binary nature, the heavy element content of Eta Cas may also limit this system’s ability to produce habitable planets. Some studies suggest the metal content of Eta Cas is much less than that of our Sun, with iron and other metals only about half the solar abundance. This often indicates such stars are older than the Sun since the heavy element abundance of our Galaxy has increased over time due to their production in high mass stars and their eventual distribution into space. So, an older age would give more time for life to develop and evolve, a positive result.

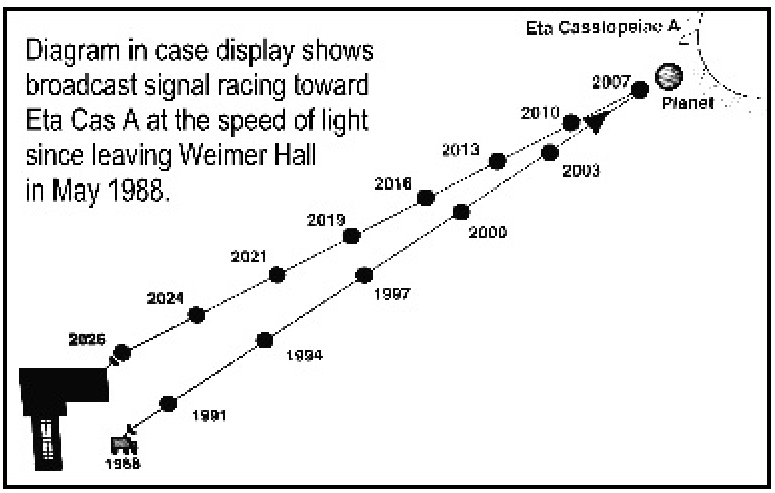
But wait. Research based on modeling Helium abundances in nearby visual binaries (J. Fernandez et al. 1998) suggests an age actually *younger* than the Sun’s 4.6 billion year age by around 500 million years. However, this age is uncertain by a few billion years. It is also possible that Eta Cas was born in a different region of the Milky Way Galaxy than the Sun with different star formation rates and chemical abundances. This might explain its younger age regardless of low metal content.

Despite the star’s age, the apparent deficiency of metals suggests a larger problem with finding habitable planets around Eta Cas. Planets like Earth (*terrestrial planets*) are mostly made of “rock.” Thus, if the Eta Cas system really contains a low abundance of heavy elements, the lack of these materials might limit the ability of a star system to form metallic (i.e., rocky) planets like Earth.

Still, Eta Cas seemed the best choice in 1988 to beam a live broadcast signal at the time of the Weimer Hall dedication. Moreover, Cassiopeia was well placed in the sky for the broadcast dish, about halfway above the northwestern horizon. So, at the time of the Weimer Hall groundbreaking, a satellite uplink vehicle directed the live ceremonial signals toward Eta Cas, more than nineteen light years away, with the hope that this star possessed habitable planets.

October 20 of this year marks the approximate date the radio signals, traveling at the speed of light, should reach the Eta Cas system. If anyone on a planet in this system receives this broadcast signal, we could potentially get a message back in the year 2027!

The showcase hanging in Weimer Hall recounts the dedication ceremony in words and pictures including a photograph showing Dr. Lowenstein presiding over the ceremonies as “Dean of the College of Journalism and Interstellar Communications.” Finally, a diagram shows the position of the interstellar signal as it journeys at the speed of light on its way to Eta Cas. In addition, the diagram shows the signal returning to Earth in 2027, assuming some alien being in the Eta Cas system immediately responds to the received signal! (See diagram.)



Note: The Weimer Hall wall display lists the return year as 2026 but this probably resulted by taking twice a 19 light year distance and simply adding the year 1988. Using a more accurate distance of 19.4 light years, and adding twice this value to 1988 May 24, yields 2007 March 17 as the (very) approximate return date. (Uncertainties in distance could produce an error in the date of a few months.)

Next time you are on the University of Florida Campus in Gainesville, take a walk to Weimer Hall and visit the Eta Cas showcase on the third floor. Perhaps, over following years, advanced technology will make possible detection of earthlike worlds in the Eta Cas system. In fact, Eta Cas A is on the target list for NASA's planned Terrestrial Planet Finder (TPF). So, who knows, perhaps the 1988 Weimer Hall live broadcast will someday mark more than a dedication ceremony! ¤

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