

# Today in Astronomy 106: contact

- Economical ways to contact, or be contacted by, exocivilizations
  - Bracewell probes
  - Von Neumann probes
- Score of the search: have other civilizations found us yet?
- The sordid tale of UFOs



Flying saucer? No, it's just a lenticular cloud.

But in the month of June 2015 in Texas, [56 UFO reports](#) were made, that were shown to be lenticular-cloud sightings.

# Uncrewed deep-space probes for exploration and communication

- As we have seen, exocivilizations at least start up as carbon/water/DNA beings like us.
- They progress past communicability, producing better and better technology, as we have started to do.
- But as long as they are carbon/water/DNA beings, they would run the same risks as we do in long space flights, probably not travelling far in person.
- So, like us, they will wonder if uncrewed space probes would be the best way to explore nearby planetary systems.
- If they're interested in communicating and exploring, and as soon as they can build probes that can operate **autonomously**, while sending reports back home, they would probably build them and use them to explore.
- That avoids the tremendous expense and risk of in-person visits, thus allowing exploration of more planetary systems.

# Uncrewed deep-space probes for exploration and communication (continued)

If the civilization has developed computer and software sophistication approaching or achieving artificial intelligence (AI), it could construct [Bracewell probes](#) (1960) for observation and timely contact:

- Each spacecraft equipped with communications gear, a great deal of information about the home planetary system, and the **autonomous** AI means to
  - travel to the neighborhood of a habitable planetary system,
  - listen until they show signs of (at least) emerging communications technology,
  - decode their language, observe their customs, and when the time is ripe,
  - contact them from close range and exchange information about their respective civilizations, in a more conversational manner and asynchronous with the home base.

# Uncrewed deep-space probes for exploration and communication (continued)

The trigger for “when the time is ripe” could be, for example,

- the target civilization’s finding of an artifact, or series of artifacts, planted by the exploring civilization, that would indicate advancement to the technological level they’re looking for.
  - The Monoliths in [2001: a space odyssey](#) (1968) are this type of Bracewell probe: signalling when the first one is found on the Moon, and leading humans further, to the next monolith on Iapetus.
- or evidence of that level of advancement, decoded by the probe’s AI from the target civilization’s radio chatter.
  - In [Contact](#), a Bracewell probe in orbit around Vega, 25 ly away, received the first powerful TV signal produced by humans, and broadcast it back to Earth along with a primer and a wealth of information for further contact. It is this broadcast that Ellie detected in the clip we watched [last week](#).

# Uncrewed deep-space probes for exploration and communication (continued)

- We will watch a brief clip from [Contact](#). Here also is the scene of discovery of the monolith in the Moon's Tycho Crater, from [2001: a space odyssey](#).



# Uncrewed deep-space probes for exploration and communication (continued)

- More advanced than the Bracewell probe, and a lot trickier, is the **von Neumann probe**, based upon [John von Neumann's universal constructor](#) (1966).
- These probes would be **self-replicating**:
  - they are supposed to carry out all the functions of a Bracewell probe, **but**
  - also to seek the materials, from the contents of their target planetary system, that it would take to build copies of themselves.
  - Then, using the gathered materials and the factory they contain, make and program at least one copy of themselves,
  - and send the copies on to other target habitable planetary systems in search of emerging civilizations.
  - With this sort of exponentially-increasing probe population, **the whole Galaxy could be explored on million-year timescales.**

# Uncrewed deep-space probes for exploration and communication (continued)

[Questionable content, 31 October 2021](#)

**Images not posted, due to copyright restrictions and creators' preferences**

# Uncrewed deep-space probes for exploration and communication (continued)

- And with that possibility, we reach the so-called **Fermi paradox** (1950):

***If there really are advanced civilizations in the Galaxy, they should have overspread it already, and we should have been visited or contacted by now. But we have not. Where is everybody?***

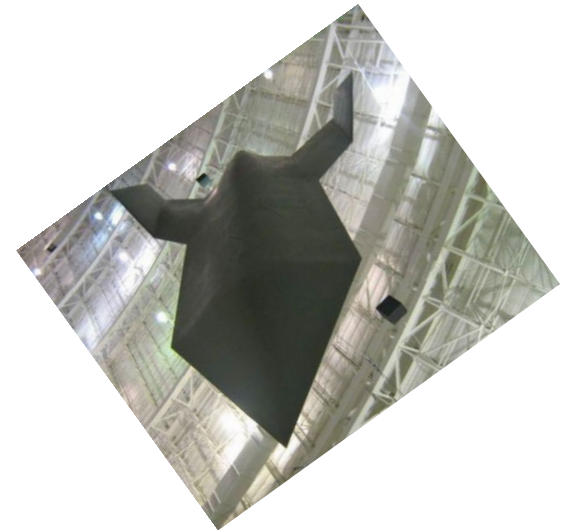
- This is not really a paradox, as it has good answers which are consistent with our estimated numbers of advanced civilizations :
  - Probes might be here but not easy to find (à lá *2001*).
  - The probes might be waiting for certain signs of advancement in our civilization, in which case we haven't received their return signal yet (à lá *Contact*).
  - Or it might simply be impossible, or too costly, to create a von Neumann probe, in which case – using only Bracewell probes – they would not have overspread the Galaxy so quickly.

# Uncrewed deep-space probes for exploration and communication (continued)

- Judging from our own exoplanet-detection abilities, their absence would not reflect our being overlooked:
  - an advanced CTC would have detected Earth and its atmosphere, probably its bio- and techno-signatures; they would know we're here.
- Nevertheless, this “paradox” is also consistent with CTCs being rare, or us being unique in the Galaxy ...
  - as [Barrow](#) has argued scientifically, but not decisively, against Drake and Sagan.
- And also that the Galaxy has indeed been overspread by CTCs, which are present in person on Earth already, notably as **UFOs**.

# Mid-lecture break

- Homework #6 is due Monday, 6 December 2021, at 7PM.
- Quiz #3 will take place Tuesday, 7 December 2021, 2-3:15 PM, right here.
- Practice Quiz #3 will be released tomorrow, for your quiz-preparing use.
- Currently it appears that weather will permit observation of our target exoplanet tomorrow (Friday) night. If you haven't yet attended an observation, please plan accordingly.



UFO, and a US aircraft that has similar shape and flight characteristics as the UFO.

# Have we been visited or otherwise contacted?

Even *via* a Bracewell or von Neumann probe?

- Easy answer: **NO**.
  - In six decades of SETI we have yet to receive our first signal from intelligent civilizations on other planets. You will hear about it loud and clear as soon as we do.
  - We have found no high-tech artifacts in any of our visits to the Moon or Mars, nor any signs on Earth-co-orbiting asteroids.
  - And there are no credible reports of in-person visits by extraterrestrial space travellers, nor “probes” requiring more advanced technology than we have, nor evidence that either has happened at any point in our past.
- Of course we must elaborate on that last experimental finding.

# Has evidence of contact been concealed?

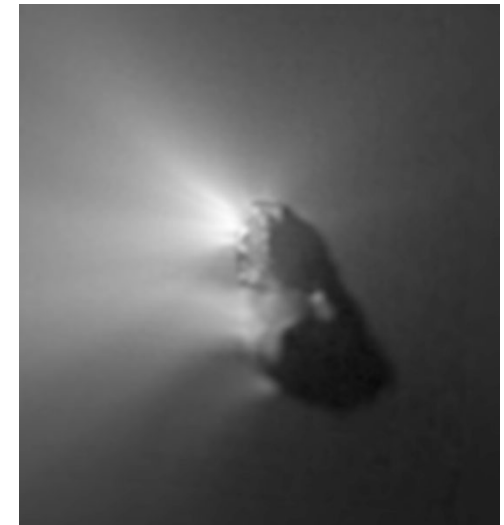
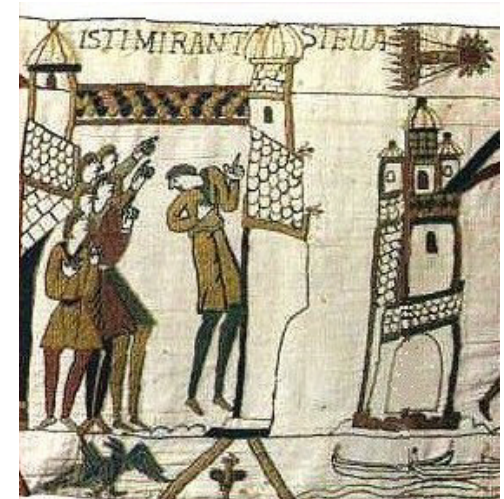
- **No.** Scientists – especially astronomers and those involved in SETI – would be the first to detect signals or artefacts from extraterrestrials...
  - Not the military! They're looking down, not up.
- ... and would publicize confirmed communications.
  - No scientist is obligated by contractual terms to conceal such information or place it first at any government's disposal, at least here and in western Europe.
  - The culture of science is such that correct results are *very* hard to conceal, and scientists are provided great incentive to be the first to reveal important results.
  - And to check each others results for correctness and completeness.

# Then what about UFOs? The sordid tale

Just because an apparently-flying object is unidentified, doesn't mean it comes from outer space or carries intelligent beings.

A cautionary tale:

- Before WW II, reports of mysterious flying objects were infrequent, and essentially always explicable in terms of natural phenomena.
  - Notably comets and meteors, which do come from outer space but are not probes sent by advanced civilizations for Earth surveillance.



Comet 1P/Halley, in 1066 (top, Queen Mathilde) and 1986 (bottom, [Giotto/ESA](#)).

# The sordid tale of UFOs (continued)

- During WW II, the number of aircraft and balloons in the air increased by many orders of magnitude. This led to greater notice of flying objects by people.
- As the war wound down and the jet age approached, many different futuristic shapes and sizes of aircraft and rockets were tried out.
- This is the real business of the top-secret US Air Force (USAF) base at Groom Lake, Nevada which you know as [Area 51](#).



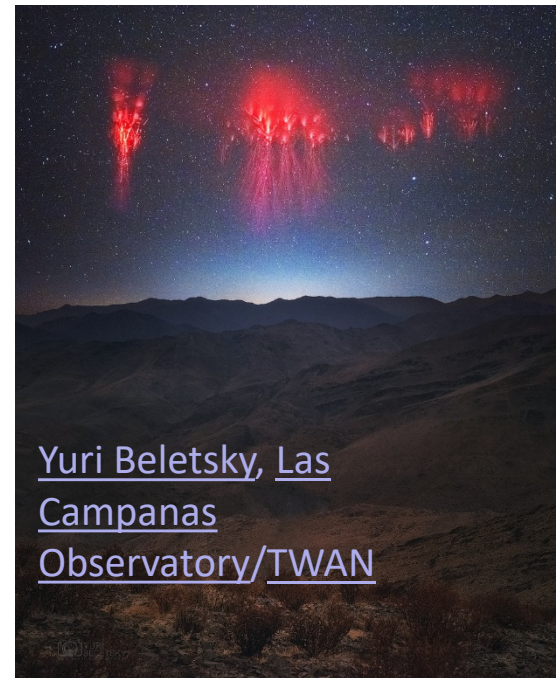
Northrop YB-49, 1947 (USAF)



Avro Y-2, 1959 (USAF/[National Archives](#))

# The sordid tale of UFOs (continued)

- Thus began great confusion provoked by sightings of flying objects, either aircraft or natural phenomena confused with aircraft.
- And an immediate factor of 10-100 increase in reports of UFOs, mostly by normal people merely curious about what they saw,
- but many fringe reports of aliens and abductions, especially as talk turned to space exploration with the approach of the Sputnik era.



Apparently, only English-speakers can see UFOs.

**Images not posted, due to copyright restrictions and creators' preferences.**

- See *Doonesbury*, 21 November 2021:

<https://www.gocomics.com/doonesbury/2021/11/21>

- or, for an animated version originating in [ESRI](#),

[https://www.reddit.com/r/ufo/comments/eup836/animated\\_maps\\_of\\_a\\_century\\_of\\_ufo\\_sightings/](https://www.reddit.com/r/ufo/comments/eup836/animated_maps_of_a_century_of_ufo_sightings/)

# Some more of Area 51's UFOs

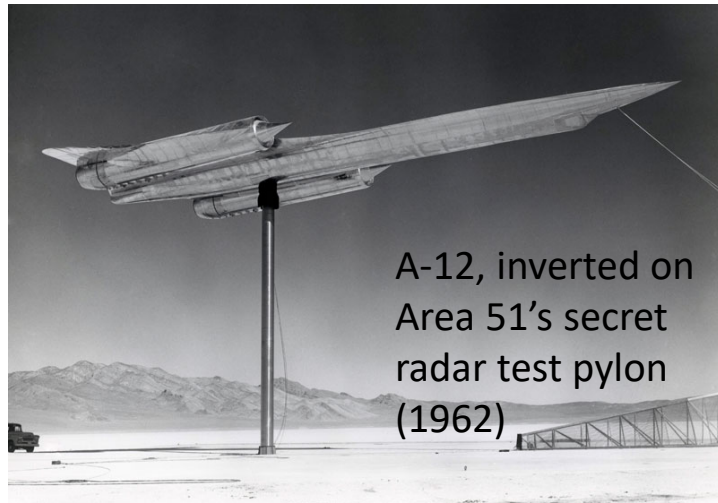


Lockheed A-12  
Oxcart (1962)

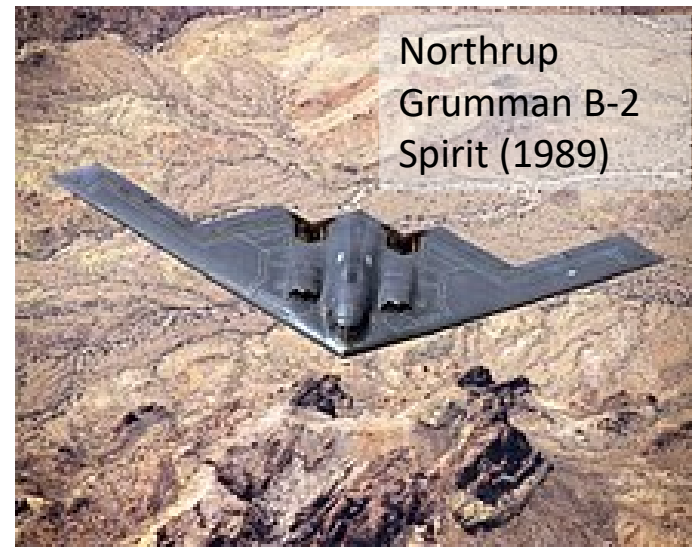


Lockheed  
F-117  
Nighthawk  
(1981)

USAF/  
CIA  
photos



A-12, inverted on  
Area 51's secret  
radar test pylon  
(1962)



Northrup  
Grumman B-2  
Spirit (1989)

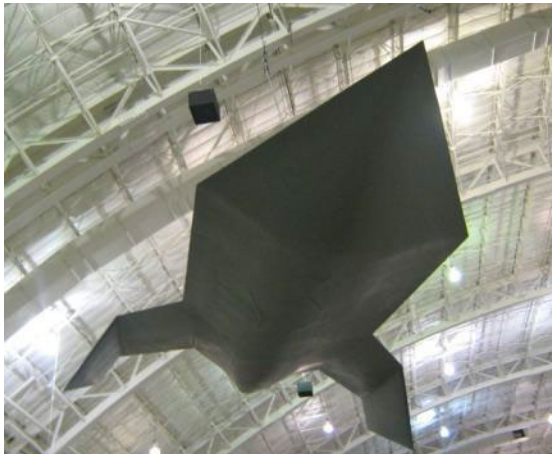
# Some more of Area 51's UFOs (continued)



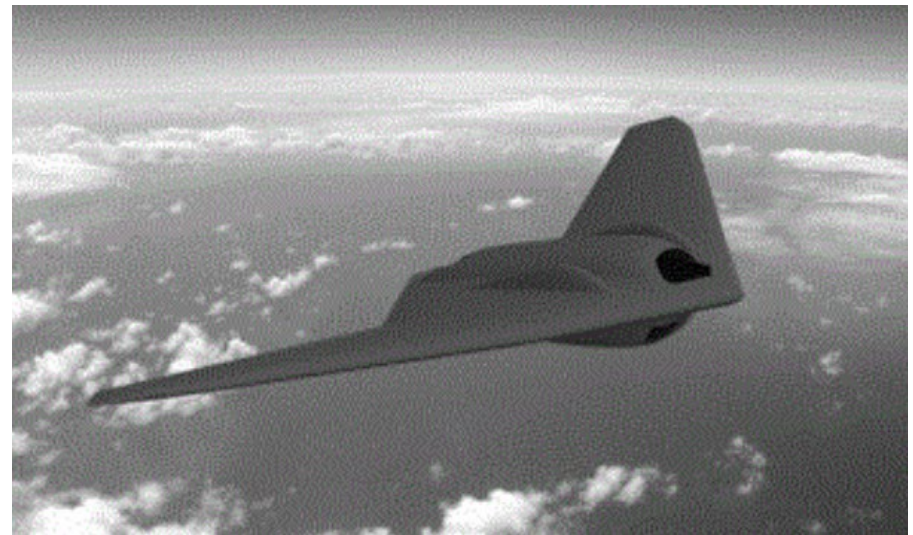
USAF Museum  
photos

US Army  
identification  
drawing

Boeing Bird Of Prey (1996),  
from the side  
and from below.



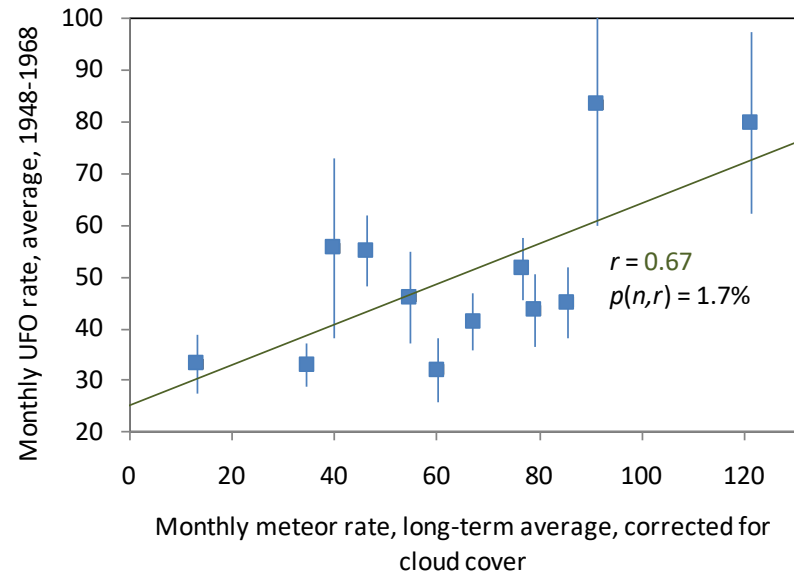
Lockheed Martin RQ-170 Sentinel (2007?)



# Natural “flying” phenomena and UFO sightings



Lenticular clouds over Boulder, CO, 2002 ([UCAR](#)).



Correlation between UFO reports and meteor showers. UFO data from [Blue Book](#), meteor shower data from the [International Meteor Organization](#), cloud cover from [U. Manitoba](#))

# The sordid tale of UFOs (continued)

- So the US Air Force conducted a study of the reports (Project [Blue Book](#), 1948-1968) to see if there was credible evidence of visits by aliens, which would have been a security risk.
  - In 21 years they investigated almost 13,000 reports, plausibly identifying all but about 700 as natural phenomena or known aircraft.
  - The others involve shaky evidence, not mysteries.
  - Thus the Air Force concluded that there was no evidence either of alien visits or a security risk.
- This was not enough for the UFO zealots, who pestered the Air Force and Congress with tales of coverups and conspiracies.

# The sordid tale of UFOs (continued)

- So the Air Force recommended, and Congress approved, an independent research-university study of Blue Book and other evidence. The lead was taken by famous atomic physicist Edward Condon (U. Colorado), and the results go by the name of the [Condon Report](#) (1969). Summary:
  - No credible evidence of visits to Earth by extraterrestrials.
  - Not even any reports sufficiently mysterious that there could be other scientific interest in their further study.
  - In essentially all cases the sightings were of aircraft, human-deployed spacecraft, or natural phenomena.
- This was not good enough for the noisiest zealots either, so the Condon Report was referred to the [National Academy of Sciences](#) for a review.

# The sordid tale of UFOs (continued)

- The eleven-member NAS panel reviewed the Condon Report – the study’s methods and results – and found themselves unanimously in [complete agreement](#) with the report and its conclusions.
- These results are still the most comprehensive study of UFOs. Note below that 13,000 >> 144!
- And this, predictably, was also not satisfactory to the zealots.
  - UFO zealots continued to saturate the airwaves with conspiracy theories and ever more detailed sightings and abduction reports.
  - As an unintended consequence of the invention of the World Wide Web, they ramped up these theories and reports exponentially, amplifying their message WAY out of all proportion to the facts.

# The sordid tale of UFOs (continued)

- Most recently (25 June 2021), the US [Directorate of National Intelligence](#) (DNI) declassified and released some images/videos of 144 related objects and a [preliminary investigation](#), concluding that they could result from one or other of these:
  - Airborne clutter, like birds, balloons, etc.
  - Natural atmospheric phenomena, like clouds or clear-air turbulence.
  - Flying objects developed by (secret) US governmental supported industrial research programs, which haven't been reported in detail yet to the DNI.
  - Foreign-adversarial systems. Naturally DNI wouldn't identify specifics of such things even if they knew, and they probably know a lot.
  - Other, "a small number" for which evidence is incomplete and for which DNI can't yet provide a definite category.

# The sordid tale of UFOs (continued)

- Again predictably, “there is no evidence any of this is extraterrestrial activity” has become “the Director of National Intelligence thinks this might be space aliens”, according to the [mass media](#).
- And the UFO zealots are having a field day.
  - The discussion from the Zealot end has long since taken on a quasi-religious character, unrefutable by definition: they think it must be true if you can’t prove it false in a manner immediately accessible to the masses.
- So most scientists have given up in impatience with trying to convert any of the zealots, focussing instead on teaching the value of evidence and critical thought.