

# Unit One Astrophysics

## **Text A**

### In Search for Alien Life, Researchers Enlist Human Minds

*(By John Markoff)*

*Six of the 42 radio telescope<sup>1</sup> dishes that make up the Allen Telescope Array used by the Search for Extraterrestrial Intelligence project in Hat Creek, Calif.*

HAT CREEK<sup>2</sup>, Calif. – On a chilly morning last week, Jill Tarter sat in a makeshift corner office facing the Allen Telescope Array<sup>3</sup>, pondering a set of parallel lines that striped a window in her MacBook<sup>4</sup>.

Dr. Tarter directs the Center for SETI<sup>5</sup> Research – SETI is the search for extraterrestrial intelligence – and the 42 antennas that sit outside her window are once again sampling radio emissions from a patch of sky that offers a window into one of the spiral arms<sup>6</sup> of our galaxy. Shuttered for more than a year by budget problems, the array was turned back on in December to continue its search. Now, the searchers have another reason for optimism.

With new Web-based software called SETILive<sup>7</sup>, an army of independent citizen-scientists are being enlisted to help with the hunt for unusual signals. The software, which can be found at setilive.org, was designed by Zooniverse<sup>8</sup>, a team of programmers and scientists who have created Web-based systems to enable citizen participation in research in fields like astronomy and marine biology. SETILive was switched on late last month.

In two weeks, more than 40,000 volunteers have signed up, and more than one million radio samples have been analyzed. (Another Zooniverse project, Galaxy Zoo, has enabled more than 600,000 amateur astronomers to help with classifying an immense number of deep-sky objects since 2007.)

Thanks to the remarkable revelations of the Kepler satellite mission, the searchers have a target list. Kepler<sup>9</sup> has revealed thousands of planets relatively close to our solar system. Now, rather than sweeping the entire sky, the array of 42 antennas, spread over the countryside in the mountain valley here in Northern California, dart electronically from target to target, capturing snippets of what the watchers hope might be evidence of alien life.

Dr. Tarter, a 68-year-old astronomer, said the use of volunteers was an experiment. She is

hoping that the SETI researchers can use human pattern recognition to fine-tune software algorithms that in the past have been used to look for tantalizing signals hidden among fields of natural stellar radiation and human-made sources of interference.

Even a single cellphone can raise havoc with the sensitive antennas, and can scan a huge swath of the radio spectrum, from 1 to 10 gigahertz.

This is not the first time that SETI has looked to human volunteers. Over the past decade, the organization has used the Internet to weave together a virtual supercomputer called SETI@Home, analyzing roughly 160 terabytes of radio data collected by the radio telescope at Arecibo<sup>10</sup>. More than six million volunteers have run the SETI@Home software on their desktop computers, and that project is now being extended to take advantage of the new information produced by the Kepler mission.

With SETILive, the researchers are hoping to add the power of the human mind to the scanning efforts. Projects in other fields have already proved the power of relatively untrained human participants. For example, Foldit<sup>11</sup>, a project of University of Washington biochemists and computer scientists, developed a Web-based video game that treated specialized biochemical features as puzzles. The researchers were able to demonstrate that the game's players, many of them high school students with little background in biology, could outperform the best algorithms.

"We have software that finds narrow-band signals much better than your eye can," Dr. Tarter said. "Basically what we're doing with humans is to see how well they do. We are giving them marking tools<sup>12</sup> and learning how they extract features."

In the past, she said, a huge challenge for the SETI researchers has been that the researchers have had to contend with powerful interference sources at the sites of their radio observatories from both Earth-based radars and satellite communications. The Allen telescope site here in Hat Creek is relatively free from interference sources.

There is also, of course, the "drunk under the streetlight<sup>13</sup>" effect. SETI researchers have devoted much of their resources to the electromagnetic spectrum from 1 to 10 gigahertz because it offers a relatively quiet window for observation from within the Earth's atmosphere. If there were an alien civilization orbiting a nearby star, no one is really certain how they would choose to communicate with us. Radio or television broadcasts are a possibility, but so are powerful pulsed lasers<sup>14</sup> and conceivably communications that employ some advanced phenomenon like quantum entanglement<sup>15</sup>.

In the past decade, because of the falling cost of advanced optical electronics detectors, some experiments have begun to take place at optical frequencies as well, Dr. Tarter said. Soon, optical experiments will also begin to look in the infrared portion of the spectrum.

For the moment, however, SETILive is adding a new, and already occasionally unpredictable, dimension to the hunt for alien worlds.

Since there is no absolute certainty about what a communication from another civilization might look like, the researchers have to put up with some of the eccentricities of their volunteers.

“People are expecting that every single thing they see is going to be a signal and so they’re drawing patterns in noise,” Dr. Tarter said. “I had someone send me a face the other day. Here’s a noise field<sup>16</sup>, and he saw a face.”

From *New York Times*

## New Words and Expressions

astrophysics [ˌæstrəʊˈfɪzɪks] *n.* 天体物理学

alien [ˈeɪliən] *adj.* 外国的, 外星人的

enlist [ɪnˈlɪst] *v.* 征募, 寻求或赢得帮助

dish [dɪʃ] *n.* 射电望远镜中巨大的抛物面状天线

extraterrestrial [ˌekstrətəˈrestri:əl] *adj.* 地球外的

makeshift [ˈmeɪkʃɪft] *adj.* 临时的, 凑合的

ponder [ˈpɒndə] *v.* 思索, 沉思

antenna [ænˈtenə] *n.* 天线

sample [ˈsɑ:m(p)əl] *v.* 从.....中抽样 (或采样); 抽样分析

spiral [ˈspɑɪr(ə)l] *adj.* 螺旋形的

galaxy [ˈgæləksɪ] *n.* 银河系; 银河

shutter [ˈʃʌtə] *v.* 使.....停止运行, 关闭

revelation [ˌrevəˈleɪʃən] *n.* 被揭露出来的事物, 暴露

dart [dɑ:t] *v.* 投射, 飞奔

snippet [ˈsnɪpɪt] *n.* 小片, 片段

fine-tune ['faɪn'tuːn, -'tjuːn] *v.* 微调

algorithm ['ælgərɪðəm] *n.* 演算法，计算程序

tantalizing ['tæntələɪzɪŋ] *adj.* 诱人的

stellar ['stelə] *adj.* 星的，星球的

havoc ['hævək] *n.* 破坏

swath [swɑːθ] *n.* 刈幅，收割的刈痕，细长的列

spectrum ['spektrəm] *n.* 波谱，光谱

gigahertz ['gɪgəhɜːts] *n.* 千兆赫

weave [wiːv] *v.* 织；编；编结

terabyte ['terəbaɪt] *n.* 兆字节

outperform [aʊtpə'fɔːm] *vt.* 做得比.....更好，胜过

extract [ɪk'strækt; ek-] *v.* 提取，提炼；推断出，引申出，总结出

contend [kən'tend] *v.* 争夺，竞争

observatory [əb'zɜːvətɔːriː, -təʊriː] *n.* 天文台；气象台

electromagnetic [ɪ,lektɹə(u)mæg'netɪk] *adj.* [物]电磁的

pulsed [pʌlst] *adj.* 脉冲的，受脉冲作用的

conceivably [kən'siːvəblɪ] *adv.* 可以想象的是；可以理解的是

quantum ['kwɒntəm] *n.* [物]量子

entanglement [ɪn'tæŋɡlmənt] *n.* 纠缠；卷入

optical ['ɒptɪk(ə)l] *adj.* 光学的

frequency ['fri:kw(ə)nsɪ] *n.* 频度, 频率

infrared [ˌɪnfrə'red] *adj.* [物]红外线的

eccentricity [ˌɛksən'trɪsɪtɪ] *n.* 古怪行为

a patch of 一块, 一片

an army of 大群的, 大量的

an array of 一排, 一群, 一批

raise havoc with 干扰, 扰乱; 对.....造成严重破坏

a huge swath of 一大片

look to 依靠(指望)某人或某事

weave together 编织在一起, 整合

free from 免于, 不受影响

## Notes

1. A **radio telescope** (射电望远镜) is a form of directional antenna radio used in radio astronomy (射电天文学). The same types of antennas are also used in tracking and collecting data from satellites and space probes. In their astronomical role they differ from optical telescopes in that they operate in the radio frequency portion of the electromagnetic spectrum (电磁波谱) where they can detect and collect data on radio sources. Radio telescopes are typically large parabolic (“dish”) antennas used singly or in an array. Radio observatories are preferentially located far from major centers of population to avoid electromagnetic interference (EMI 电磁干扰) from radio, TV, radar, and other EMI emitting devices. This is similar to the locating of optical telescopes to avoid

light pollution, with the difference being that radio observatories are often placed in valleys to further shield them from EMI as opposed to clear air mountain tops for optical observatories.

2. **Hat Creek** is a census-designated place (CDP) in Shasta County, California. Hat Creek sits at an elevation of 3,422 feet (1,043 m). Hat Creek is home to the Hat Creek Radio Observatory, run by SRI International. The town's main economies are tourism, fishing, camping, and lodging. It's still a travel hot spot in Shasta County, although it's about 70 miles east of Redding, CA and about the same to Susanville, CA.

3. **The Allen Telescope Array** (艾伦望远镜阵列, 简称 ATA), formerly known as the One Hectare Telescope, was a joint effort by the SETI(搜寻地外文明计划) Institute and the Radio Astronomy Laboratory (RAL) at the University of California, Berkeley to construct a radio interferometer that is dedicated to astronomical observations and a simultaneous search for extraterrestrial intelligence (外星人). UC Berkeley completed divestment from the project in April 2012 and the facility is now managed by SRI International, an independent, nonprofit research institute. The ATA is under construction at the Hat Creek Radio Observatory, 290 miles northeast of San Francisco, California. When completed, the array is expected to consist of 350 antennas. The first phase with 42 antennas (ATA-42) is complete and became operational on 11 October 2007. However, in April 2011, the ATA was placed in operational hibernation due to funding shortfalls. In August 2011, short-term funding was found, and operation of the ATA was resumed on December 5, 2011.

4. **The MacBook** is a brand of notebook computers manufactured by Apple Inc. from early 2006 to late 2011. It replaced the iBook series and 12-inch PowerBook series of notebooks as a part of the Apple–Intel transition from PowerPC. Positioned as the low end of the MacBook family, below the premium ultra-portable MacBook Air and the powerful MacBook Pro, the Apple MacBook was aimed at the consumer and education markets. It was the best-selling Macintosh in history, and according to the sales-research organization NPD Group in October 2008, the mid-range model of the MacBook was the single best-selling laptop of any brand in US retail stores for the preceding five months.

5. **The SETI Institute** is a not-for-profit organization whose mission is to “explore, understand and explain the origin, nature and prevalence of life in the universe”. SETI stands for the “search for extraterrestrial intelligence”. One program is the use of both radio and optical telescopes to search for deliberate signals from extraterrestrial intelligence. Other research, pursued within the Carl Sagan Center for the Study of Life in the Universe, includes the discovery of extrasolar planets, potentials for life on Mars and other bodies within the Solar System, and the habitability of the galaxy [including the study of extremophiles(极端微生物)]. The SETI Institute's public outreach efforts include working with teachers and students in promoting science

education and the teaching of evolution, working with NASA on exploration missions such as Kepler and SOFIA, and producing a weekly science program: Big Picture Science.

6. **Spiral arms**(旋臂) are regions of stars that extend from the center of spiral(漩涡星系) and barred spiral galaxies(棒旋星系). These long, thin regions resemble a spiral and thus give spiral galaxies their name. Naturally, different classifications of spiral galaxies have distinct arm-structures. Sc and SBc galaxies, for instance, have very “loose” arms, whereas Sa and SBa galaxies have tightly wrapped arms (with reference to the Hubble sequence). Either way, spiral arms contain a great many young, blue stars (due to the high mass density and the high rate of star formation), which make the arms so remarkable.

7. **SETILive** is an online project of Zooniverse. Its goal is to use the human brain’s ability to recognize patterns to find extraterrestrial intelligences (ETI’s). The project was launched in February 2012 as part of Jill Tarter’s 2009 TED Prize Wish. SETILive uses data provided by the Allen Telescope Array and presents it visually so that the public can collectively search for radio signals. The project focuses on radio frequencies that automated detection systems ignore due to the prevalence of man-made noise. Jill Tarter hopes that human analysts will be able to detect low signal-to-noise transmissions which confuse computers. The telescope scans the zone between a known star and a known planet where water is possible. This is called the habitable zone. The website displays one to three different scans of an area of space. Its energy is measured and put into a waterfall display. Users must identify the areas of high energy – signals – by making two points through which a line is drawn. Users classify signals as: broken, continuous, or parallel.

Users then must classify the signal as: erratic(飘忽不定的), wide, or narrow. Many of the signals are just satellites that give off energy.

8. **Zooniverse** is a citizen science web portal owned and operated by the Citizen Science Alliance. The organization grew from the original Galaxy Zoo project and now hosts dozens of projects which allow volunteers to participate in scientific research. Unlike many early internet-based citizen science projects (such as SETI@home) which used spare computer processing power to analyse data, known as volunteer computing, Zooniverse projects require the active participation of human volunteers to complete research tasks. Projects have been drawn from disciplines including astronomy, ecology, cell biology, humanities, and climate science. As of 14 February 2014, the Zooniverse community consisted of more than 1 million registered volunteers. The volunteers are often collectively referred to as “Zooites”. The data collected from the various projects has led to the publication of more than 50 scientific papers.

9. **Johannes Kepler** (1571–1630) was a German mathematician, astronomer, and astrologer. A key figure in the 17th century scientific revolution, he is best known for his laws of planetary motion, based on his works *Astronomia nova*, *Harmonices Mundi*, and *Epitome of Copernican Astronomy*. These works also provided one of the foundations for Isaac Newton’s theory of

universal gravitation.

10. **Arecibo**(阿雷西博) is a municipality on the northern coast of Puerto Rico, on the shores of the Atlantic Ocean. It is about 50 miles (80 km) west of San Juan(圣胡安), the capital city. Arecibo is the largest municipality in Puerto Rico by area. Its population in 2010 was 96,440. The Arecibo Observatory, known for housing the world's largest radio telescope, is located here.

11. **Foldit** is an online puzzle video game about protein folding. The game is part of an experimental research project, and is developed by the University of Washington's Center for Game Science in collaboration with the UW Department of Biochemistry. The objective of the game is to fold the structure of selected proteins as well as possible, using various tools provided within the game. The highest scoring solutions are analysed by researchers, who determine whether or not there is a native structural configuration (or native state) that can be applied to the relevant proteins, in the "real world". Scientists can then use such solutions to solve "real-world" problems, by targeting and eradicating diseases, and creating biological innovations.

12. **Marking tool**: 划线工具

13. **The "drunk under the streetlight" effect**("街灯下的醉汉"效应) here refers to the streetlight effect(街灯效应), a type of observational bias where people only look for whatever they are searching by looking where it is easiest. The parable is told several ways but includes the following details:

A policeman sees a drunk man searching for something under a streetlight and asks what the drunk has lost. He says he lost his keys and they both look under the streetlight together. After a few minutes the policeman asks if he is sure he lost them here, and the drunk replies, no, that he lost them in the park. The policeman asks why he is searching here, and the drunk replies, "This is where the light is." David Freedman apparently coined the phrase "streetlight effect," but the story, and concept, were used much earlier, e.g., by Abraham Kaplan, in his classic work *The Conduct of Inquiry: Methodology for Behavioral Science*, where he refers to this as "the principle of the drunkard's search" .

14. **Pulsed lasers**(脉冲激光器) are lasers which emit light not in a continuous mode, but rather in the form of optical pulses.

15. **Quantum entanglement**(量子纠缠) is a physical phenomenon that occurs when pairs or groups of particles are generated or interact in ways such that the quantum (量子) state of each particle cannot be described independently – instead, a quantum state may be given for the system



as a whole.

16. **noise field:** 噪声场

## Exercises

### I. Read the text only once and then answer the following questions.

1. Why are the researchers optimistic about the search for extraterrestrial intelligence?

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2. How do the searchers benefit from the Kepler satellite mission?

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3. Why do the professionals ask volunteers to participate in the hunt for unusual signals?

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4. What does the “drunk under the streetlight” effect refer to?

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5. Why do not the researchers stop amateurism(业余性) of volunteers?

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### II. Complete each sentence with a word or phrase given below. You may need to change the form if necessary.

havoc	snippet	makeshift	eccentricity	fine-tune
swath	tantalizing	extraterrestrial	enlist	revelation

1. Tourist could almost smell the \_\_\_\_\_ aroma of purple lilacs when they passed the garden on the university campus.

2. Several hours after the 7.0 magnitude quake hitting Ya'an city, rescue workers put up \_\_\_\_\_ shelters to house survivors.

3. Young mothers often can be frustrated to find that several small children together can create \_\_\_\_\_ in a house.

4. An aerial view of the countryside shows wide \_\_\_\_\_ of green and red.

5. I had to cut down a tree and \_\_\_\_\_ the help of seven neighbours to get it out of the garden!

6. The shocking \_\_\_\_\_ by documents from MikiLeaks caused quite a storm among the western world.

7. With extensive research, he found that the code \_\_\_\_\_ in the ancient book provides a scenario where the treasure was hidden.

8. He was known as Mad Shelley partly because of his \_\_\_\_\_ and partly because of his violent temper.

9. Discovering just one \_\_\_\_\_ civilization would have profound significance , NASA

claims.

10. The Federal Reserve Board (美国联邦储备委员会) is \_\_\_\_\_ interest rates to achieve economic growth without inflation.

**III. Translate the following sentences into English.**

1. 你现在应该停下来仔细考虑一下。(ponder)

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2. 一大群蚂蚁在沙丘上爬动。(an army of)

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3. 我找到了一点你可能感兴趣的消息。(snippet)

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4. 空气中充满诱人的烤牛肉香味。(tantalizing)

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5. 龙卷风一般都会对人们的生活造成很大的破坏。(raise havoc with)

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**IV. Translate the following sentences into Chinese.**

1. Shuttered for more than a year by budget problems, the array was turned back on in December to continue its search.

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2. In two weeks, more than 40,000 volunteers have signed up, and more than one million radio samples have been analyzed.

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3. Even a single cellphone can raise havoc with the sensitive antennas, and can scan a huge swath of the radio spectrum, from 1 to 10 gigahertz.

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4. If there were an alien civilization orbiting a nearby star, no one is really certain how they would choose to communicate with us.

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5. Since there is no absolute certainty about what a communication from another civilization

might look like, the researchers are having to put up with some of the eccentricities of their volunteers.

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