REPORT ON THE TALK GIVEN BY PROFESSOR FRAZER PEARCE

OF UNIVERSITY OF NOTTINGHAM ENTITLED:-

SETI – ARE WE ALONE

PROFESSOR FRAZER PEARCE

As Arthur C. Clarke. Once said, “Two possibilities exist: either we are alone in the Universe or we are not. Both are equally terrifying.”

SETI is the acronym for Search for Extraterrestrial Intelligence.

Frazer started the Presentation with an analysis of the Drake Equation.

The **Drake equation** is a probabilistic argument used to arrive at an estimate of the number of active, communicative extraterrestrial civilisations in the Milky Way Galaxy (our Galaxy).

The number of such civilizations, *N*, is assumed to be equal to the mathematical product of

(i) The average rate of star formation, R_*, in our galaxy,

(ii) The fraction of formed stars, f_p, that have planets,

(iii) The average number of planets per star that has planets, n_e, that can potentially support life,

(iv) The fraction of those planets, f_l, that actually develop life,

(v) The fraction of planets bearing life on which intelligent, civilized life, f_i, has developed,

(vi) The fraction of these civilizations that have developed communications, f_c, i.e., technologies that release detectable signs into space, and

(vii) The length of time, *L*, over which such civilizations release detectable signals, for a combined expression of:

$$N=R^*f_p n_e f_l f_i f_c L$$

(*Post script*) The Drake Equation was written in 1961 by Dr Frank Drake, not for purposes of quantifying the number of civilizations, but as a way to stimulate scientific dialogue at a meeting on the search for extraterrestrial intelligence (SETI). [See Note 2]

The equation summarizes the main concepts which scientists must contemplate when considering the question of other radio-communicative life. Criticism towards the Drake equation follows from the fact that several of its terms are conjectural, the net result being that the error associated with any derived value is very large such that the equation cannot be used to draw firm conclusions.

Astronomer, Sara Seager, later proposed (in September 2013) a revised equation that focuses on the search for planets with biosignature gases. These gases are produced by living organisms that can accumulate in a planet atmosphere to levels that can be detected with remote space telescopes. [See Note 1]

The second half of the meeting was taken up with a very entertaining and wide ranging Question and Answer and a general discussion on what type of life we could expect to find in other parts of our galaxy. Would they still be carbon based or some other completely different form?

Are we looking in the right place and are we using the right sort of communications to detect other forms of life? We have been sending information into space now since the start of radio and television age and we wondered if these would – at some stage – be detected. If so and the messages were answered – would we – as a life form – still exist on this planet. This could be just as true of life on other planets.

The question was raised regarding the different types of intelligent life. For example – Dolphins and whales can be considered as intelligent but they are not able (or likely to be able) to communicate with other planets and could this be the case on many of the planets in our galaxy?

Is there any evidence that we could be alone in the galaxy? Well Enrico Fermi (Physicist - Note 3) thought so. He said that if there are really a lot of alien societies, then some of them might have spread out across our galaxy. Fermi realized that any civilization with a modest amount of rocket technology and an immodest amount of imperial incentive could rapidly (in astronomical terms) colonize the entire Galaxy. Within ten million years, every star system could be brought under the wing of such an empire.

So this triggered Fermi to ask if that is the case then… Where is everybody?

The problem is that the last three elements of Drake's equation rely heavily on guesswork and conjecture and it is this that prompts us to continue to ask the question…

ARE WE ALONE?

General Notes:

Note 1

The Seager equation looks like this:

$$N_* F_Q F_{HZ} F_O F_L F_S$$

Where:

N = the number of planets with detectable signs of life

N_* = the number of stars observed

F_Q = the fraction of stars that are quiet

F_{HZ} = the fraction of stars with rocky planets in the habitable zone

F_O = the fraction of those planets that can be observed

F_L = the fraction that have life

F_S = the fraction on which life produces a detectable signature gas

Seager stresses, “We’re not throwing out the Drake Equation, which is really a different topic,” explaining, “Since Drake came up with the equation, we have discovered thousands of exoplanets. We, as a community, have had our views revolutionized as to what could possibly be out there. And now we have a real question on our hands, one that’s not related to intelligent life: Can we detect any signs of life in any way in the very near future?”

Note 2

Frank Donald Drake (born May 28, 1930) is an American astronomer and astrophysicist. He is most notable as one of the pioneers in the search for extraterrestrial intelligence, including the founding of SETI, mounting the first observational attempts at detecting extraterrestrial communications in 1960 in Project Ozma, developing the Drake Equation, and as the creator of the Arecibo Message, a digital encoding of an astronomical and biological description of the Earth and its lifeforms for transmission into the cosmos.

Note 3

Enrico Fermi was born in Rome on 29th September, 1901, the son of Alberto Fermi, a Chief Inspector of the Ministry of Communications, and Ida de Gattis. He attended a local grammar school, and his early aptitude for mathematics and physics was recognized and encouraged by his father's colleagues, among them A. Amidei. In 1918, he won a fellowship of the Scuola Normale Superiore of

Pisa. He spent four years at the University of Pisa, gaining his doctor's degree in physics in 1922, with Professor Puccianti.

He subsequently played an important part in solving the problems connected with the development of the first atomic bomb (He was one of the leaders of the team of physicists on the Manhattan Project for the development of nuclear energy and the atomic bomb.)

The Nobel Prize for Physics was awarded to Fermi for his work on the artificial radioactivity produced by neutrons, and for nuclear reactions brought about by slow neutrons.

REFERENCES for further reading:-

Frank Drake info is here:

https://en.wikipedia.org/wiki/Frank_Drake

Drake Equation Primer:

https://en.wikipedia.org/wiki/Drake_equation

Drake plaque:

http://www.setileague.org/photos/miscpix/drakeqn.jpg

Fermi paradox:
https://en.wikipedia.org/wiki/Fermi_paradox