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New OSETI Observatory to Search for Interstellar Probes

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ABSTRACT

Numerous researchers have suggested the importance of including a near-Earth search for interstellar probes in the search for extraterrestrial intelligence. This paper documents some of the scientific work that has already been undertaken in this field and my own intended contributions. The research under discussion includes both the theoretical and the practical. T. Roy Dutton's Astronautical Theory is introduced, which includes a hypothetical pattern of navigational tracks above the Earth. Summaries of research findings by Italian radio astronomers and Norwegian engineers in Hessdalen (Norway) are provided to support the importance of a careful and thorough near-Earth search. The Italian team discovered highly anomalous periodic VLF signals characterized by spike-like and Doppler-like morphology. They theorize that these may have been the result of high-energy mechanisms in our atmosphere whose origin is still unknown but which, on the basis of Galilean objective possibilities, might involve both natural and non-natural causes. They stress the need for further investigation using the highest scientific standards of skepticism. The Norwegian engineers obtained unexplained findings, in particular in relation to magnetic field perturbations and their time-correlation with light-phenomena. The research of both the Norwegian and Italian teams indicate that advanced optical photometric and spectroscopic equipment is needed and hence the possible relevance to OSETI. The author discusses the range of optical equipment being established at Kingsland Observatory in Ireland. The implementation of this equipment may contribute effectively to the near-Earth search for interstellar probes, and in any case will provide precious information on still unexplained physical laws governing atmospheric plasmas—knowledge that is of basic importance for fundamental science. In addition to two robotic telescopes (36-in. and 16-in.), Kingsland Observatory includes an autonomous robotic platform made up of optical and ancillary devices to monitor the celestial dome. Innovative optical instrumentation will be included to obtain spectra and to furnish recordings in the visible and near-infrared ranges. This equipment will be discussed in detail together with the rationale for its use. The constant monitoring with the proposed instrumentation will also result in data that may support or refute Dutton's Astronautical Theory.

Keywords: Interstellar probes, SETI, OSETI, SETA, SETV, Astronautical Theory, Hessdalen, Embla Mission, Kingsland Observatory, spectroscopy

1. INTRODUCTION

Most SETI and OSETI researchers focus mainly on distant stars. Much of this work is based on the hypothesis that extraterrestrial intelligence exists and is technology-based.[1,2] It follows that technologically advanced civilizations may have already deployed interstellar probes, such as those of the Von Neumann/Bracewell type.[3,4,5] If this were the case, it is possible that extraterrestrial probes may have already reached our solar system and might be detected using existing terrestrial technologies. The near-Earth search for extraterrestrial intelligence is not a new idea. Freitas and Valdes carried out a search for these kinds of artificial objects.[1,2,6,7] Other proposals to search for extraterrestrial artifacts within our solar system have been proposed by Papagiannis.[8,9] Matloff has reasoned that due to stellar motions many stars have approached the Sun within 1 light year over the past billion years, and that hypothetical advanced civilizations may have constructed habitats on small solar system objects.[10,11] Lemarchand is another scientist in favor of keeping an open mind in relation to the manifestation of extraterrestrial technologies. In 1994 he stated, "We must be aware and open to the numerous ways in which advanced civilizations across the Milky Way and beyond may make themselves known to others in the galaxy, both directly and as the extraneous results of their technological activities."[12] Tipler seems to throw down the gauntlet to scientists to take a closer look for these hypothetical civilizations who may have used Von Neumann probes by provocatively suggesting that if they have not been found so far they do not exist.[13,14] Taking up the gauntlet, Scot L. Stride

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has recently proposed that ground-based robotic monitoring stations be established to gather technical data from a range of sensors to search for any hypothetical interstellar robotic probes, in particular between the Earth and Moon. This approach is referred to as the Search for Extraterrestrial Visitation (SETV).[3,15] Arkhipov and Graham suggest that the Moon be considered in the SETI strategy.[16] Tough suggests a wide range of search tactics, including innovative near-Earth methodologies.[17] There is no lack of theoretical models in support of strategies to specifically include a near-Earth search in the search for extraterrestrial intelligence.

There is also a wide range of theories setting out hypothetical models for interstellar migration and propulsion. Jones[18] and Zuckerman[19] have each published highly mathematical works in relation to the question of interstellar probes. Other significant research into the nature of technology that might be employed by such probes can be found in another mathematical work by Jones[20] and in research by others such as Harris,[21] Maccone[22] and Crawford.[23] NASA's Marc G. Millis gives a lengthy discussion of various hypothetical propulsion mechanisms that might eventually be developed by humans in the future, and it is not unreasonable to suppose that an extraterrestrial civilization may have already solved technological problems in these areas that we have not.[24]

In this paper I will introduce a new theory relating to the near-Earth search for extraterrestrial intelligence: T. Roy Dutton's Astronautical Theory, which is testable using a platform of specialized equipment. This theory was the subject of a joint essay by Edward Ashpole and T. Roy Dutton, which was a winner in the first essay competition sponsored by the National Institute for Discovery Science (NIDS) in December 1998.[25] I will also discuss some of the findings of two research missions involving periods of constant monitoring by a range of instrumentation (not unlike Stride's proposal, albeit with a more modest initial price tag): Project Hessdalen in Norway (in particular the 35-day mission in 1984 and the permanent equipment subsequently established in the late 1990s), and preliminary findings of the 25-day Embla Mission 2000 carried out by Italian astronomers in August 2000. In addition to discussing the relevance of the findings in their own right I will also examine their results in relation to Dutton's theory. Finally, I will describe Kingsland Observatory and the instrumentation I am developing in Ireland to gather information on atmospheric plasmas and to test Dutton's Astronautical Theory, which may lead to a significant improvement in the quality and quantity of research findings in the near-Earth search for interstellar probes.

2. DUTTON'S ASTRONAUTICAL THEORY

2.1. Development of the theory

T. Roy Dutton is an aeronautical engineer employed for most of his career at British Aerospace. He is a Chartered Engineer, a Member of the Institution of Mechanical Engineers and a Member of the Royal Aeronautical Society. His Astronautical Theory was developed over a period of more than 30 years and is considered by him to be a work in progress that is constantly being reexamined in light of additional information. The initial formation of his theory was based on 1300 reliable observations dating back to the 1880s. Dutton's analyses of both historical and current data have led him to hypothesize that a program of observation of the Earth may have been going on that predates Earth-based human aeronautical technology. The initial theory led to calculations of co-ordinates for star-related orbital tracks that, when projected onto the rotating surface of the earth, produce corridors that appear to have been used with some regularity over more than 120 years. The theory is testable by appropriate observation. This involves the correlation of any eventual signals with longitude, latitude, time and a time graph generated according to the theory.

Dutton's research has led him to hypothesize that the "adopted strategy seems to involve frequent meteoric injections" of hypothetical structured objects, some of which may be interstellar robotic probes, into partial orbits of our planet.[26] This theoretical release and subsequent retrieval by some unknown phenomenon may have been observed on various occasions. In many cases these involved light phenomena, and in some cases apparent structures were perceived. Dutton hypothesizes that aerial events are usually observed either soon after delivery from space or just prior to their retrieval.

2.2. Navigational links

The Astronautical Theory hypothesizes that established navigational links with the stars, the earth's terminator, and key points on the earth's equator may exist. This has led him to postulate the existence of many orbital tracks around the earth, and also has led to the development, with colleagues, of software that can produce a rough timetable for potential events for any location on Earth. The periodic properties of the observed objects or events are particularly well suited to study using

purpose built instrumentation. The use of such instrumentation to test Dutton's theory by correlating any eventual signals with the corresponding time graph is one of the purposes of the OSETI work at Kingsland Observatory.

3. HESSDALEN EVENTS

3.1. Overview

"Project Hessdalen"[27] refers to the ongoing research undertaken by a scientific team directed by Erling Strand, Associate Professor of Engineering at Østfold College, located near the Hessdalen valley in Norway. This area has had occurrences of multiform luminous phenomena for many years. The research was carried out by a multi-disciplinary group of researchers skilled in atmospheric physics, geophysics and engineering.

3.2. Previous scientific research

Strand's research is not the first of its kind. Previous research designed to observe, study and measure anomalous aerial activity in the Earth's atmosphere using rigorous scientific methods has been significant. This legacy is not as widely known in today's scientific community as it deserves to be. In Austin, Texas, Ray Stanford established a permanent monitoring station for 3 years in the mid-1970s.[28] His "Project Starlight International" found that the events they were studying had an infrared component. Another major study was the 5-year "Project Identification" led by physicist Harley D. Rutledge.[29] In the 1970s he and his team based in Missouri were able to successfully calculate distance, velocity and apparent size of unknown atmospheric phenomena. They were also able to obtain relatively high quality photographs. Despite their significant results, both these projects were eventually discontinued for lack of funding. In this context it is all the more impressive to realize that Erling Strand has been carrying out research at Hessdalen since 1983—over 17 years.

3.3. 1984 observations and results

A series of observations were carried out in Hessdalen during an intensive 35-day constant monitoring period between January and February of 1984. They used telephoto lenses, dispersion gratings, IR viewer, seismograph, radar, Geiger counter, radio spectrum analyser, magnetometer and a laser device. Their optical equipment was relatively unsophisticated, and was inadequate to obtain detailed optical data. However, they were very successful in getting significant results from their radar, radio spectrum analyser and magnetometer. Some of their most interesting results include the following:

1) The luminous phenomenon had a very marked radar signature.
2) The luminous phenomena were observed to have a fairly regular pulsation.
3) The pulsation rate changed immediately when a laser device was pointed at the target.
4) The team recorded sudden oscillating radio spikes of unexplained origin.
5) These oscillating radio spikes were not usually at the same time as the luminous phenomena.
6) Together with the luminous phenomena were pronounced, pulse-like magnetic perturbations of intensities ranging from 0.5γ to more than 10γ.[27]

3.4. Relationship between lights and magnetic events

The Hessdalen team discovered that the luminous phenomena and these pronounced magnetic events were related within a time frame ranging from a few seconds to a few hours[27,30] This clear relationship may be one of the most significant results of this initial intensive measurement campaign. The same Norwegian team has since carried out similar measurements on other continents, including the Australian desert[31] and at a major volcano in Mexico[32]. In each of these locations the team discovered luminous phenomena and similar magnetic pulsating events, but with a significant difference—the magnetic intensities were of a factor 10 to 100 times higher than the ones measured in Hessdalen in 1984. As in Hessdalen, the luminous phenomena and the magnetic phenomena seemed to be closely related. This pattern of related luminous and magnetic events as recorded in Hessdalen and other locations could have some significant connection with the reported magnetic interference effects on electrical devices, apparently due to close light phenomena, that have been observed throughout the world.[33] The team was also successful in obtaining visual recordings of the phenomena, although as already mentioned it was clear that better equipment would be needed to provide more detailed information. A conventional photographic documentation, even if of good quality, cannot provide any substantial information on the intrinsic physical properties of the given phenomena.

3.5. Significance of Project Hessdalen

The work carried out by Project Hessdalen is some of the most significant data gathering that has taken place to date in relation to phenomena that may indicate a most unusual unknown natural phenomenon or perhaps the presence of extraterrestrial activity in our atmosphere. As with much groundbreaking scientific work, the results raise more questions than they answer. Strand's research indicates unknown physical mechanisms which require further analysis. It is likely that many if not most of the Hessdalen phenomena will be shown to be related to natural phenomena.[34] It is also possible that there may be an overlapping of natural and technological phenomena.[34,35,38] Deeper understanding of naturally-occurring atmospheric phenomena is critical so that those searching for interstellar robotic probes are not misled. Further research will confirm or refute the various hypotheses currently under consideration.[34,38] Any inference of extraterrestrial intelligence would be premature until the likely natural components have been further studied.[36,38]

Strand stresses the need to develop a wide range of instrumentation under computer control to enable more information to be obtained. Towards this end he has established a fixed monitoring station known as the Hessdalen Interactive Observatory, which has been operational since 1998.[37] The equipment Strand has established has allowed him to carry out constant monitoring of luminous phenomena up to the present day that is of great statistical significance.[35] He hopes to upgrade his optical instrumentation in the near future. In both the areas of planning potential scientific projects[34] and of active missions,[35] he has also triggered a successful collaboration with a team of astronomers from Italy.

4. EMBLA 2000 PROJECT

4.1. Collaboration

In August 2000 a team of Italian radio astronomers, astrophysicists and technicians carried out an instrumental expedition in Hessdalen called the EMBLA Project. It was the result of a collaborative effort between the Institute of Radioastronomy (IRA: a specific department of the National Council of Research (CNR)), in Bologna, Italy and the Østfold College of Engineering in Norway. The scientific supervisor of the EMBLA Project was astrophysicist Massimo Teodorani, a consultant of the CNR-IRA. He was joined by the project's Technical Director, Stelio Montebugnoli, who is the Director of the Radioastronomy Station in Medicina of CNR-Bologna. Other participants were CNR's engineer Jader Monari and a team of several additional researchers. This was the first of a series of scientific missions planned by the joint Italian-Norwegian EMBLA Project. The goal of the expedition was to carry out further in-depth study of the atmospheric phenomena occurring in the Hessdalen valley. Its main focus was the study of the radio spectrum in the UHF, VLF and ELF wavelength ranges.[35,38]

4.2. Initial results

The Italian team used radio spectrum analyzers that were in constant operation for 25 days.[35] This led to the discovery of highly anomalous periodic signals. These unusual signals were characterized by spike-like and Doppler-like characteristics and were mostly detected in the VLF radio range. The EMBLA team members also scheduled many skywatching sessions during this 25-day period. During this time they sighted many luminous atmospheric phenomena in various locations in the Hessdalen valley. Some of the phenomena were plasma-like and others seemed to show a structured morphology. They were also successful in obtaining some photographs.[35] Both the radio and photographic data are still being analyzed.[35,36,38]

The highlights of the initial results included two kinds of radio signals which were highly unexpected and unusual:

1) SPIKE signals. These were spike-like signals that appeared in the 3-7 kHz range as very sharp, straight "narrow lines". These spikes behaved in a strictly periodic way by showing regular "on" and "off" phases. This specific phenomenology has been interpreted as the apparent effect due to the pulsation of a radio-emitting source or alternatively as the rotation of a spheroidal source with a radio-emitting spot on its surface.[35]

2) DOPPLER signals. Doppler-like signals, which sometimes accompanied the spike-like signals, appeared intermittently in the 1-2 kHz range as somewhat sloping "broad lines". They covered a narrower frequency range than the spike-like signals. From the measured frequency shift the EMBLA team was able to determine the velocity of the emitting source, which was changing abruptly (i.e., within several seconds) by a factor of 10 from 10,000 km/sec up to 100,000 km/sec. The inclination of the "broad lines", which occasionally changed from "negative" to "positive", clearly indicated to Teodorani and his team that the Doppler shift was both red-wards and blue-wards.[35,36] Within the limits of a preliminary interpretative model, the very high measured velocities, together with the periodic inversion of the Doppler shift, are hypothesized to be due to a physical mechanism

involving the magnetically collimated acceleration of particles modulated by the rotation of a self-contained "plasma spheroid" whose magnetic axis is misaligned in comparison with its rotation axis.[35,38]

Both mechanisms may logically explain the observed effects due to the two reported types of signals; nevertheless their origin (natural and/or non-natural) is unknown at present.[36,38]

4.3. Working hypothesis

Teodorani is currently also investigating the possibility of a photon-electron interaction as a potential explanation for the observed radio signals and their possible connection with luminous phenomena.[36,38] Some of the light phenomena may be triggered by some self-contained low-energy plasma that is producing emissions in the radio range which, for unknown reasons (possibly piezo-electricity), manifests itself in some localized areas of Earth. In this situation the constantly changing high-energy cosmic-ray radiation might inject some additional energy (photons) to the pre-existing low-energy plasma, resulting in raising the electrons of the plasma to a much higher quantum state (photo-excitation and photo-ionization). This could have the result of shifting the emissions from the radio range to the optical, and a ball of light becoming visible. The ongoing random changes in cosmic–ray radiation could produce corresponding changes in light intensity. This could continue until the high-energy cosmic-ray radiation ceases and the light disappears. This is but one hypothesis that must be investigated before considering any technological interpretations. Several other theories and hypotheses invoking a natural origin of the phenomenon (such as piezo-electricity, solar activity, and magnetic monopoles) have been extensively investigated by Teodorani and Strand, in the ambit of a research plan aimed at proving or disproving any theory by using repeated physical experimental tests.[34] The "non-natural" hypothesis is also investigated, together with the absolutely necessary tests in order to confirm or reject it by using rigorous observational experiments.[30,34]

4.4. Importance of optical instrumentation

The EMBLA team has stressed the importance of implementing more sophisticated optical instrumentation than what has been available to date.[30,34,35] In particular they referred to their inability of obtaining any accurate numerical measurements of optical luminosity, optical spectrum or infrared radiation. They simply did not have the optical equipment needed to obtain these kinds of data, and this was due to lack of funding at that time.[30,41] Project Hessdalen also found that they would need to seriously upgrade their present equipment if they were to be successful in obtaining data such as emission and absorption lines in optical spectra.[39] This conclusion by both the Norwegian and Italian researchers spotlights the need for the application of more advanced optical technology, which is something that Kingsland Observatory will address.

5. CORRELATIONS WITH DUTTON'S ASTRONAUTICAL THEORY

5.1. Positive correlations

In early 2000 T. Roy Dutton completed a comprehensive analysis of the Hessdalen project's 1984 events. He began this assessment because the 1984 Hessdalen phenomena had seemed to demonstrate the effect of ionization of atmospheric gasses.[40] (This effect had been observed and commented on by many individuals, including NASA scientist Paul Hill who discussed his theories of the physics behind this kind of phenomenon.[33]) When he processed the 117 Hessdalen observations from the 35-day 1984 project, he found that 103 occurred within the +/- 20 minutes qualifying limits for acceptable correlation with his theory's projected timings. The data obtained by the EMBLA 2000 team also has some interesting correlations with the Astronautical Theory. In particular, the two most striking visual observations had very precise correlations with the timings indicated by the time graph for the Hessdalen valley.

5.2. Future testing needed

Dutton's theory is one that merits further investigation. Instrumentation and observation with extremely accurate records of timing are particularly important in further testing this theory. An accurate assessment of any correlation with Dutton's time graphs requires that more projects be undertaken that pay close attention to precise timing. The instrumentation being established at Kingsland Observatory will be able to record timings with the necessary precision. This will make it possible to test the theory.

Whether or not this particular theory is shown to be valid, a crucial element in the near-Earth search for extraterrestrial intelligence is the development of appropriate instrumentation. In the optical area in particular it has become clear that

high-quality optical devices are needed. This is an area of particular interest to me, and next I will discuss some of the instrumentation that I am developing and assembling for this purpose.

6. KINGSLAND OBSERVATORY

6.1. Purpose

Past and present instrumented projects studying atmospheric phenomena show that it is possible to tackle this problem scientifically with the appropriate methodologies and the appropriate equipment.[41] Kingsland Observatory in northwestern Ireland will contribute to this process, particularly in the area of an innovative optical approach. The instrumentation selected will be able to record accurate data, even when the anomalous targets are subject to random and unpredictable motion. Once analyzed, new data may furnish fundamental information on the physical mechanisms governing the behaviour of these phenomena.

6.2. Instrumentation and observational strategies

The instrumentation consists of a group of all-sky cameras that will be in constant operation. They have the ability to identify targets and trigger a video platform that has additional cameras with large telephoto lenses, an infrared camera, a high-speed photometer and a specially designed wide field spectral imager. As a direct result of the Italian findings I also plan to include a radio spectrum receiver geared towards the ULF to VLF spectrum from 0.1 kHz to 14.0 kHz. As a result of the Hessdalen findings, I also plan to use a laser of 30mW in the 532nm range for reaction tests on the target. Such specific tests might show that the reactive light enhancement from a luminous target is due to a surplus energy-injection over the stable energy state of a simple natural plasma of unknown origin; nevertheless an effect due to a deliberate "answer" to an energy pulse cannot be excluded a-priori. Only an accurate spectral analysis can ascertain the exact nature of the source (see topic 6.3 below), so that any "reaction" from the target can be correctly interpreted.

The all-sky cameras will be used to obtain the target information. There are 10 cameras that together can cover the whole sky hemisphere. Each camera has a hypersensitive half-inch CCD that is designed to obtain high-quality images in extremely low light conditions. The cameras will be connected to a digital multiplexer, which has motion sensing capabilities, digital zoom facility and multi-screen displays. The multiplexer triggers the automatic tracking system for the wide field spectral imager and infrared camera.

6.3. Wide field spectral imager and infrared camera

The wide field spectral imager was designed to be able to measure the spectrum of a moving object across a field of view of 3.5°. As existing spectrographs for astronomy have an extremely narrow field of view, this posed a considerable technical problem. The instrument I have designed to solve this problem uses a high-speed lens system. It projects the light through the entrance slit and onto a 5-inch flat reflective diffraction grating. The grating disperses a spectrum of the incoming light onto a sensitive 1-inch CCD detector. A critical part of the design is the lateral movement of the entire slit assembly (in addition to the movement of the slit itself), so that the narrow beam passing through the slit will reflect off of different parts of the diffraction grating. As a result this single device will cover a wide field of view across the range of spectra, from the ultraviolet all the way through to the near infrared.

An infrared camera is linked to the multiplexer and relies on the all-sky cameras for its information to track and record data in the infrared. The infrared camera can detect a 33-foot (10-metre) object at a distance of 10 miles (16 kms). Its field of view is 12° x 6°. The detector operates between 7μ and 14μ. In the future, radar and/or magnetometers may also be included.

7. CONCLUSION

Excellent work has already been carried out by research teams who have been focusing on near-Earth atmospheric phenomena that may or may not be linked to the activity of interstellar robotic probes. This is a new field for OSETI, and one that holds promise. The substantial amount of theoretical work in this field is at last being supplemented by pertinent experimental research that is already starting to yield data. The preliminary results obtained by Project Hessdalen and the EMBLA 2000 Project point the way towards future research projects that are needed, and the nature of the needs for

specific kinds of instrumentation. T. Roy Dutton's Astronautical Theory presents some intriguing possibilities that can be tested simultaneously with a wide range of data acquisition techniques. The instrumentation of Kingsland Observatory can possibly furnish knowledge about whether there is any likelihood of discovering interstellar probes near Earth. If it proves that this is not the case, such an observatory will nevertheless make a significant contribution to science by providing a unique opportunity for physicists to acquire numerical multi-wavelength data regarding currently unexplained natural light phenomena on Earth. The scientific understanding of these phenomena could furnish a fundamental improvement in the general knowledge of unknown physical mechanisms of atmospheric plasmas, and might suggest ways to harness them technologically. The scientific study of these phenomena is therefore of double significance, and Kingsland Observatory looks forward to contributing to this research.

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