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MEMORANDUM

Date: 3 June 1969
A-830-BB01-WPW-37

TO: R. M. Wood, A-830

FROM: W. P. Wilson, Jr., A-833

SUBJECT: FIELD DATA ACQUISITION REQUIREMENTS

COPIES TO: J. M. Brown, D. B. Harmon, H. C. Bjornlie, A-830; File

REFERENCE: 1) Memorandum A-830-BB01-JMB-13 Atmospheric Van Meeting, dated 7 November 1968
2) Memorandum A-830-BB01-WPW-14 Mobile Field Data Acquisition Instrumentation, dated 14 November 1968

INTRODUCTION

This memorandum discusses the sensor and operational requirements for a mobile and partially self-sustaining remote, semi-permanent, field data acquisition system designed to obtain the signatures of anomalous atmospheric phenomena unidentified flying objects, i.e., UFO's.

The applied rationale is an attempt to define potential anomolistic targets with their space-time outputs which may produce observable effects. By relating a general description of their possible outputs to the normal background of physical phenomena it is possible to obtain an understanding of sensing requirements. Following the UFO sensing requirements, the requirements for sensing ball lightning and various other meteorological phenomenon are developed.

The final section of this memorandum presents the operational requirements such as set-up time, time on station and fail safe considerations.

UFO TARGETS

A basic analysis of UFO reportings strongly indicates that their presence and operation may be associated with any one or a combination of several observable physical phenomena. They may produce steady state and cyclic changing, magnetic, electric, electromagnetic (photon) and gravitational fields. They may emit nuclear particles, generate steady state or acoustical atmosphere pressure fields and leave pronounced residual effects.

The targets may produce weak or strong signals with respect to the ambient background and may be within range of the sensors for long periods to short time intervals. The shortest interval would most probably be associated with a close range fly-by. For this reason, it may be seen that the shorter times might produce the strongest signals.

For example, a very close fly-by at 10,000 feet per second could be within the range of practically all sensors for a period of several seconds. A data system that would not saturate and could record all possible signals for these conditions would provide significant information. Therefore, sensor system capabilities which will respond in the magnitude range of ambient to a high level, to give spectral content (and polarization, where applicable), and to be activated over the full time of event, would be the ideal system for these extremes.

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In fact, the above target event apparently establishes the ideal goals of a data system.

The capabilities actually selected, i.e., the fall-back position accepted, should be those which approach this event as near as is practical. In view of these considerations, Table I partially lists the UFO sensing requirements. Table II presents the EM spectrum in bands, wavelength, frequency and period relationships.

These tabulations are compressed from a lengthy but not exhaustive survey of related literature, current methodology and commercial instrumentational offerings.

METEOROLOGICAL REQUIREMENTS

The primary meteorological requirement is to record ball lightning phenomena including the environmental conditions prior to and after the event occurrence. The longest lived ball lightning has a signal life corresponding roughly to the shortest UFO signal. Even shorter signals are produced by ordinary lightning. The data system should be designed to record these events based on the known signatures of lightning or other electric, magnetic, electro-magnetic and acoustical phenomena. It is possible that there are some gravitational effects and, therefore, the data system should include a capability to record gravitational changes.

The suggested approach for recording lightning is to monitor the background electric field with slow-time recording, then, at a threshold in absolute level or rate of change, fast time recording equipment would be automatically initiated. After the event either automatic or manual cut-off could be utilized. The problem then is to determine the thresholds and to prevent equipment saturation during the event. Tables are being prepared to examine the pertinent characteristics of lightning related phenomena and other meteorological requirements.

OPERATIONAL REQUIREMENTS

The utility and continuing success of a field data acquisition system such as this, equates directly to the quality of pre-planned operational capabilities and procedures. This should include standard operating procedures coupled with the flexibility of "in-field" improvisation.

Among the many items to be considered, the following are considered to be the most critical:

o Mobile Capability

1. Selection of sites - Range
Time on Station

2. Cruising Capabilities

    a. Monitoring while in motion
    b. Set-up time when event occurs

3. Monitoring - vs. in-depth recording while on site

4. Data Processing - On site / Relay / Return to home

5. Fail-Safe Considerations - What if all electrical things go out?

    a. Diesels still running
    b. Diesels not running, mechanical gadgets, etc

6. Personnel Safety

o Remote Field Stations

1. Selection of Sites and Accessability

    a. Degree of self-sustainment
    b. Range and depth of monitoring

2. Data Acquisition and Processing

    a. Most suitable or useful methods
    b. On-site, relay, return home

3. Fail Safe, Down Time Back Up

    a. Event induced causes
    b. Local power source failures
    c. Vandals or other reasons

4. Personnel Safety

To further the definition of the particular requirements, a continuing study of field installations, methods and instrument applications is being conducted. This study has and will include trips to typical observation locations and discussions with persons knowledgable in the field of atmospheric electrical observations.

W. Paul Wilson Jr.
W. P. Wilson, Jr.
Advanced Concepts

WPW:msb
Attachments - Noted (DP)

TABLE I - UFO SENSING REQUIREMENTS

1. MAGNETIC VECTOR - H FIELD, UNITS IN GAMMAS ($1 \times 10^{-}$ Oersted)

	Duration Sec	> 10	1	10^{-1}	10^{-3}	10^{-6}
3 Components	Ambient	50,000 ± 20	50,000 ± 0.1		50,000 ± 0.01/t	
	Lower Limit	±10	±1	±1	±100	$\pm 10^3$
2 Places	Upper Limit	$\pm 10^8$	$\pm 10^8$	$\pm 10^8$	$\pm 10^8$	$\pm 10^5$

Sensors - Magnetometer, Absolute and Relative Measurements
Readout Analog, Real Time
Cesium Beam - Varian Model V-4938 — Approximate Cost $10,900

Magnetometer, Gradient Sensing Readout: Analog, Real Time
(Three) Internally Constructed, - Approximate Cost $250.00 Each — 750

2. ELECTRIC VECTOR - VOLT/METER

	Duration Sec	> 10	1	10^{-1}	10^{-6}
3 Components	Ambient	100			
	Lower Limit	± 100	± 1	± 1	± 0.01
2 Places	Upper Limit	±10,000	±1,000	±1,000	±10

Sensors - Electrostatic Voltmeter, Absolute and Relative Measurements
Readout Analog, Real Time To Chart Recorder
Comstock & Wescott - Model 12008 - — Approximate Cost $ 3,100

Electrometer, Relative and Gradient
Readout Analog - Real Time To Chart Recorder
(Three) Internally Constructed - Approximate Cost $150.00 Each — 450

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3. ELECTROMAGNETIC - RADIO - WATTS AND/OR VOLTS/METER

	Duration-Sec		10^{-3}	10^{-6}	10^{-12}	Secs/Cycle
Polarization	Ambient	City	10^{-2}	10^{-4}	10^{-6}	Volts/Meter
		Country	10^{-4}	10^{-6}	10^{-8}	Volts/Meter
Direction	Signal		10^{-12}	10^{-12}	10^{-12}	Watts (μV/50Ω)

Sensor - Broadband Spectrum Analyzer Absolute Measurements

Power - Amplitude and Spectral Content .01 to 1,250 Mhz

Readout in Real Time, Time Domain and Frequency, Visual Display and Analog or Digital Data to Chart or Magnetic Tape Recorder

Hewlett Packard Model 8554L R.F. Section with the 8552A I.F. and 140S Display System

Approximate Cost $6,000

Radiometers and Auxiliary Radio Equipment Approximate Cost 3,500
Readout In Real Time, Visual Display, Analog or Digital To Chart or Magnetic Tape Recorder

4. ELECTROMAGNETIC - IR - WATTS AND SPECTRAL CONTENT

	Duration-Sec	10^{-12}	10^{-13}	10^{-14}
Polarization	Ambient	Limits Vary As To Location, Day-Night & Local Artificial Heat & Light Conditions		
Direction	Signal	Expected Levels To Be Determined		

Sensors - Standard Radiometric or Photographic Techniques, Polarity & Color Sensing, Thermal & Photosensitive Devices

Radiometers - Photometers and Spectrometers
Suitable Manufacturers: Types and Approximate Cost To Be Determined
Will Be RElated To Following Two Items (5) and (6)
Readout: Analog, Digital to Chart or Magnetic Tape Recorder

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5. ELECTROMAGNETIC (OPTICAL) - POWER LEVELS AND SPECTRAL CONTENT

	Duration-Sec.	2.3×10^{-14}	1.4×10^{-14}	Secs/Cycle
Polarization	Ambient	Day-Night Atmospheric & Local Artificial Lighting Conditions		
Direction	Signal	Expected Levels To Be Determined		

Sensors - Photographs (Movie Camera - Color)
Photo-Optical Tracking - Photographic, Still & Motion Picture - Black-White & Color
Polarity & Color Sensing, - Related Spectrum Analysis Instrumentation & Readout as Under Item (4)

6. ELECTROMAGNETIC (UV)

Duration-Sec	1.4×10^{-14}	3×10^{-26}	(Soft X-Ray)
Ambient	Day-Night, Atmospheric & Local Artificial Lighting Conditions		
Signal	Expected Levels To Be Determined		

Sensors - Photo-Optical Tracking - Photosensitive Devices & Photographic Materials, Polarity Sensing
Related Spectrum Analysis, & Readout Instrumentation as Under Items (4) and (5)

7. ELECTROMAGNETIC (X-RAY)

(1) Soft X-Ray (2) Hard X-Ray (3) Gamma Radiation

Duration	May Be Coherent CW, Periodic or Random Radiation @ 3×10^{-16}- 3×10^{-19} Secs/Cycle or Discrete Particles vs. Time
Ambient	Day-Night Atmospheric & Local Normal Background
Signal	Any Levels Above Background, Time Averaged, Steady State or Particles vs. Time

Sensors - Gamma Sensitive Photographic Materials - Radiation & Particle Counters, Crystal Scintillators To Measure Photon Flux and Energy

Readout: Spectral Content - Time Density Averaging To Analog or Digital Data To Chart or Magnetic Tape Recorders.

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8. GRAVITATION -

Duration Secular

Ambient

Signal

9. ATMOSPHERIC PRESSURE

Duration-Sec	>10	10^{-1}	10^{-4}
Ambient			
Signal			

Nuclear Particle

10. NATURAL AND RESIDUAL SIGNATURES

Odors

Ground Deformation

Response of Trees and Plants, Animals, Humans,

Vehicle Parts

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II. SITE CHARACTERISTICS

Location

Terrain

Time of Day

Weather Conditions (Required for UFO and Ball Lightning)

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TABLE II

EM SPECTRUM CLASSIFICATION

ARBITRARY STANDARD USAGE BY BANDS IN WAVELENGTH - FREQUENCY - TIME

BAND		WAVELENGTH- λ $3\times10^8/fcps$		FREQUENCY-fcps $3\times10^8/\lambda$		TIME PERIOD-t Sec. $(3\times10^8/\lambda)^{-1}$		EXPLANATION OR APPLICATION
		Meters		Cycles/Second		Seconds		
MP		3×10^{11}	1×10^{8}	10^{-3}	3	1×10^{3}	3.3×10^{-1}	Micro Pulsations-Cosmic & Geophysica[l]
ELF		1×10^{8}	1×10^{5}	3	3×10^{3}	3.3×10^{-1}	3.3×10^{-3}	Extremely Low Frequency - Cosmic & Geophysical
VLF	4	1×10^{5}	1×10^{4}	3×10^{3}	3×10^{4}	3.3×10^{-3}	3.3×10^{-4}	Very Low Frequency - Longwave Radio
LF	5	1×10^{4}	1×10^{3}	3×10^{4}	3×10^{5}	3.3×10^{-4}	3.3×10^{-5}	Low Frequency - Longwave Radio
MF	6	1×10^{3}	1×10^{2}	3×10^{5}	3×10^{6}	3.3×10^{-5}	3.3×10^{-6}	Medium Frequency - Broadcast Radio
HF	7	1×10^{2}	1×10^{1}	3×10^{6}	3×10^{7}	3.3×10^{-6}	3.3×10^{-7}	High Freauency - Shortwave Radio
VHF	8	1×10^{1}	1.0 Meter	3×10^{7}	3×10^{8}	3.3×10^{-7}	3.3×10^{-8}	Very High Frequency-Commercial Radi[o]
UHF	9	1.0 Meter	1×10^{-1}	3×10^{8}	3×10^{9}	3.3×10^{-8}	3.3×10^{-9}	Ultra High Freauency - Radio & Radar (P-L)
SHF	10	1×10^{-1}	1×10^{-2}	3×10^{9}	3×10^{10}	3.3×10^{-9}	3.3×10^{-10}	Super High Frequency - Radar (L-S-X)
EHF	11	1×10^{-2}	1×10^{-3}	3×10^{10}	3×10^{11}	3.3×10^{-10}	3.3×10^{-11}	Extremely High Freauency - Radar (X - K - Q - V)
MM	12	1×10^{-3}	1×10^{-5}	3×10^{11}	3×10^{13}	3.3×10^{-11}	3.3×10^{-13}	Micrometric - Radio to Far Infrared
INFRARED		1×10^{-5}	1×10^{-6}	3×10^{13}	3×10^{14}	3.3×10^{-13}	3.3×10^{-14}	Longwave IR & Thermal Radiation
INFRARED		1×10^{-6}	6.8×10^{-7}	3×10^{14}	4.4×10^{14}	3.3×10^{-14}	2.3×10^{-14}	Near Infrared to Visible Light
VISIBLE		6.8×10^{-7}	4.2×10^{-7}	4.4×10^{14}	7.1×10^{14}	2.3×10^{-14}	1.4×10^{-14}	Visible Light to Near Ultraviolet
ULTRAVIOLET		4.2×10^{-7}	7×10^{-7}	7.1×10^{14}	3×10^{15}	1.4×10^{-14}	3.3×10^{-15}	Near UV to Far UV (Vacuum)
ULTRAVIOLET		1×10^{-7}	1×10^{-8}	3×10^{15}	3×10^{16}	3.3×10^{-15}	3.3×10^{-16}	Far UV to Soft X-Ray Radiation
X-RAY		1×10^{-8}	1×10^{-9}	3×10^{16}	3×10^{17}	3.3×10^{-16}	3.3×10^{-17}	Soft X-Ray to Hard X-Ray & Gamma
PARTICLE & COSMIC RAY								

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