A SEARCH FOR POSSIBLE CAUSAL ASSOCIATIONS BETWEEN UFOs & PERTURBATIONS IN RECORDED GEOPHYSICAL DATA

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ABSTRACT

This paper presents the results of an extensive phenomenological search for perturbations in recorded geophysical data in time coincidence with 73 high quality UFO reports. The data searched includes solar, ionospheric, and geomagnetic recordings routinely archived at the World Data Center, Boulder, Colorado. Conclusions are presented that bear upon the phenomenological association of UFO events to physically measurable quantities. No absolutely consistent trends are found, however, several possible associations are noted

INTRODUCTION

Irrespective of their ultimate origins, unidentified flying object (UFO) reports can be legitimately categorized as a world-wide phenomenon. The phenomenology of UFOs have, in the main, eluded classical scientific investigation primarily because of the anecdotal, spectacular, and sometimes theatrical character of the accounts and secondly, because of their ephemeral natures. Fortunately, there are sufficient numbers of motivated scientists to whom controversy and deliberate contrivance pose no major obstacles. The second problem, however, presents a rather formidable challenge to science simply because of the transitory and elusive nature of the events which are totally out of the control of the experimenter and consequently notoriously difficult to deal with. If scientific progress is to be made on whatever physical attributes the UFO may possess, then it must be clearly established beyond any doubt that the phenomenon is manifestly physical and can be accomodated within the conceptual framework that the sciences are accustomed to dealing with. Scientific progress depends upon linkage to a physically measurable quantity. One cannot expect otherwise.

A common misconception which has become institutionalized and nearly hereditary is that science can deal with everything. There are things that our current levels of science and technology cannot deal with. This is fortuitous in some respects because it provides scientists with something to do, and it may well be that the UFO phenomenon falls within this category, but that does not imply non-existence, nor does it provide circumstantial testimony by way of default to the often suggested extraterrestrial origins of the phenomena. It is difficult to comprehend that UFOs, if physical, do not interact with their surroundings in a way that is measurable. Indeed, if it is physical it must interact in some fashion and at least a thread of physical quantification apart from the mental transcripts of the witnesses must exist, howsoever slender. The laws of nature have heretofore been largely enforced and either reconciliation or refutation must eventually come to pass.

BACKGROUND

The idea that the UFO might be established as a physical entity with measurable properties by conducting an instrumented search goes back at least 20 years to Edward Ruppelt[1] when a group of scientists working on their own apparently found some interesting correlations between sudden increases in nuclear radiation levels and radar-visual sightings of UFOs.* French astrophysicist Vallee[2] recommended to private UFO researchers that observation networks be formed. Such networks were formed in Britain and France but did not yield fruitful results for reasons apparently not connected with the phenomenon.[3,4] Kocher[5] in an internal Rand Corporation document recommended that "existing sensor records be exmined for anomalies." In testimony before the committee on Science and Astronautics in July of 1968[6,7] made an essentially identical recommendation. The need for instrumental data was again voiced in the Condon Report by Ayer.[8]

Reports of physical effects of UFOs are varied[9] but quite often allude to electromagnetic disturbances as the cause for reported ignition and lighting system failures in automobiles. Taking one such report seriously, Wood[10] calculated a magnetic field of 10^6 gauss could have been responsible for an apparent polarization effect reported by an eye-witness. In other accounts[11,12] time coincidences between UFO sightings and fluctuations in magnetometer traces have been reported. Oswald[13] conducted a 20 month survey in Exeter, NH utilizing several homemade magnetometers of "high" sensitivity. Out of more than seventy sightings, 2 were reported as recording a magnetic disturbance in time coincidence with a UFO sighting. In what is the most reliable and encouraging work to date, Poher[14] showed a statistical correlation of 0.58 between UFO events and the vertical component of the geomagnetic field as recorded at Chambon-le-Foret Geophysical Station in France. Unfortunately, with the exception of the last cited reference, reports of measured magnetic disturbances in time coincidence with UFO sightings are poorly documented.

PURPOSE

The purpose of this effort was to conduct an intensive search for corroborative associations or perturbations in routinely recorded geophysical data archived at the World Data Center[15] and maintained the U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA).

In excess of 65 categories of geophysical data including solar and interplanetary phenomena, ionspheric and geomagnetic phenomena and cosmic ray data are routinely recorded at sites throughout the world. This data is collected and archived at several locations and made available to interested scientists through NOAA.

In the course of a collective effort of this magnitude, some justification exists if only on the basis of sheer probability, that the disturbances of a UFO, if any, could have been inadvertently recorded and stored in the archives of the World Data Center. Further, by the same reasoning, some association between the UFO phenomena and the geophysical environment may be discovered. Two essential assumptions form the basis of this search: that such disturbances or associatons exist and that there is a reasonable probability of detection of those relationships.

A third variable appears in the problem and that is the reliability of the UFO sightings in general. This topic is discussed in detail in the following section.[16]

SELECTION OF EVENTS

The task of selection of sightings was independently undertaken by a committee under the supervision of the Center for UFO Studies utilizing the computerized files of UFOCAT.[17]

One hundred high reliability sightings were requested that met the following general criteria:

a. Entry based on a first-hand written report of an on-the-scene investigation, of the equivalent.

b. Date of event to be 1957 or later.

c. Year, month, date, hour, and minute data fields are complete.

d. Absence of flags indicating uncertainty or known error in date and time fields.

e. Geographic location of event is known.

f. Event located within the 48 continental United States.

g. Multiple witnesses involved.

h. Type of report specifies a minimum strangeness level of 4 (object moved in a non-continuous trajectory, with more than one discontinuity).

i. Absence of a "possible, probable, or definite" conventional explanation for the report based on the investigation.

The following is a summary of the selection process.

The first stage in this study was the preparation of a working list of "quality" UFO reports with precisely known times and locations. UFOCAT was queried to produce a list of 100 reports with certain criteria, including precise reporting times. The resulting list was reviewed and interesting reports checked against the original sources for completeness and accuracy; additional information found was added to the UFOCAT entries. The list was then rerun with a more stringent set of minimum report criteria. The original intent was to limit the working list to multiple witness cases, but in the course of review, it was found that some interesting reports with various kinds of instrumented substantiation had only a single human witness. Therefore the list was printed in two parts: Part 1 -- multiple witness cases only, UFOCAT type 3 and above, and Part 2 -- single or unspecified number of witnesses to UFOCAT type 5 and above alleged events. This process considered about 60,000 UFOCAT cases and selected 104 in Part 1 and 48 in Part 2. Lists and background information were distributed to members of a review committee.

The goal of the committee was not to find individual reports that would prove to be unidentifiable after unlimited investigation, nor to produce a list of the "100 best reports" but to cull the printed lists to produce a very high "signal to noise ratio" report list with accurate time and location data. Each report was reviewed and discussed in turn. (In addition to intimate knowledge of the UFO literature, familiarity with UFOCAT coding conventions was a factor in selecting the committee). Marginal cases were deleted from Part 1, and strong cases were added from Part 2. Although 100 reports were requested, the committee did not attempt to fill a quota. The final count for the working list is 73 reports, the number of selected reports was allowed to seek its own level.

The following is a description of the working list:

• SOURCE OF REPORT

1. Investigative files: 49 (67.1%, from 5 government or private groups plus 3 individuals.

2. UFO journals: 13 (17.8%), from 3 different titles.

3. First edition books: 9 (12.3%), from 3 different titles.

4. Committee and clipping files: 1 report each (2.8%).

• LOCATION BY STATE

(Preference was given to reports from investigators whose work is known to members of the committee. This affected the geographical distribution somewhat).

California - 17
Texas - 7
Pennyslvania - 5
Arizona - 4
Ohio - 4
North Carolina - 3
New Mexico - 3

Nine additional states had 2 reports each, and 12 states had 1 report each. A total of 28 states are represented among the 73 reports.

• YEAR AND MONTH

Every year from 1957 to 1977 is represented except 1962, 1963, 1969, and 1970. The largest number for any one month is 4 reports from April, 1975. Reports represent 52 different months well scattered over the 20.5 year period.

• TIME OF DAY

(Preference was given to daylight reports. In that respect the working list is atypical of the report population in general. The expected evening peak remains, however).

Local Time	Reports
0001 - 0200	9
0201 - 0400	6
0401 - 0600	4
0601 - 0800	1
0801 - 1000	4
1001 - 1200	5
1201 - 1400	2
1401 - 1600	3
1601 - 1800	6
1801 - 2000	8
2001 - 2200	17
2201 - 0000	8

• REPORT STRANGENESS
(Preference was given to high strangeness reports. UFOCAT types 1 and 2 were not considered in computer selection.)

UFOCAT Type	Reports	%	Description/Strangeness
3	7	9.6	Single discontinuity of motion
4	6	8.2	Multiple discontinuity of motion
5	46	63.0	Close encounter
6	9	12.3	Landing
7	4	5.5	Occupant
8	-	---	Contact
9	1	1.4	Abduction
	73	100.0	

• REPORT FEATURES
(Preference was given to reports with interesting features.)

Features aiding in documentation:

Instrumentation	6
Radar (including 5 radar-visual & 3 multiple radar)	8
Photos	4
Independent witness	15
Witness' sketch	8

Effects:

Physical traces	7
Electromagnetic effects	7
Animal effects	3
Psychological effects	2

Descriptive features:

Disc shape	19
Noise or sound	5
Acrobatics	4
Chasing, pacing	4

• NUMBER OF WITNESSES
(Single witness cases were considered only if other factors were especially favorable.)

Witnesses	Reports
1	4
2	30
3	7
4	8
5	2
6	4
9	1
12	1
several	1
numerous	8
unspecified	2
	73

(A normal report distribution would be about 50% single witness cases.)

• DURATION OF SIGHTING

Minutes	Reports
Below 0.5	4
0.5 - 1	2
1 - 5	14
5 - 10	7
10 - 15	4
15 - 20	7
20 - 60	3
above 60	8
Total	49

The duration of the sighting was unknown for the remaining 24 cases. This distribution differs dramatically from the normal report population, which has about half the reports at one minute or less. Absence of very short durations has been shown to be a characteristic of lists of unidentified reports. The automated computer search was not programmed for selection on the basis of report duration, but this factor was considered by the screening committee. Of note was the concentration of very long duration cases in the final list. It is possible that radar, photo, instrumented observations, and other preferred report features tend to be long duration cases.

• NUMBER OF OBJECTS REPORTED

Objects	Reports	%
1	59	80.7
2	4	5.5
3	6	8.2
4	1	1.4
6	1	1.4
14	1	1.4
54	1	1.4
	73	100.0

This distribution is believed to be roughly the same as the general report population.

In summary each report has individually survived a series of computerized selection tests and a final review by a committee of individuals experienced in the field. Some of the reports have interesting credentials such as being Project Bluebook "unknowns." While it cannot be ascertained that a working list consists of "genuine UFOs" the profile of the list is highly consistent with other groups of truly puzzling reports. The variety of report types represented mirrors the multi-faceted nature of the UFO problem, and the list is well distributed in time and location. It can be reasonably asserted that the working list selected is appropriate to the methodology of the instrumented data search.

THE DATA SEARCH

This data search approaches the problem from a phenomenological point of view rather than a statistical one. It is essentially a "first look" process which might serve to identify those phenomena, if any, that merit further investigation. Time coincident events in a local rather than a world-wide sense were considered to be first priority items of interest. In practice, this was not always possible so that the final results represent a compromise between the two; being largely a matter of data avilability. In all, 17 different categories of data were examined, not all of which were available for each sighting. No a priori expectations were considered in the selection of data categories which, again, became a matter of availability. In spite of these limitations the final result represents a reasonable sampling of generic classes of phenomenon both on a local and world-wide basis.

The list of UFO reports was prepared independently of the data search by other investigators, the author having no input whatsoever in the selection of the sightings. Further, the author is, with the exception of one or two cases, unfamiliar with the details of these events. The concern was with the date, time, and location of the event, other details were temporarily deemed irrelevant.

THE DATA CATEGORIES

The following categories of recorded geophysical data were examined for possible time coincidences with the sighting list. A "time coincidence" is defined as a correlation between a UFO sighting and a fluctuation in the recorded data. The actual intervals for use in the declaration of a time coincidence range from several minutes to 24 hours, the later necessitated by some data, sunspot numbers, for example, being reported only on a daily basis. To include this type of association, the time window of interest was widened accordingly.

Over the approximately 20 years of data availability, the reporting formats and types of data being reported and compiled, progressively evolved. Stations cease operations and others begin. The quantity of data is immense and the formats and explanations in some cases complex. The following abbreviations will be used throughout the remainder of this paper and indicate a generic class of instrumental data. More detailed explanations and reporting procedures are available in the literature.[18,19] Examples from selected cases are given in the Appendix.

• SFL - SOLAR FLARES

A short lived increase in the intensity of radiation emitted in the neighborhood of sunspots. They are characterized by a rise time of several minutes and decay time on the order of tens of minutes. Optical flares are generally accompanied by radio and x-ray bursts and occasionally by high energy particle emission. Time coincidences with flares consider only the immediate component (10 min.) of electromagnetic radiation. Delayed effects were not considered.

• SRE - SOLAR RADIO EVENTS (FIXED FREQUENCY)
These are defined as increases or bursts in solar radio emission occurring in conjunction with sunspots. Observations are made at a number of different frequencies in the electromagnetic spectrum.

• SRES - SOLAR RADIO EVENTS (SPECTRAL OBSERVATIONS)
As the above except a wide range of frequencies are monitored simultaneously.

• SFLX - SOLAR FLUX
Flux densities in units of 10^{-22} w M^{-2} Hz^{-1} at 2800 MHz of the total radio emission from the solar disk are measured at local noon in Ottawa.

• IE - IONOSPHERIC EFFECTS
A compilation of several phenomena including short wave fadeouts, enhancement of low frequency atmospherics and increases in cosmic absorption.

• GAI - GEOMAGNETIC ACTIVITY INDEX
This data is referred to in terms of the K index and is a measure of the disturbances in the Earth's magnetic field. The index is determined at 3 hour intervals from the magnetic field measurements at various stations after correction for lunar, solar, and solar flare effects. The index is defined as the difference between the maximum and minimum values of the field component during that interval. As an example, if the excursions of the components in gammas are between:

0 - 5	then K = 0
5 - 10	then K = 1
10 - 20	then K = 2
20 - 40	then K = 3
40 - 70	then K = 4
70 - 120	then K = 5

• CRI - COSMIC RAY INDICES
This data is a measure of neutron or meson components of the cosmic ray flux incident at ground level. It is generally reported in bi-hourly intervals.

• SNB - SUNSPOT NUMBERS
Sunspots are optically dark (by contrast to the surrounding solar surface) photospheric regions of lower temperature and high magnetic field generally exhibiting an 11 year periodicity. Most spots appear in groups and this is taken into account when defining the sunspot number index. These data are reported on a daily basis in terms of the American relative sunspot number and provisional Zurich sunspot numbers.

• REV - RIOMETER EVENTS
A riometer measures the absorptive properties of the ionosphere by monitoring changes in the incident cosmic noise at a single frequency, usually at 20, 30 or 60 Mhz. Events are defined as large changes in the absorption process.

• PMS - PRINCIPAL MAGNETIC STORMS
A geomagnetic storm is a worldwide transient variation in the geomagnetic field.

• SMI - SUDDEN MAGNETIC IMPULSES
Similar to the sudden commencement phase of a magnetic storm but of smaller amplitude. They are not followed by main phase storms.

• SC - SUDDEN COMMENCEMENTS
The initial phase of a magnetic storm.

• SFLE - SOLAR FLARE EFFECTS
Enhanced lower ionospheric ionization from solar flare x-rays resulting in variations in the geomagnetic field.

• SID - SUDDEN IONOSPHERIC DISTURBANCES
These events are usually attributed to solar flare electromagnetic radiation incident on the ionosphere. SID's are observed on the sunlit hemisphere and occur almost simultaneously with visual flare observations.

• SP - SOLAR PROTONS
Significant numbers of charged particles are accelerated at the Sun during many solar flares. Some of these particles are subsequently detected within the interplanetary medium and at the Earth. The few data points reported herein are from satellite observations.

• FPLT - F - PLOTS
Many of the characteristics scaled from bottomside swept frequency ionograms are presented in graphical form called f-plots. Of particular interest is fbEs, the blanketing frequency of the E layer often associated

with a layer of anomalous ionization referred to as sporadic E. The time window for declaration of a time coincidence is approximately ± 2 hours.

• NMAG - NORMAL MAGNETOGRAMS A continuous record of the magnitude of several components of the geomagnetic field.

DETAILED DATA SUMMARY

27802 Las Cruces AFS, NM
57 02 07 1053
SFL, #151B
SRE, 2800 MHz, Ottawa, #151B
*SRE, 100 MHz, Cornell
(Several off scale events 1500-2000UT)

28362 Cleveland, OH
57 07 30 0431
SFL, #156B
SWF, #157B
SRE, 2800MHz,Ottawa, #157B
SRE, 200 MHz, Cornell, #157
SRE, 450 MHz, Boulder, #157
*FPLT, Wash., D.C. (fbEs = 6 MHz)
*FPLT, Ft. Monmouth (fbEs = 8 MHz)
FPLT, White Sands, negative
NMAG, Fredricksburg, Negative

28368 Wilmington, DE
57 07 30 1657
All data as above except:
*F

28368 Wilmington, DE
57 07 30 1657
All data as above except:
*FPLT, Ft. Monmouth, (fbEs = 7 MHz)
FPLT, Wash., D.C., no data
*FLPT, White Sands, fbEs = 8 MHz
NAMG, Fredricksberg, negative

28498 Cambria AFS, CA
57 08 22 0358
SFL, #157B
SRE, 2800 MHz, Ottawa, #157B
SRE, 200 MHz, Cornell, #157B
SRE, 167 MHz, Boulder, #157B
SRE, 450 MHz, Boulder, #157B
SWF, #158B
*FPLT, Ft. Monmouth (fbEs = 4 MHz)
FPLT, White Sands, negative

60326 Whittier, CA
57 08 22 1919 57 08 23 0319
SRE, 2800 MHz, Ottawa, #157
SRE, 200 MHz, Cornell, #157
SRE, 167 MHz, Boulder, #157
SRE, 450 MHz, Boulder, #157
SWF, #158
*FPLT, White Sands (fbEs = 6 MHz)
FPLT, Ft. Monmouth, negative

29321 Wabash, IN
57 11 05 1812 57 11 05 2312
SFL, #160B
SRE, 2800 MHz, Ottawa, #160B
SWF, #161B
SRE, 167 MHz, Boulder, #162B
FPLT, Ft. Belvoir, no data
FPLT, White Sands, negative
FPLT, Ft. Monmouth, no data

31075 Pueblo, CO
58 06 14 1605 58 06 14 1646
SFL, #167B
SRE, 2800 MHz, Ottawa, #167B
SRE, 200 MHz, Cornell, #167B
SRES, 100-580 MHz, Ft. Davis, #167B
SWF, #168B
SRE, 167 MHz, Boulder, #169B
SRE, 9530 MHz, Wash., D.C., #170B
SRE, 3200 MHz, Wash., D.C., #170B
IE, #174B
FPLT, White Sands, negative
*FPLT, Ft. Belvoir, (fbEs = 5 MHz)
FPLT, Ft. Monmouth, negative

31381 Miles City AFS, MT
58 09 07 1108
SFL, #170
SRE, 9530 MHz, Wash., D.C., #170B
SRE, 3200 MHz, Wash., D.C., #170B
*SRE, 2800 MHz, Ottawa, #170B
(3 min event at 1059 UT)
SWF, #171B
GAI, #171B
FPLT, Ft. MOnmouth, no data
FPLT, White Sands, no data
FPLT, Ft. Belvoir, no data

69340 Elsinore, CA
58 12 01 0207 58 12 01 1007
FPLT, White Sands, no data
FPLT, Ft. Belvoir, no data

32139 Pease AFB, NH
59 05 03 0023
*SFL, #178B, (flares reported at 0008, 0052UT, 15 min. duration)
SRE, 2800 MHz, Ottawa, #178B GAI, #179B
*SRE, 167 MHz, Boulder, #179B
(events recorded at 0010, 0012 UT)
*SWF, #179B (events recorded from 0000 - 0042 UT)
IE, #184B
*SRES, 25 - 580 MHz, Ft. Davis, #184B
(slow & fast bursts at 0011 - 0022)
*CRI, Deep River, #195B
(increase noted May 02 - May 04)
FPLT, Ft. Monmouth, no data
FPLT, White Sands, no data
FPLT, Ft. Belvoir, no data

32152 Offut AFB, NE
59 05 14 0321
SFL, #178B
SRE, 2800 MHz, Ottawa, #178B
SWF, #179B
SRE, 167 MHz, Boulder, #179B
GAI, #179B
IE, #184B
*CRI, Deep River, #195B
(sudden decrease noted)
FPLT, Ft. Monmouth, ro data
FPLT, White SAnds, no data
FPLT, Ft. Belvoir, no data

32372 Washington, D.C.
59 08 02 0528
SFL, #185B
SRE, 2800 MHz, Ottawa, #181B
SWF, #182B
GAI, #182B
*SNB, #182B, (increase on 08/02 noted)
FPLT, Wash., D.C., no data
*FPLT, White Sands, (fbEs = 4 MHz)
FPLT, Ft. Belvoir, no data
*NMAG, Washington, D.C.

32884 Dubuque, IA
60 03 04 1757 60 03 04 2357
SFL, #188B
SRE, 2800 MHz, Ottawa, #188B
SRE, 167 MHz, Boulder, #188B
SWF, #189B
SID, #189B
GAI, #189B
CRI, Deep River, #195B
SRES, 25 - 580 MHz, Ft. DAvis, #197B
SRES, 2100 - 3900 MHz, Ft. Davis, #197B
FPLT, Ft. Belvoir, no data
*FPLT, White SAnds, (fbEs = 4 MHz)
FPLT, Ft. Monmouth, no data

33963 Cape Canaveral, FL
61 01 10 1714
SFL, #198B
SRE, 2800 MHz, Ottawa, #198B
SRE, Boulder, #198B
SRES, 450 - 1000 MHz, Owens Valley, #198B
CRI, Deep River, #199B
GAI, #199B
SWF, #199B
IE, #199B
FPLT, Ft. Monmouth, no data
*FPLT, White Sands (fbEs = 6 MHz)
FPLT, Wash., D.C., no data
FPLT, Boulder, ?

80245 Benjamin, TX
61 01 10 2112 60 01 11 0312
SFL, #198B
SRE, 2800 MHz, Ottawa, #198B
SRE, 108 MHz, Boulder, #198B
SWF, #199B
IF, #199B
CRI, Deep River, #199B
GAI, #199B
FPLT, Ft. Monmouth, no data
FPLT, White Sands, no data
FPLT, Wash., D.C., no data

9400 Boulder, CO
61 01 11 0402
SFL, #198B
SRE, 2800 MHz, Ottawa
SWF, #199B
IE, #199B
CRI, #199B
GAI, #199B
FPLT, Boulder, no data
FPLT, Wash., D.C., no data
FPLT, White Sands, negative
FPLT, Ft. Monmouth, no data
*NMAG , Boulder

88989 S. Datil, NM
64 04 30 1022 64 04 30 1722
SRE, 2800 MHz, Ottawa, #237B
SRES, 7.6 - 41 MHz, Boulder, #237B
CRI, Climax, #238B
GAI, #238B
FPLT, Ft. Belvoir, negative
FPLT, P. Arguello, negative
FPLT, Wallops Is., no data
FPLT, Ft. Monmouth, no data
*FPLT, White Sands (fbEs = 6 MHz)

*FPLT, Boulder (fbEs = 4 MHz)
NMAG, Dallas

37585 Cambridge, MA
64 05 26 1943
SFL, #238B
SRE, 2800 MHz, Ottawa, #238B
SRES, 7.6 - 41 MHz, Boulder, #239B
*FPLT, Pt. ARguello (fbEs = 7 Mhz)
FPLT, Ft. Monmouth, negative
*FPLT, White Sands (fbEs = 5 MHz)
FPLT, Boulder, no data

38357 Lighfoot, VA
65 01 23 0843 65 01 23 1343
SFL, #246B
SRE, 2800 MHz, Ottawa, #246B
SRES, 7.6 - 41 MHz, Boulder, #246B
IE, #247
CRI, #247
GAI, #247
FPLT, Pt. ARguello, negative
FPLT, Wallops Is., no data
FPLT, White Sands, no data
FPLT, Boulder, no data
FPLT, Ft. Belvoir, no data
NMAG, Fredricksburg, negative

90793 Toano, VA
65 01 23 2043 65 01 24 0143
SFL, #246B
SRE, 2800 MHz, Ottawa, #246B
SRES, 7.6 - 41 MHz, Boulder, #246B
IE, #247B
CRI, #247B
GAI, #247B
FPLT, Wallops Is., no data
FPLT, White Sands, no data
FPLT, Ft. Monmouth, no data
FPLT, Boulder, no data
FPLT, Ft. Belvoir, no data
NMAG, Fredricksburg, negative

90104 Wilmer, AL
66 01 07 1527 66 01 07 2127
SFL, #258
SRE, 10700 - 2700 - 960 - 328 MHz, Penn State, #258B
SRE 2700 MHz, Penticton, 258B
SRE, 108 MHz, Boulder, #258B
SRE, 7.6 - 41 MHz, Univ. of CO, #258B
SRE, 8800 - 2700 - 1415 - 606 MHz, Sagamore Hill, #258B
FPLT, Pt. ARguello, negative
FPLT, Wallops Is., (fbEs = 3 MHz)
FLPT, Boulder, negative
FPLT, Ft. Belvoir, negative

41036 Ravenna, OH
66 04 17 0507 66 04 17 1007
*SFL, #261 (flares reported 0900 - 1002 UT)
SRE, #261
*IE, #262 (events 0844 - 1013 UT)
*REV, #262 (events 0406 - 1344 UT, Great Whale River, 30 MHz)
CRI, Deep River, #262
GAI, #262
FPLT, Pt. Arguello, negative
FPLT, Wallops Is., negative
FPLT, White Sands, no data
FPLT, Boulder, no data
FPLT, Ft. Belvoir, no data
NMAG, Fredricksburg, negative

93276 White Sands, NM
66 09 02 0043 66 09 02 0743
*SFL, #266 (events from 0631 - 0930 UT)
SRES, 7.6 - 41 MHz, Univ. of CO, #266
IE, #267
CRI, Deep River, #267
GAI, #267
*PMS, #270 (storms beginning 0325 UT lasting several days)
SMI, #273
SFLE, #273
FPLT, White Sands, negative
FPLT, Boulder, no data
FPLT, Ft. Belvoir, negative
NMAG, Dallas, negative

42137 England AFB, LA
66 09 29 0031
SFL, #266
SRE, 2800 MHz, Ottawa, #266
CRI, Deep River, #266
IE, #267
GAI, #267
PMS, #270
SMI, #270
SFLE, #270
FPLT, Wallops Is., negative
FPLT, White Sands, negative
FPLT, Boulder, negative
FPLT, Ft. Belvoir, negative
NMAG, Dallas, negative

42467 Sinton, TX
66 11 17 0411 66 11 17 1011
SFL, #268
IE, #268
SRE, 2800 MHz, Ottawa
SRES, 7.6 - 41 MHz, U. of CO, #268
REV, 30 MHz, Great Whale River, #269
*GAI, #269 (index 3)
*CRI, #269, (sudden decrease)

*PMS, #270, (storm commencing 0016 UT to 1000 UT)
SMI, # 273
SFLE, #273
FPLT, Wallops Is., negative
FPLT, White Sands, no data
FPLT, Boulder, no data
FPLT, Wash., D.C., no data

87315 Elyria, OH
66 12 09 1644 66 12 09 2144
*SFL, #269 (large numbers of flares reported 2000 - 2400 UT)
*SRE, #269, (burst recorded 2000 - 2025 from Ottawa)
*SRES, #269 (bursts 2126 - 2127 UT, 22 - 41 MHz)
*SID, #270 (disturbances 1859 - 1901 UT)
*REV, #270 (disturbances 1859 - 1901 UT)
*REV, #270 (events 1710 - 2152 UT, Great Whale River)
CRI, Deep River, #270
GAI, #270
*SNB, (large increase in count 12-09 through 12-16) #269
SFLX, #269 (increase noted from 12-04 through 12-20)
FPLT, Wallops Is., (fbEs = 4 MHz)
*FPLT, White Sands (fbEs = 3.5 MHz)
FPLT, Boulder, negative
*FPLT, Wash. D.C., (fbEs = 4.0 MHz)
NMAG, Fredricksburg, negative

65216 Strongsville, OH
66 12 13 1553 66 12 13 2053
*SFL, #269 (flares reported 1835 - 2300 UT)
*SRE, #269 (events 2100 - 2115 UT)
SRES, #269
*SID, #270 (event 1921 - 1927 UT)
*REV, #270 (events 0227 - 2236 UT)
*CRI, #269 (sudden decrease noted, Depp River)
*GAI, #269 (increase noted)
*SNB, #269 (large increase in count 12-09 through 12-16)
*SFLX, #269 (increase noted from 12-04 through 12-20)
*FPLT, Wallops Is., (fbEs = 4 MHz)
*FPLT, White Sands (fbEs = 5.0 MHz)
*FPLT, Boulder (fbEs = 8.0 MHz)
*FPLT, Wash., D.C., negative
NMAG, Fredricksburg, negative

43188 Nelson, NH
67 01 31 2014 67 02 01 0114
SFL, #271
SRE, #271 NOP
SRES, 7.6 - 41 MHz, Univ. of CO, #271
SID, #272
CRI, Deep River, #272
GAI, #272
SNB, #272
*SFLX, #272 (2800 MHz, Ottawa, up slightly)

69592 Kingman, AZ
67 02 16 2343 67 02 17 0643
SFL, #271
SRE, #271
SID, #272
*REV, #272 (events 0056 - 2214 UT, Great Whale River)
*GAI, #272 (sudden decrease noted, Deep River)
*CRI, #272 (sudden decrease noted Deep River)
FPLT, Vendenburg AFB, no data
FPLT, Wallops Is., negative
FPLT, White Sands, no data
FPLT, Wash., D.C., no data
NMAG, Tucson, negative

57792 Benton Harbor, MI
67 03 06 0601
SFL, #272
SRE, #272
SRES, 7.6 - 41 MHz, U. of CO, #272
SID, #273
CRI, #273
*GAI, #273 (index 3)
FPLT, Vandenburg AFB, no data
FPLT, Wallops Is., no data
FPLT, White Sands, no data
FPLT, Boulder, no data
FPLT, Wash., D.C., no data

58046 Phoenix, AZ
67 04 12 2059 67 04 13 0359
SID, #274
CRI, Deep River, #274
GAI, #274
*SRES, #277 (burst at 0231 UT)
FPLT, Vandenburg AFB, no data
FPLT, Wallops Is., no data
FPLT, White Sands, no data
FPLT, Boulder, no data
FPLT, Wash., D.C., no data
NMAG, Tucson, negative

81238 Yorba Linda, CA
67 07 07 2113 67 07 08 0513
SFL, #276
SRE, #276
SRES, 7.6 - 41 MHz, U. of CO, #276
SID, #277

GAI, #277
SNB, #277
FPLT, Vandenburg AFB, no data
*FPLT, Wallops Is., (fbEs = 4.8 MHz)
*FPLT, White Sands, (fbEs = 5.0 MHz)
FPLT, Boulder, negative
*FPLT, Wash., D.C., (fbEs = 5 MHz)
FPLT, Stanford, no data

81239 Yorba Linda, CA
67 07 08 0123 67 07 08 0923
Data as previous except:
*FPLT, Vandenberg AFB, ?
*FPLT, Wallops Is., (fbEs = 4 MHz)
FPLT, Stanford, no data
*FPLT, White Sands (fbEs = 5 MHz)
FPLT, Boulder, negative
FPLT, Wash., D.C., negative

46574 Milledgeville, GA
67 10 13 0436 67 10 13 0936
FPLT, Vandenberg AFB, negative
FPLT, Wallops Is., negative
FPLT, Stanford, no data
FPLT, White Sands, no data
*FPLT, Boulder (fbEs = 4.5 MHz)

76922 Yucaipa, CA
68 01 03 2214 68 01 04 0614
SFL, #287
SID, #282
SRES, #283
CRI, #283
GAI, #283
*FPLT, White Sands, (fbEs = 2.0 MHz)
FPLT, Boulder,
FPLT, Wash. D.C., no data
FPLT, Wallops Is., no data
FPLT, Stanford

81272 Hollywood, CA
68 01 23 1709 68 01 24 0109
SFL, #287
SID, #282
SRES, #283
GAI, #283
*FPLT, White Sands, (fbEs = 6 MHz)
FPLT, Boulder, no data
FPLT, Wash., D.C., no data
FPLT, Stanford, no data
FPLT, Wallops Is., no data

47770 Barkhamsted, CA
68 02 21 0012 68 02 21 0512
SFL, #283
SRE, #283
SID, #284
SRES, #284
CRI, #284
GAI, #284
SNB, #283
SFLX, 2800 MHz, Ottawa, #283
FPLT, Stanford
*FPLT, White Sands, (fbEs = 2 MHz)
FPLT, Boulder, no data
FPLT, Wash., D.C., no data
FPLT, Wallops Is., no data

90883 Apache Junction, AZ
71 03 14 2106 71 03 15 0406
SFL, #320 Part I
SRE, # 320, Part I
FPLT, Wallops Is., no data
FPLT, White Sands, no data
FPLT, Stanford, no data
*NMAG, Tucson

63604 Greensburg, PA
72 04 17 2019 72 04 18 0119
SFL, #333 Part I
SRE, #333 Part I
*SID, #334, Part I (event reported 0101 - 0153 UT)
FPLT, White Sands, negative
FPLT, Wallops Is., negative
FPLT, Stanford, no data

92919 Colby, KS
72 08 19 0207 72 08 19 0807
SID, #338 Part I
SRES, #338 Part I
CRI, Calgary, #338 Part I
GAI, #338 Part I
SFL, #342 Part II
SRE, #342 Part II
FPLT, Stanford, no data
FPLT, White Sands, no data
FPLT, Wallops Is., no data
*NMAG, Boulder

93156 Piedmont, MO
73 04 13 1927 73 04 14 0127
SFL, #345 Part I
SRE, #345 Part I
SID, #346 Part I
*CRI, #346 Part I (sudden decrease noted)
*GAI, #346 Part I (index 4)
*SC, #346 Part I (0247 UT)
*PMS, #346 Part I (storms commencing at 0243 UT)
*FPLT, Wallops Is., (fbEs = 1.8 MHz)
FPLT, Stanfrod, no data
NMAG, Tulsa, negative

73703 Pleasant Unity, PA
73 07 14 0026 DST 73 07 14 0426
SFL, #348 Part I
SRE, #348 Part I
SID, #349 Part I
SRES, #349 Part I
CRI, #349 Part I
GAI, #349 Part I
*FPLT, Wallops Is., (fbEs = 2.8 MHz)
FPLT, Stanford, no data
NMAG, Fredricksburg, negative

73713 New Alexandria, PA
73 08 04 2227 DST 73 08 05 0227
SFL, #349 Part I
SRE, #349 Part I
SID, #350 Part I
SRES, #350 Part I
CRI, #350 Part I
GAI, #350 Part I
NMAG, Fredricksburg, negative
*FPLT, Wallops Is., (fbEs = 3.8 MHz)
FPLT, Stanford, no data

92218 Tucson, AZ
73 09 12 1542 73 09 12 2242
SFL, #350 Part I
SRE, #350 Part I
SID, #351 Part O
SRES, #351 Part I
GAI, #351 Part I
*FPLT, Wallops Is. (fbEs = 4 MHz)
FPLT, Stanford, no data
NMAG, Tucson, negative

92248 San Antonio, TX
73 10 23 0226 73 10 23 0826
SFL, #351 Part I
SID, #352 Part I
SRES, #352 Part I
CRI, #352 Part I
GAI, #352 Part I
SRE, #351 Part I
FPLT, Wallops Is., no data
FPLT, Stanford, no data

90885 Buena Park, CA
73 10 25 1902 73 10 26 0302
SFL, #351 Part I
SRE, #351 Part I
SID, #352 Part I
SRES, #352 Part I
CRI, #352 Part I
GAI, #352 Part I
GAI, #352, Part I
FPLT, Wallops Is., no data

72081 Paso Robles, CA
73 12 14 2143 73 12 15 0543
SFL, #353 Part I
SRE, #353 Part I
SID, #354 Part I
SRES, #354 Part I
CRI, #354 Part I
*GAI, #354 Part I (Index 3 -)
FPLT, Wallops Is., negative
FPLT, Stanford, no data

80589 Mansfield, PA
74 03 14 2127 74 03 15 0227
SFL, #356 Part I
SRE, #357 Part I
SID, #357 Part I
CRI, #357 Part I
GAI, #357 Part I
*FPLT, Wallops Is., (fbEs = 1.3 MHz)
FPLT, Stanford
NMAG, Fredricksburg, negative

80680 Lincoln Park, MI
74 04 27 2011 74 04 28 0111
SFL, #357 Part I
SRE, #357 Part I
SID, #358 Part I
SRES, #358 Part I
FPLT, Wallops Is., negative
FPLT, Stanford, no data

80758 Peru, IN
74 06 21 0208 74 06 21 0708
SFL, #359 Part I
SRE, #360 Part I
SID, #360 Part I
SRES, #360 Part I
CRI, #360 Part I
GAI, #360 Part I
*FPLT, Wallops Is. (fbEs = 3.7 MHz)
FPLT, Stanford, no data

80951 Grand Forks AFB, ND
74 10 14 2109 74 10 15 0309
SFL, #368 Part II
SRE, #368 Part II
FPLT, Wallops Is., negative
FPLT, Stanford, no data

88996 Austin, TX
74 11 11 1836 74 11 12 0036
SID, #365 Part I
SRES, #365 Part I
CRI, #365 Part I
*GAI, #365 Part I (Index 6^+)
SRE, #369 Part I

FPLT, Wallops Is., negative
FPLT, Stanford, no data
*NMAG, Dallas

81027 Buena Park, CA
74 12 07 0613 74 12 07 1413
SFL, #365 Part I
SID, #366 Part I
SRES, #366 Part I
CRI, #366 Part I
GAI, #366 Part I
*SRE, #370 Part II (event at 1406 - 1408 UT)
*FPLT, Wallops Is., (fbEs = 3.5 MHz)
FPLT, Stanford, NOP

81043 Marshalltown, IA
74 12 19 1742 74 12 19 2342
SID, #366 Part I
SRE, #366 Part I
CRI, #366 Part I
*GAI, #366 Part I (Index 5-)
*SRE, #370 Part I (events reported at 2330)
FPLT, Wallops Is., no data
FPLT, Stanford, no data

89143 Canton, IL
75 01 03 1802 75 01 04 0002
SID, #367 Part I
*SRES, #367 Part I (events reported 0000 - 0930 UT)
CRI, #367 Part I
*GAI, #367 Part I (Index 4 -)
SRE, #366 Part II
SFL, #371 Part II
FPLT, Wallops Is., negative

89147 Tacoma, WA
75 01 05 2152 75 01 06 0552
SID, #367 Part I
SRES, #367 Part I
CRI, #367 Part I
*GAI, #367 Part I (index 3)
SRE, #366 Part I
FPLT, Wallops Is., no data
NMAG, Victoria, negative

89128 Kansas City, MO
75 01 16 0003 75 01 16 0603
SRE, #366 Part I
SID, #367 Part I
SRES, #367 Part I
CRI, #367 Part I
*GAI, #367 Part I (index 3)
FPLT, Wallops Is., no data
NMAG, Tulsa, negative

87914 Woodland Hills, CA
75 02 25 1732 75 02 26 0132
SFL, #367 Part I
SRE, #372 Part II
SNB, #367 Part I
FPLT, Wallops, Is., no data

86984 Brentwood, CA
75 03 27 0054 75 03 27 0854
SRE, #368 Part I
SID, #369 Part I
SRES, #369 Part I
CRI, #369 Part I
GAI, #369 Part I
FPLT, Wallops Is., no data

91264 Decatur, TX
75 03 31 2158 75 04 01 0258
SRE, #370 Part I
SID, #370 Part I
CRI, #370 Part I
PMS, #370 Part I
SFL, #375 Part II, NOP
FPLT, Wallops Is., no data
*NMAG, Tulsa
*NMAG, Dallas

91193 Lumberton, NC
75 04 0142 75 04 04 0642
SRE, #370 Part I
SID, #370 Part I
CRI, #370 Part I
GAI, #370 Part I
PMS, #370 Part I
SFL, #375 Part II
NMAG, Fredricksburg, negative

91338 Rock, PA
75 04 06 1208 75 04 06 1708
Data same as 91193 except:
*PMS, #370 Part I (storm commencing at 2100 UT)

91175 Fayetteville, NC
75 04 08 0038 75 04 08 0538
Data same as 91193 except:
*PMS, #370 Part I (storm in progress)
*SNB, #370 Part I (increase noted)
*NMAG, Fredricksberg

86079 Mt. Washington, CA
75 08 23 2132 DST 75 08 24 0432
SFL, #378 Part II
SRE, #378 Part II
SID, #378 Part II
SRES, #378 Part II

CRI, #378 Part II
GAI, #378 Part II
PMS, #378 Part II

86080 Mt. Washington, CA
75 08 23 2206 DST 75 08 24 0506
Data same as previous

88995 Austin, TX
75 12 10 2058 75 12 11 0258
SRE, #377 Part I
SID, #378 Part I
CRI, #378 Part I
GAI, #378 Part I
PMS, #378 Part I

89564 Texico, NM
76 01 23 0302 76 01 23 1002
SFL, #378 Part I
SID, #378 Part I
SRES, #378 Part I
CRI, #378 Part I
GAI, #378 Part I
PMS, #378 Part I
*PS, #383 Part I (proton burst noted)

86092 Sherman Oaks, CA
76 02 01 1858 76 02 02 0258
SID, #380 Part I
SRES, #380 Part I
CRI, #380 Part I
*GAI, #380 Part I
PMS, #380 Part I
SFL, #384 Part II, NOP
SRE, #379 Part I

89626 Orlando, FL
76 06 30 2238 76 07 01 0338
No data

93601 Colusa, CA
76 09 10 0054 76 09 10 0854
SID, #387 Part I
*SRES, #387 Part I (events reported 0539 - 1732 UT metric band)
CRI, #387 Part I
GAI, #387 Part I
PMS, #387 Part I
SFL, #391 Part II
*SRE, #391 Part II (events commencing at 0819)
*SNB, #387 Part I (increase noted)
*PS, #391 Part II (increase noted)

93696 Rockford, IL
77 01 16 2038 77 01 17 0238
SFL, #390 Part II
SRE, #390 Part II
*SNB, #390 Part I (increase in progress)

93731 Newport Beach, CA
77 04 09 2252 77 04 20 0652
SFL, #393 Part I
SRE, #393 Part I
SID, #394 Part I
SRES, #394 Part I
CRI, #394 Part I
GAI, #394 Part I
PMS, #394 Part I

91309 Wakulla Springs, NC
75 04 04 2249 75 04 05 0349
Data same as 91193 except:
*SNB, #370 Part I (large increase noted)
NMAG, Fredricksberg, negative

SPECIFIC CONCLUSIONS

SOLAR FLARES

Of the 63 cases examined, 3 were adjudged to be in time coincidence with the immediate component (electromagnetic) of the flare radiation reaching earth. Associated with larger flares are proton showers which are delayed from 0.5 to 16 hours from the visual flare and are responsible for disturbances in the geomagnetic field. The delayed component was not considered in the search. From the very low frequency of occurrence it is concluded that there is no association between the immediate electromagnetic component of solar flares and UFO reports.

SOLAR RADIO EVENTS (FIXED FREQUENCY)

Of the 63 cases examined, 8 were adjudged to be in time coincidence with solar radio events. Of these at least 3 can be attributed to solar flares. These observations are taken at a number of difference frequencies with highly sensitive directional radio receivers. In spite of the directionality, response on the side lobes of the antenna could be sufficient to detect an intense source. However, the very low frequency of occurrence and geographical considerations suggest coincidence rather than association. Nevertheless, if the UFO electromagnetic emission hypothesis were pursued, then it would be possible to estimate some upper limits on such emission if the antenna side lobe response were known.

SOLAR RADIO EVENTS (SPECTRAL DATA)

Of the 28 cases examined, 5 were adjudged to be in time coincidence with these measurements. Of these at least 3 were associated with solar flares. With discussion similar to the previous section, it is concluded that the remaining events are probably coincidental and no association exists.

SOLAR FLUX

Of the 73 cases examined, 3 were adjudged to be in time coincidence with a rise in time integrated daily solar flux measurement at 2800 MHz taken at Ottawa. These are again relegated to coincidence.

SHORT WAVE FADEOUTS

Of the 14 cases examined, only one was adjudged to be in time coincidence with this category of phenomenon. It is concluded that no association exists.

IONOSPHERIC EVENTS

Of the 12 cases examined, 1 was adjudged to be in coincidence with this category. It is concluded that no association exists.

GEOMAGNETIC ACTIVITY INDEX

Of the 55 cases examined, 12 were adjudged to be in time coincidence with a rise in the K index. Since this index is a worldwide average over 3 hour periods, it is difficult to assert a phenomenological association. However, the relatively high frequency of occurrence renders it equally difficult to ascribe this category to random coincidence. Until further investigations are carried out, this category is adjudged to be indeterminate.

COSMIC RAY INDICES

Of the 50 cases examined, 6 were adjudged to be in time coincidence with fluctuations in the cosmic ray index. At least 2 of these were associated with sudden decreases in the index. A fairly low frequency of occurrence suggests no association exists.

SUNSPOT NUMBERS

Out of 73 cases examined, 7 were adjudged to be in time coincidence with increases in the sunspot numbers. The frequency of occurrence is again too low to suggest any association.

RIOMETER EVENTS

Of the 5 cases examined, 4 were adjudged to be in time coincidence, yielding a relatively high frequency of occurrence. However, the small number of cases examined renders this category indeterminate.

PRINCIPAL MAGNETIC STORMS

Of the 16 cases examined, 5 were adjudged to be in time coincidence with principal magnetic storms. This represents a relatively high frequency of occurence. Nevertheless, this category is adjudged to represent a possible association.

SUDDEN MAGNETIC IMPULSES

Insufficient data.

SOLAR FLARE EFFECTS

Insufficient data.

SUDDEN IONOSPHERIC DISTURBANCES

Of the 43 cases examined, 3 were adjudged to be in time coincidence with this phenomenon. The low frequency of occurrence suggests that no association exists.

SUDDEN COMMENCEMENTS

Insufficient data.

SOLAR PROTONS

Insufficient data.

F-PLOTS

Of the 42 cases examined, 26 were adjudged to be in time coincidence with a relatively large fluctuation in fbEs, the blanketing frequency of the sporadic E-layer.[1] The sporadic E layer is a relatively thin layer of anomalous ionization that manifests itself within the normal E layer from time to time. The frequency of occurrence of this phenomenon at any given geographical location is about 1% or less, averaged on a yearly basis. There is no known relationship between sporadic E and any solar phenomenon. However, it seems to exhibit a slight preference for the summer months and a decrease during the course of the night. It also seems to be a fairly localized event with distinct horizontal boundaries, and very little geographical correlation between events at distances beyond 400 km.

It appears that several different

physical phenomena are lumped together under the general heading of sporadic E. Currently held theories allude to the equatorial electrojet as being responsible for the phenomena in the equatorial zones with wind shear and charged particle bombardment being the causative agent in temperate and auroral zones respectively. Meteoritic dust has also been cited[20,21,22]. The relatively high frequency of occurrence suggests a possible association.

NORMAL MAGNETOGRAMS

Of the 26 cases examined, 8 were adjudged to be in time coincidence with fluctuations in one or more components of the geomagnetic field. This relatively high frequency of occurrence is moderated by two considerations. Firstly, the fluctuations are subtle and secondly, a high probability of other causative agents is present. Nevertheless, this category is adjudged to represent a possible association.

GENERAL CONCLUSIONS

The data presented herein have served two principal purposes relative to the primary objective of attempting to find some clue as to causal relationships in the UFO phenomenon. The first was an examination of the hypothesis that UFOs may cause some perturbations in recorded instrumental data. A fortuitous by-product of the study allows the examination of an alternative hypothesis namely that UFOs are in some way related to environmental changes as measured by the instrumental data.

Neither of these approaches are all-encompassing in the sense that only limited amounts of data and phenomena can be examined. The conclusions therefore must be presented in the same context. Time coincidences do not demand causality but merely imply a cause and effect relationship may exist.

In the attempt to draw conclusions, the principal assumptions are restated: that UFOs are physical entities and interact with or are the byproduct of environmental effects, and that in some way, these relationships may be discovered, provided the right effects are both being measured and scrutinized.

Additional assumptions about the reports per se were also required. As was stated earlier, considerable effort was expended in the compilation of a list of "quality" reports. It is assumed that all such events are members of a representative sample of the most credible events documented and all constitute valid data points with which to seek cause and effect relationships.

A possible source of error is the conversion in some instances of local time to universal time. This uncertainty arises from the local time zone in which the event was reported. A further possible source of error lies within the ralm of subjective judgment on the part of the investigator as to what consitutes a time coincidence. Since no absolute judgments are presented and since a fairly large number of cases were examined, it can be reasonably asserted that an occasional error of this sort would not appreciably influence the outcome.

There are six categories of phenomenological occurrences that seem to merit further attention. These are listed below with individual conclusions arrived at in the previous section.

1. Geomagnetic activity Index (indeterminate)
2. Principal magnetic storms (possible)
3. Solar protons (insufficient data)
4. f-plots (possible)
5. Normal magnetograms (possible)

The first hypothesis to be examined concerns sheer coincidence. This explanation is possible due to the limited scope of the investigation. However, this does not appear likely if the results can be taken at face value. Clearly, much more work is needed and cases should be examined extensively on an individual basis to resolve this question. It is the author's considered opinion that the frequency of occurrence of one or more of these associations are unusually high, perhaps too high to ascribe them to random coincidence especially in consideration of past results, albeit poorly documented. There exists sufficient evidence to at least seek and examine an alternative hypothesis.

Individually, the above conclusions do not offer nearly as much potential for suggesting possible association as when they are considered collectively. It is noted that all of these categories, with the possible exception of f-plots, can be associated with charged particle showers incident on the ionosphere and magnetosphere. The Geomagnetic Activity Indes, Principal Magnetic

TABLE II. SUMMARY BY DATA CATEGORY

DATA CATEGORY	# CASES EXAMINED	# TIME COINCIDENCE	FREQUENCY OF OCCURRENCE	OVERALL CONCLUSION
Solar Flares	63	3	.05	No association with fast component
Solar Radio Events (fixed frequency)	63	8	.13	No association
Solar Radio Events (spectral)	28	5	.18	No association
Solar Flux	73	3	.04	No association
Short Wave Fadeouts	14	1	.07	No association
Ionospheric Events	12	1	.08	No association
Geomagnetic Activity Index	55	12	.22	Indeterminate
Cosmic Ray Index	50	6	.12	No association
Sunspot Numbers	73	7	.10	No association
Riometer Events	5	4	.80	Indeterminate
Principal Magnetic Storm	16	5	.30	Possible
Sudden Magnetic Impulses	3	0	.00	Insufficient Data
Solar Flare Effects	3	0	.00	Insufficient Data
Sudden Ionospheric Disturbances	43	3	.07	No association
Sudden Commencements	1	1	1.0	Insufficient Data
Solar Protons	2	2	1.0	Insufficient Data
f-plots	42	26	.62	Possible
Normal Magnetogram	26	8	.31	Possible

Storm, and Normal Magnetogram are all measurements of the Earth's magnetic field and perturbations are largely the result of charged particle influx from the interplantary medium. The Riometer Events and Solar Proton measurements are additional and independent indications of the charged particle influence. Taken together, the tentative hypothesis of charged particle association is reinforced.

F-plots are indications of ionospheric perturbations manifested in large fluctuations in fbEs, the blanketing frequncy of the sporadic "E" layer (a thin region of anomalous ionization existing at times in the normal E layer). There are as yet some questions on the formative mechanisms for sporadic E in temperate regions so that whether or not this specific result is an exception to the above trend is an open question.

There arise a number of specific questions or objections to the above apparent trends with regard to the manifold complexities of the UFO phenomenon. Of these the most prominent is one concerning consistency . If the representative sample of quality UFO reports all represent valid data points, then it is pertinent to ask why the associations are not consistently observed. For example, a UFO was reported over a city in which a magnetograph was recording data and yet no perturbations were noted. There are other examples of these glaring inconsistencies. It is possible that UFOs are multi-faceted phenomena exhibiting different characteristics at different times. Clearly, this conjecture amplifies the existing complexities many times.

It is also possible that the list of UFO reports used in this search contains a mixture of truly inexplicable events, misidentifications and contrivance.

All of these objections are valid possibilities and a considerable amount of effort will be required to glean some definitive answers.

In spite of these objections, there seems to be sufficient justification for further efforts of this kind.

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REFERENCES

Some of the publications cited in the references are not generally considered to be reputable scientific journals. However, it has been the author's experience that each work should be examined individually. More importantly, there are very few places that even the most scholarly and legitimate work on UFOs can be published.

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