UNIDENTIFIED AEROSPACE PHENOMENA (UAP) AND EXPERIMENTAL STRATEGY:

METHODS, EQUIPMENT AND LESSONS FROM INSTRUMENTED FIELD STUDIES

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1. BACKGROUND

- Since 1947, numerous UAP sightings have been documented using diverse measures (e.g. physical traces and effects, radarscope data, photographs, film and video footage).
- Almost all these previous data have not been acquired under controlled conditions with scientific instrumentation and have failed to provide sufficiently reliable evidence to convince the scientific community of the existence of anomalous aerial phenomena.
- To maximize the chances of acquiring reliable and valid data on the UAP phenomenon, instrument observations are essential, preferably coupled with visual observations. Instrumentation can assist in obtaining quantitative data required to understand basic physical characteristics of UAP.
- As early as the 1950s some attempts to detect and analyze UAP using scientific equipment have been carried out in the field in areas where anomalous aerial events had been reported.
- Field research give support to the idea that the UAP phenomenon could be studied on a rigorous and empirical basis.

2. PURPOSE

- The purpose of this research is (1) explore the principal UAP instrumented field studies deployed around the world since the 1950s, (2) analyze the most important results obtained, and (3) highlight the limitations and shortcomings in extant field research with the objective of refining future instrumented projects.

3. METHODS

- Data Collection and Analysis:
  We identified relevant projects throughout review of the ufological literature, consulted official declassified documents and interviewed researchers and projects leaders.
- Sample:
  Selection and analysis of 26 instrumented field experiments implemented between 1950 and 2013, on 4 continents.
- Method:
  For each project, we analyze the different schemes and strategies devised, the composition of the scientific instrumentation used on the field and report on the most important results obtained. We also highlight the main common difficulties and the lessons learned by the researchers.

Fig. 1: Field experiments location

5. LIMITATIONS AND SHORTCOMINGS

- Problems with financial resources.
- Organizational and logistics capabilities.
- Lack of competent technical personnel that is constantly on the field.
- Incomplete familiarity with the instruments.
- Difficulties of a regular and prompt maintenance during hardware or software failure.
- Unprepared governmental teams sent on the field.
- Human observers and researchers are highly suggestible and, particularly in a situation where a novel observation occurs, they are looking for an explanation for what they experienced. The latter can lead to some very erroneous conclusions.
- Results of UAP field experiments efforts have almost never been published (Hessdalen's work has been an important exception since about 2000).

Fig. 13: Institut fur technische UFO-forschung

6. CONCLUSIONS

- Field studies should definitely be done where UAP have more frequently been reported, as there is a very small likelihood that a UAP will be detected otherwise.
- The UAP phenomenon, even in areas where it occurs more frequently, is still intermittent in its appearance and so research most continue for many months, at least.
- The most successful projects were those where researchers could be on-site with equipment and could both initiate and visually corroborate instrumented observations.
- Some projects have managed to acquire some preliminary data, albeit inconclusive. It can be concluded that anywhere that UAP appear often enough they can be photographed. In this respect, UAP are literally "real".
- The past limited success of the past field studies provides support for continued and enhanced field work. Whatever UAP are, they can be studied with the right equipment in the right place at the right time. The challenge is not the technology, but the other two components.
- Progressing on UAP physics' working hypotheses is only feasible if field work includes simultaneous measurements with sensors functioning at different wavelength ranges.
- A robust automatic monitoring system appears to be the best trade-off option, and ideally a network of several stations.
- Advances in technology and informatics open up new and more effective options for the detection and analysis of UAP.
- The amount of funds required for field study of the phenomenon is not excessive, as shown by past efforts, but any project requires a sustained effort over time, and thus long-term funding.
- Having a network of observers and a comprehensive UAP reporting network near station locations is very important to coordinate physical measurements with UAP sightings, and projects often had less success with this aspect of the work.
- Field studies require effective collaboration between scientists from several disciplines (e.g. atmospheric physics, geology, meteorology).
- Cooperation between UAP field works specialists shall be improved.
- Accurately documenting and preserving the information pertaining to field experiments is required for guiding future projects.
- UAP sightings reliable databases/statistics (e.g. from GEIPAN) are indispensable in order to refine instrumentation and research strategies.
- The ultimate goal of instrumented field studies is to ascertain the nature of the UAP phenomenon and which physics can be extracted from it.

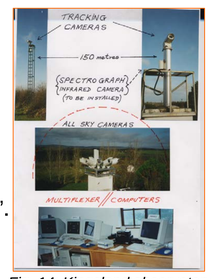

Fig. 14: Kingsland observatory

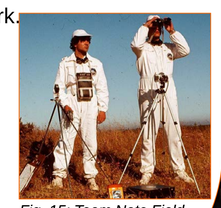

Fig. 15: Team Note Field

4. KEY FINDINGS

- Contrary to popular belief, there have been many attempts at field measurement/detection of UAP and very few of them were predicated on an extraterrestrial visitor hypothesis.
- Field experiments peaked in the 1970s and early 1980s, then virtually disappeared in the 1990s. The decline may be attributable to the closure of the American project "Blue Book", the decrease of UAP sightings, the focus on other topics in the USA (e.g. Roswell, abductions) and the institutional and scientific climate gradually becoming less supportive of studying UAPs.
- An increase in the number of initiatives around the world (mainly in Europe) is evident since the 2000s.
- Several long-term field projects continue into the new millennium, including the Project Hessdalen (Norway) running since 1984.

Fig. 2: Field Experiments timeline

- Civilian UAP researchers have attempted to use scientific instrumentation to measure and assess the UAP phenomenon. They have deployed more equipment and in many more locations than the few government projects that attempted similar research.
- The majority of the systematic, instrumented efforts have been devoted to the study of "nocturnal lights" (also called "earthlights"). This kind of phenomenon is much more frequent than reported "unidentified structured aerial objects".

Fig. 3: Askania Theodolite

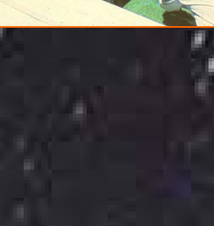

Fig. 4: Project Identification

Field Tactics: Early projects centered on acquiring photographic evidence and the detection of fluctuations in magnetic fields, on the assumption was that UAP were at least emitting some type of magnetic field (spinning of compasses has been described in some cases). Most projects that used an automatic trigger used some type of magnetic detection, and this often led to too many false positives.

Fig. 5: Videon camera

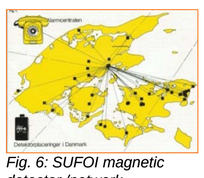

Fig. 6: SUFOI magnetic detector /network

PROJECT	FIELD EXPERIMENT TACTIC	FIELD STRATEGY	RESULTS
PROJECT TWINKLE	Askania instrument triangulation, Mitchell camera using spectrum grating, Electromagnetic Frequency measurements.	Manned fixed stations between sunrise and sunset. Shift from Vaughn location to Holloman AFB (New Mexico) to follow phenomena activity.	Official document confirms some visual sightings and Askanias pictures taken in two cases (however photographic evidence not available).
PROJECT MAGNET	An ionospheric reactor to determine the height, pattern and conduct of the ionized layer of gases several hundred miles in the atmosphere, a gamma ray counter to detect atomic rays from the outer atmosphere, various types of radar, a gravimeter to measure the Earth's gravity, a compass type magnetometer to measure the variations in the magnetic field, and a radio set for picking up any radio noise.	Group of instruments set up in a hut. Not manned but connected directly by an alarm bell system with the nearby ionosphere station at Shirley bay.	Alarm bell triggered once by the deflection on the gravimeter, however low overcast prevented visual observation.
VIDEON CAMERA	Stereo cameras "Videon" containing two F3.5 lenses with focal lengths of 45 mm. Shutter speed locked at 1/20th of a second and distance at infinity. One lense equipped with a diffraction grating (15000 vertical "hairlines" to the linear inch.	73 cameras distributed to selected radar stations and control towers throughout the United States.	None.
TULLY MONITOR STATIONS	Monitoring stations built around a photo-cell and sensitive magnetic compass. The photo-cell light beam was interrupted if magnetic disturbance occurred. And the fluctuation of photo-cell current then activated the cine-camera release (Eumig 8mm, auto.). The camera was energised so long as magnetic field disturbance continued (five frames exposed per 2-second interval).	Two un-manned stations placed at undisclosed locations near the Horseshoe Lagoon near Tully, Queensland and in the south, 20 miles out of Brisbane.	Monitor triggered two times and film exposed. Package sent to Kodak (Melbourne) for processing but alledgedly arrived without the film.
THE EXETER EXPERIMENT	Set-up of a small network of 15 sensitive magnetometers. All detectors had the same design, using a suspended magnet that triggered an alarm when affected by changes in local magnetic fields.	Detector sites clustered around Exeter (New Hampshire) in random patterns. A total of 15 detectors were operated at 13 different sites (the greatest distance between two sites was 13 km). Units functioned for periods ranging from 51 to 675 days (approx. 22 months). Only 6 sites operated on a 24-hour basis, most of them were operated only when people were at home. Oswald routinely maintained the system and kept careful records on the status of each detector and collected sighting reports from the Exeter area for the duration of the experiment (46 events).	659 alarms recorded during the experiment. Vast majority of most of the hundreds of the detectors alarms could be linked to geomagnetic phenomena and other variables not related to UAPs. There were only two instances in which a UAP was sighted at the same time of a magnetometer's alarm.
FILTERS JOBIN-YVON	Diffraction gratings for cameras (Density of 300 lines/mm)	Distribution of Cie JOBIN-YVON's diffraction gratings to +/-3500 "Brigades de Gendarmerie" across France, to be mounted on their cameras (model Minolta HI-MATIC 24*36, ROKKOR 38mm lense, 125 ASA black & white film ILFORD FP4).	None.
MFI-6 MAGNETIC DETECTORS	Network of magnetic detectors. A fully electronic item, The MFI 6 instrument was a full electronic item with a coil as a sensor device aimed at detecting whether the coil current was generated from a magnetic change. Also a very compact model (13*6*3 cm).	Production and sale of 200 detectors in Denmark between 1981 and 1984. An alarm central office was also set up, but only 42 buyers signed up to the SUFOI reporting system for submitting report forms with alarms from the detectors	None. Many detectors' false alarms due to various man-made factors that could trigger the alarm (e.g. fridges, televisions, thunderstorms, cars traffic).

- Areas where ''nocturnal light'' activity occurred frequently (e.g. Yakima reservation, Marfa, Hessdalen) became outside "laboratories" for physical research, locations where scientific observations and measurements could be conducted with continuity.
- Field work often used state-of-the art equipment despite small budgets. As researchers suspected that the UAP phenomenon emitted radiation at several wavelengths and as technology became more powerful and affordable, new sensors sensitive to different wavelengths of the electromagnetic spectrum were added to the optical instruments (e.g. Toppenish, Starlight, Marfa).

Fig. 7: Project Starlight

Fig. 8: Toppenish field study

PROJECT	FIELD EXPERIMENT TACTIC	FIELD STRATEGY	RESULTS
TOPPENISH FIELD STUDY	**1.** Sound Recording Equipment (Uher 4000 Report-L tape recorder and microphone, WWV time receiver (5, 10, and 15 MHz) with 100 Hz IRIG filter, Crystal controlled reference oscillator (10 kHz, sine wave output), Cassette tape recorder). **2.** Optical Equipment (35mm SLR camera with 35, 55, 105, and 500 mm lenses (w/polar filters), 35mm SLR camera with 50mm lens and 13,400 LPI replica grating, 35mm viewfinder camera with 50mm lens and Wratten 89B filter (infrared), Infrared photometer with audio output (phototransistor sensor), 16mm SLR motion picture camera with 18-86 mm/f2.7 zoom lens, Kodak Ektachrome High speed "B" reversal film in all cameras except IR, Kodak High Speed Infrared film (Black and White) in IR camera. **3.** Additional Instruments (G-M counter – Gamma and beta (>.25 Me V) sensitive, Ultrasonic frequency translating microphone (40 kHz ± 2 kHz to 2 kHz to 6 kHz), Magnetic Compass, All band radio receiver – 200 Hz to 108 MHz, High level magnetic field detector (reed switch with SCR latch), VHF-FM, 30-50 MHz and 146-175 MHz monitor receivers, APRO San Diego Group recording magnetometer/compass spin detector: -Frequency Response: 0.1 Hz to 1 kHz -Low Field Sensitivity: 4 V/gamma Hz to input of VCO - VCO sensitivity: 500 Hz/V - 60 Hz notch filter - VCO for recording of data to cassette tape. All instruments were battery operated.	- Initial (1972) eleven days field study on the Yakima Indian Reservation ran by one trained person. A "hit and run" strategy, of moving the instruments to a location where activity was previously observed was adopted. Several other people assisted periodically but none was familiar with all of the instruments. Flexible and unobstrusive approach: creating no publicity and drawing no attention to his work. Attempt to get close to the phenomena but not to chase UAP. - Elaboration of specific communication protocols between fire lookouts for calling each other' attention in case of UAP sightings. - As from 1996 work on instruments suitable for detecting possible dynamic magnetic fields related to UAP activity began (Field tests using magnetometers devices were done in 1998, 2001 and 2002).	Various nocturnal photographs and detection of wide magnetic pulses of unknown origin (however not simultaneously with UAP visual sightings).
PROJECT STARLIGHT INTERNATIONAL	**1.** The UFO/VECTOR (UFO/Video Experiment Console for Transitional-Overt Response): Suite of sophisticated equipment incorporated a TV-aimed, remote-control console of various instruments and in particular a ideo-modulated Liconix 605M helium–neon laser, a Criterin Dynamax 8 Schmidt–Cassegrain telescope, a RADAR (Raytheon Model 1700), a photomultiplier and video amplifier, a Sony video camera. **2.** A light pattern response experiment: a circle of spotlights composed of ninety 150W lamps, forming a ring of 100 feet in diameter (These lamps could switch on and off according to various sequences and therefore could potnetially serve as communication device). **3.** System ARGUS (Automated Ringup on Geolocated UFO Sightings): Highly exact UFO distance information electronically derived from reflected radar signal return-time data allowing to determine the specific sector over which it determined the UFO to be passing, hovering and landing. Also a Detection Alert system of volonteers located within the computed visibility radius of a detected UFO. **4.** A computer-interfaced magnetometer system.	- Permanent base of continuous equipment operation on a four-undred acre research site, 24/7 (outside Austin). - Equipments could be disassembled and be individually placed on sturdy tripods (i.e.mobile laboratory) to areas in which concentrated UFO activity would reportedly occuring. - System ARGUS: Based on Phototheodolites data and computer calculations, the system would scan its memory for the names and phone numbers of all ARGUS volonteers located within the computed visibility radius of a detected UFO, and begin a completely automated telephoning of all these volonteers using several lines simultaneoutsy. At the same time, computer capable of generating a general UFO alert via selected and citizen's band radio frequencies.	- Two documented magnetometer (PMS model 100 automatic recording magnetometer with 105 sensor) recordings of magnetic effects, at the same time than visual sightings. - UFO film (super 8 mm via 72 mm telephoto) with simultaneous magnetic-effect and visula sighting. - Detection/recording of both radio frequency and magnetic disturbances simultaneously. - Capture of the first known UFO light spectra (recorded on 35 mm Tri-X film using a Bausch and Lomb blazed diffraction grating), color photos on 35 mm Ektachrome, using a 300 mm Rexatar lens. - UFO sound-effect recording (made with a high quality directional microphone).

Field Strategies: UAPs do not appear everywhere. While some projects placed instruments at spots where UAP are more frequently seen (e.g. Marfa, 45° GRU), others placed instruments where it was convenient (e.g. Exeter, Starlight). The former had more success than the latter.

- Advances in technology and informatics allowed the introduction of automatic unmanned observation stations (e.g. Hessdalen).
- A "hit and run" strategy of moving the experts and instruments to a location where activity was previously observed has been successfully adopted by different projects (e.g. Project Identification, Operacao Prato).
- Other innovative approaches have included attempts to "catch" the UAP phenomenon in the act. These have included camouflaging an automatic camera as an ordinary rock, quietly pre-positioning a network of observers in strategic places over an extended duration, and, in one case, attempting to trigger UAP activity over a specific location (alleged Russian military operation Ring-Koltso).
- Since 2000 Project Hessdalen has successfully built up an international technical cooperation (Norway, Italy, France), aimed at increasing the range of instruments investigating UAP's electromagnetic signature (e.g. using radio astronomy techniques, infrasound array, UHF radar).

Fig. 9: Marfa lights investigation

Fig. 10: Copper Medic's camouflaged camera

	FIELD EXPERIMENT TACTIC	FIELD STRATEGY	RESULTS
PROJECT IDENTIFICATION	Radar, electromagnetic frequency analyser, high-frequency low-intensity sound detector, spectroscopic camera, Questar astronomical telescopes with cameras attached and photographic equipment.	From 1973–1980, Rutledge set up a total of 158 viewing stations in three major geographical areas (around Piedmont, Missouri), during which the sky was watched for 427 h, by more than 600 observers at various times.	During 157 project sightings, 178 declared UFO observations. Pictures taken. Rutledge believed that in some cases the movement of lights was synchronised with observers' actions.
OPERACAO PRATO	**1.** Camera Minolta SRT 101, lens 100/200 mm. **2.** Camera Yashika Eletro35 TLS lens 400 mm 1:6.3. **3.** Camcorder 8/16 mm. **4.** Recorder UHER. **5.** Portable transceiver CBT. **6.** Binoculars *5 zoom. **7.** Meteorological Theodolite. **8.** Helicopter UH-1-H (Huey).	- Field investigations of a small number of the Air Force Officers and of Secret Services agents (+/-20 dressed as civilians) between September and December 1977. - One operations' base set up on the beach and one near a road. Two teams postioned in places with more cases reported (many interviews and collections of testimonies from witness and victims of the phenomena). Organisation of night shifts.	- Numerous pictures (some of them have surfaced) and various films (mentioned in the written reports but not made available) taken by the teams dispatched, - Drafting of vigorous activity reports including many drawings and characteristics of the observed phenomena, - Many witnesses' interviews.
MARFA LIGHTS INVESTIGATION	Three automated monitoring stations used together to capture nightly video. Also binoculars, cameras, telescopes plus a spectrometer, magnetometers, EMF meters, gas meters, air ion counter, Geiger counter.	Three monitoring stations at different locations used for night videos. On-site observations accomplished during 280 nights with a variety of equipment.	Pictures, spectra data (although incomplete), videos of MARFA lights.
COPPER MEDIC	Bell & Howell pulse cameras using 16mm film in fifty-foot rolls, a 25mm Berthiot lensthat could be set from f1.9 to f16, the slowest possible daylight film. Camera connected to a intervalometer timing circuit to send pulses to the camera. Power source was a set of two Eagle-Picher batteries mounted to give a twelve-volt direct current source.	Automatic camera camouflaged as an ordinary rock on an isolated slope overlooking a canyon where UFO had repeatedly been observed. Camera timed to take one picture every six minutes (ten pulses per hour) from 6 A.M. to noon, every day for a month.	None.
45°GRU	**1.** Astronomical instrumentation, Spectroscopy, Infrared viewers, Analogic cameras with IR film, Digital cameras IR/UV, Radio receivers ULF-ELF-VLF, Receivers HF-VHF-UHF-SHF, Radiometers, Infrasound home-made probes. **2.** Two small laboratories, dedicated to monitoring the optical/radio meteorscatter of meteors and TLE, using 4 astronomical cameras, radio monitoring, meteorscatter and radiometry.	Weekly skywatch (4 hours) moving with the jeep on the grounds of Polesine (green area of the Po Valley in Veneto) , utilisation of two fixed small laboratories for continuously monitoring the sky for optical/radio meteorscatter of meteors and TLE, experimental study on infrasound on listening for the study of possible seismic precursors.	Pictures, spectras and videos of anomalous luminous phenomena.

Results: For the most part, photographs and spectra data have been the most useful data collected by these projects, demonstrating unequivocally that aerial phenomena exist which cannot be conclusively identified.

- Pictures have also been collected automatically (e.g. Marfa and Hessdalen).
- Some success in recording other anomalous physical data has also been claimed (e.g. magnetic anomalies, radar correlation).

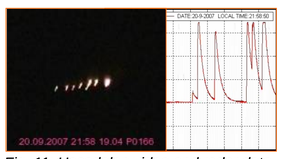

Fig. 11: Hessdalen video and radar data

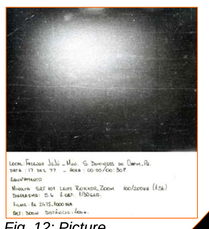

Fig. 12: Picture Operacao Prato