

International Air Safety Report
NARCAP IR-4, 2012

Aviation Safety and Unidentified Aerial Phenomena:
A Preliminary Study of 600 cases of Unidentified Aerial Phenomena (UAP)
Reported by Military and Civilian pilots

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March 2012
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Abstract

This report presents the findings of a comprehensive review of 600 cases, over a period of sixty-four years in which pilots have reported the presence of one or more unidentified aerial phenomena (UAP) during flight. In 443 cases (74%) these UAP are described as “objects” (42% circular-shaped) more than as point sources of light. In 162 cases (27%), the visual observation is confirmed by detection by ground and/or airborne radar. This report focusses more especially on 290 cases (48%) in which UAP have had (or could have had) an impact on flight safety. In 108 cases (37% of the 290 cases), pilots have estimated that the impact on flight safety was high enough for them to submit an official Airmiss/Airprox report. It was found that the most reported events with potential impact(s) on aviation safety were: “UAP approached aircraft on a collision course” (78 cases) and “UAP circled or maneuvered close to aircraft” (59 cases). It was found also that in 81 cases (14% of the 600 cases) pilots reported alleged electro-magnetic effects on one or more aircraft systems. Radio and compass systems were the predominant systems affected. Private aircraft were more affected by the E-M effects (alleged caused by UAP), probably due to the fact that their avionics and compasses are less shielded against magnetic/radio frequency interference and ionizing radiation than are commercial or military aircraft. It was found that in four cases military aircraft weapon systems were momentarily ineffective when targeted towards the UAP. Finally, in 31 cases pilots had to take evasive action to avoid a collision with UAP, injuring several passengers in five cases. These findings are potentially important and deserve further in-depth study and confirmation by obtaining additional high quality aviation reports.

IMPORTANT:

These aerial phenomena are considered unidentified by the pilots at the time of their sightings, and for several of them after official investigation. It does not mean that all these cases will remain unidentified. More details and further investigations would have probably explained many of them. Furthermore, the author has no explanation or theory about the real nature of the probably various unknown phenomena encountered by pilots (unknown natural phenomenon, “black” projects highly classified at the time of observation, etc.). The main purpose of this report is to show that these phenomena occur and that they could have an impact on flight safety. They deserve a more in-depth scientific study.

The author

¹ GEIPAN (*Groupe d'Etude et d'Information sur les Phenomenes Aerospatiaux Non-identifies*) is the French official Agency established in 1977 within the French National Center for Space Studies.

Introduction

For more than 60 years, military and civilian aircraft pilots and crews have reported sightings and flight encounters with “lights” or “objects” which do not have the appearance or flight characteristics of any known aircraft or aerial phenomena.

Richard F. Haines² has provided the following definition for the term Unidentified Aerial Phenomenon - UAP- (1980): *"An unidentified aerial phenomenon (UAP) is the visual stimulus that provokes a sighting report of an object or light seen in the sky, the appearance and/or flight dynamics of which do not suggest a logical, conventional flying object and which remains unidentified after close scrutiny of all available evidence by persons who are technically capable of making both a full technical identification as well as a common-sense identification if one is possible."*

The following study and statistics were based on 600 cases of UAP sightings reported by civilian and military pilots. Summaries of these 600 cases compiled by the author are contained in the AIRPANC Catalogue (2nd edition, 2010).

This analysis of 600 cases was focused on 25 among of the 39 factors (fields) of the AIRPANC database. (See list of factors in annex 1.)

This report is divided into three parts:

1. Analysis of the 600 UAP cases (sections n° 1 to 14)
2. A focus on the 290 cases (48%) in which the encounter with the UAP have had, or could have had, a real impact on aviation safety (near-collision, collision course, trajectory deviation, manoeuvres to avoid collision, passengers injured, etc.). Including 31 cases (11%), in which the pilots were forced to make evasive actions, sometimes abruptly, and passengers or crew members were injured (section n° 15).
3. Additional analysis of details from the 81 cases in which pilots have reported alleged electro-magnetic effects on one or more aircraft systems (section n° 16).

² NARCAP Science Director and former chief of the Space Human Factors Office at NASA Ames Research Center and a former senior research scientist for both NASA and Raytheon.

1. Period of time :

These 600 cases cover a 64 years period of time (1946 to 2010) and are distributed by year as follows:

1946	2	1962	11	1978	15	1994	4
1947	7	1963	2	1979	15	1995	8
1948	7	1964	3	1980	10	1996	5
1949	9	1965	9	1981	8	1997	4
1950	10	1966	9	1982	7	1998	6
1951	17	1967	13	1983	4	1999	5
1952	83	1968	10	1984	3	2000	8
1953	39	1969	7	1985	7	2001	4
1954	40	1970	4	1986	5	2002	1
1955	30	1971	6	1987	2	2003	0
1956	22	1972	7	1988	5	2004	5
1957	34	1973	10	1989	2	2005	1
1958	9	1974	7	1990	6	2006	0
1959	11	1975	5	1991	7	2007	1
1960	2	1976	4	1992	2	2008	0
1961	6	1977	11	1993	0	2009	2
						2010	1
	10 to 20 cases per year						
	More than 20 cases per year						

The distribution of the 600 cases by year shows that 320 cases (53%) have occurred in a 16 year period (from 1946 to 1960), with 275 cases (46%) between 1950 and 1957. 1952 (83 cases) was the year with the greatest number of cases, followed by 1954 with 40 cases. These two years are considered as the two surge years of UAP sightings: 1952 in United States and 1954 in Europe.

January	54	August	55
February	46	September	46
March	42	October	45
April	29	November	51
May	44	December	45
June	56	Unspecified	12
July	75		

The distribution of these 600 cases by month shows no specific seasonal pattern. July with 75 cases has the highest number of cases compared with other months, and April with 29 cases has the lowest number of cases. The other ten months have a number of cases between 42 and 56 which does not appear to be a significant difference.

2. Ambient illumination (time of sighting):

Concerning the factor *Ambient illumination*, the time of the sighting was not mentioned in 38 cases (6% of the 600 cases) by the witnesses. A little more than half of the remaining 562 cases (305 cases / 54%) occurred at night and 257 cases (46%) took place during daylight.

3. Location:

The 600 cases are distributed nearly worldwide. They are located above continental zones (564 cases), including 56 countries and above maritime zones (36 cases). The American continent (North, Central and South America) showed 376 cases (58%) including 298 cases for North America (Canada and USA). 108 cases are located above Europe including 33 cases reported in the French airspace.

Table 3: Distribution of sightings by geographic zones (terrestrial and maritime)

Table 3: Distribution of sightings by geographic zones (terrestrial and maritime)							
Geographic Zone:		Countries:					
North America	298	South Africa (SA)	1	Ecuador (EC)	1	Paraguay (PA)	1
South America	78	Algeria (AL)	2	Egypt (EG)	1	Netherlands (NL)	1
Europe	108	Germany (GE)	5	Spain (SP)	10	Peru (PE)	6
Middle East	4	Angola (AN)	1	USA (US)	275	Philippines (PH)	1
North Africa	9	Argentina (AR)	10	Finland (FL)	4	Poland (PL)	2
Africa	6	Australia (AU)	10	France (FR)	33	Portugal (PO)	5
Asia	42	Austria (AS)	3	Greenland (GR)	3	United Kingdom (UK)	18
Australia / Oceania	19	Bahrain (BA)	1	Iceland (IC)	2	Russia (RU)	6
Total	564	Bolivia (BO)	1	India (IN)	1	Sudan (SU)	1
Maritime Zone:		Brazil (BR)	17	Iran (IR)	2	Sweden (SW)	1
Atlantic Ocean		Canada (CA)	23	Ireland (IL)	2	Taiwan (TW)	1
Pacific Ocean		Chile (CE)	18	Italy (IT)	5	Thailand (TH)	1
North Sea		China(CH)	9	Japan (JP)	17	Tunisia (TU)	3
Channel		Colombia (CO)	2	Kazakhstan (KZ)	1	Uruguay (UR)	1
Total	36	Congo (CN)	1	Morocco (MO)	3	Venezuela (VZ)	11
		Korea Nord/Sud (KO)	11	Mexico (MX)	8	Yugoslavia (YU)	5
		Costa Rica (CR)	1	Mozambique (MB)	1	Zimbabwe (ZE)	2
		Cuba (CU)	1	Norway (NO)	2		
		Denmark (DK)	1	New Zealand (NZ)	9		

4. Type of aircraft:

The distribution of the 600 cases by the factor **type of aircraft** gives the following results:

Table 4a: Distribution of sightings by type of aircraft 1946 to 2010 (600 cases)

Military aircraft (M)	251 cases	41%
Commercial aircraft (C)	233 cases	39%
Private aircraft (P)	105 cases	18%
Other *	11 cases	2%

(*) Observations reported from several aircraft of various types (Military and commercial: 8 cases; Private and Commercial: 3 cases)

Among the 600 cases distributed over 64 years, the UAP sightings reported by military pilots are the most numerous: 251 cases (42%). Commercial pilots have reported 233 cases (39%) and private pilots have reported 105 cases (18%).

Considering only the past 20 years (1990 to 2010), the result is totally different. Among 70 cases, the commercial aircraft cases are the most numerous: 49 cases (70%). Military pilots have reported 12 cases (17%) and private pilots have reported 9 cases (13%).

Table 4b: Distribution of sightings by type of aircraft from 1990 to 2010 (71 cases)

Commercial aircraft (C)	49 cases	70%
Military aircraft (M)	12 cases	17%
Private aircraft (P)	9 cases	13%

Furthermore, a more detailed examination of the distribution of military aircraft cases by year show that 75% of them (189 cases) occurred on a 14 years period of time (from 1946 to 1959). Most of these cases were U.S. military cases from the 1950s and many official reports from that period were declassified in the following years (U.S. Air Force Projects Sign, Grudge, and Blue Book).

In 141 cases (24%), almost a quarter of the 600 cases, the phenomenon was observed from two or more aircraft in flight.

5. Number of witnesses:

In 415 cases (69%), there were two or more eye witnesses. In 185 cases (31%), the pilot, or the co-pilot, was the only witness. This result shows that in more than two thirds of the 600 cases the witnesses were two or more individuals.

In 98 cases (16%), ground witnesses have confirmed the sighting of phenomena reported by the pilot and/or crew members.

6. Reports and official reports:

Reports of sightings were written by pilots and crew in 218 cases (36% of the 600 cases). Among these 218 cases, there are 197 official reports (33%). Military pilots submitted the greatest number of official reports (103) more than half (52%) of the total of the 197 official reports, Commercial pilots and private pilots made official reports in 80 cases and in 14 cases, respectively. Among the 233 commercial aircraft cases of the present analysis, pilots reported their sightings via official channels in 34% (80 cases).

7. Type of aircraft propulsion:

The distribution of the 600 cases according to the type of propulsion is as follows:

Table 5: Type of propulsion system

Propeller	312	53%
Jet engine	268	45%
Helicopter	10	2%
Unspecified	10	

Propeller aircraft cases are the largest percentage (53% of the 600 cases). This result could be explained due to the fact that 320 cases (53%) occurred between 1946 and 1959, a period of time where commercial planes were mostly propeller powered aircraft.

8. Phase of flight:

Cases were distributed according to the phase of flight during the sighting. The flight is divided in six phases: Take off, climb, cruise, descent, approach. The results are as follows:

Table 6: Distribution by Phase of flight		
Take off	5 cases	1%
Climb	32 cases	5%
Cruise	509 cases	85%
Descent	21 cases	4%
Approach	31 cases	5%
Unspecified	2 cases	

Distribution of cases according to the phase of flight shows that a large majority of sighting occurred while the aircraft was in cruise flight. It should be added that during this phase of flight, the pilot has more time to look at the sky as the aircraft is often on autopilot. On the other hand, during the four other phases of flight pilots turn their attention to piloting and to flight instruments.

9. Radar detection of UAP:

There are three types of Radar-Visual (RV) sightings: (1) detection by ground radar (GR), (2) detection by airborne radar (AR), (3) detection by both ground radar and airborne radar (AGR). A fourth category (NR) exists when ground control has checked but did not see any target on the radar display and could not confirm the visual sighting.

Among the 600 selected cases, radar check (positive or negative) was done in 278 cases (46%) and the results are distributed as follows:

Positive radar detection (GR+AR+AGR)	162 cases (27% of 600 cases)
Negative radar detection (NR)	115 cases

It is interesting to notice that the percentage of positive radar detection (27%) is exactly the same as the one resulting of a previous study of 300 cases³.

In 162 cases (27% of 600 cases), the visual sighting of a UAP was confirmed by a radar detection. According to the location of the radar system, the distribution of these 162 Radar-Visual cases gives the following results:

Table 7: Distribution by type of radar detection		
1. Ground radar only (GR)	103 cases	64%
2. Airborne radar only (AR)	25 cases	15%
3. Ground and airborne radar (AGR)	34 cases	21%

³ NARCAP International Technical specialist Report , ITR-1, February 16, 2010.

In 34 cases (21%), the visual sighting of the phenomenon was confirmed both by airborne and ground radar.

Example: On landing approach, the co-pilot of a Caravelle sighted off the right wing tip five or six lights that followed the aircraft on a parallel course. He asked the air traffic controller about any other aircraft on final approach. ATC gave a negative answer but confirmed that they had a radar echo on the right of the aircraft which followed it. The lights disappeared from the right and suddenly appeared again off the left wing tip. The pilot switched on the autopilot and checked the on-board radar which confirmed an echo on the left. At the same time the air traffic controller confirmed that the unknown echo was now on the left of the Caravelle. (Case: 1352, France 1979)

Radar-visual cases are very important and interesting for two reasons: (1) they confirm the visual testimony of the pilot and/or the crew by a technical record of the phenomenon; (2) and sometimes they give technical measures like speed, altitude or trajectory of the UAP.

Example: The crew of a B-757 saw a dark cigar-shaped wingless object below their aircraft off their right, and between 15 to 20 miles from the airliner’s position. NORAD/WASD (Western Air Defence Sector) HQ at Tacoma had an unknown track. It appeared stationary at first then accelerated in a sudden burst of speed for 20 to 30 seconds before coming to an abrupt stop. It hovered for one and a half minutes, then accelerated again in another sudden burst of speed. This was repeated several times over a period of about 4 minutes, after which the target disappeared. The speed was computed to be between 1,000 and 1,400 mph. (Case: 1266, USA 1995)

10. Type of UAP :

The phenomena observed by pilots are classified in two categories: the “lights” points and the “objects”, when it has a “solid” aspect. The 600 cases are distributed as follows:

Table 8: Distribution by type of UAP		
Object (OB)	443 cases	74%
Light (LT)	156 cases	26%
Unspecified (UN)	1 case	

In almost three quarters of the cases (74%), UAP reported by pilots and crews are described having a material or three-dimensional, solid aspect. UAP described as solid, more often reported as “objects”, have various shapes. The most often reported shapes are circular (or elliptical) with a metal looking surface (sphere, silvery disc, etc.). Meanwhile, numerous other shapes were observed, some of them being very strange and inconsistent with conventional aerodynamic designs.

Examples: Two yellow objects shaped like hamburgers (Case 1149, USA 1980); a black cylindrical object 24 feet long and nine feet wide (Case 1123, Italy 1979); a giant triangle-shaped with intense lights joining the edges (Case 1113, Chile 1978); a long brown cigar-shaped object (Case 1050, Portugal 1976); an airliner fuselage without any wings or tail and with portholes lighted from inside (Case 1347, France 1985); an elliptical shape, flat below and slightly domed on the upper part (Case 1245, Sahara 1965); a large elliptical object looking like a metallic mushroom, which at times appeared to be translucent, and seemed to have a transparent glass-like dome (Case 556, Australia 1954).

In 127 cases the UAP was described as an object without any more details about the exact shape of the phenomenon. The shape of the “object” was described in 316 cases.

These 316 cases reported as objects with description of the shape are distributed as follows:

Table 9: Distribution of cases by shape of UAP		
Reported shape (by group)	No of cases	%
1. Disc (or circular, saucer, round)	132	42%
3. Spherical (Sphere, balloon, orb)	89	28%
4. Oval (elliptical, egg)	51	16%
5. Cigar (fuselage)	31	10%
6. Triangle (delta, flying wing)	15	
7. Missile (rocket, torpedo, bullet)	11	
8. Cylindrical	9	
9. Half-sphere (inverted bowl, half-moon)	7	
10. Changing (UAP shape changed during observation)	1	
11. Other shapes (Crescent, banana, mushroom, rectangle)	5	

Circular shape (disc, saucer, round) is the most frequently reported (132 cases – 42%). Other shapes are distributed as follows: spherical⁴ (89 cases), oval (51 cases), cigar-shaped (31 cases) and missile-shaped (11 cases). Oval-shaped and cigar-shaped objects could be considered circular shaped objects seen from a different angle (as a disc shaped object slightly sloping).

If we add cases describing circular, oval and cigar shaped objects, we obtain a total of 273 cases (86%) among the 317 cases described as objects.

11. Number of UAP:

In more than two third of the 600 selected cases (474 cases - 78%) the witnesses have reported only one UAP. In 117 cases (20%), pilots reported the sighting of two or more UAP⁵. In 12 cases, groups of more than 10 UAP were observed at the same time.

Examples: The pilot of a B727 saw a formation of 10 or 15 orange, saucer-shaped luminous objects flying in a precise formation from south to north (Case 1018, Portugal 1974); the pilot and gunner of a USAF RB-66 observed 16 oval or oblong shaped cream-colored objects which were about 40-60 feet in length and 30-40 feet in width (Case 809, China Sea 1959); four U.S. Marine Corps jet pilots flying saw a formation of 16 disc-shaped objects below them (Case 580, USA 1954).

These 117 cases of multiple UAP sightings are distributed as follows: Two UAP (41 cases); three UAP (32 cases); four UAP (10 cases); five UAP (7 cases); six UAP (3 cases); seven UAP (6 cases); eight UAP (2 cases); nine UAP (3 cases); ten to nineteen UAP (9 cases); twenty UAP and more (3 cases) and in 9 cases the number of UAP was not mentioned.

12. UAP estimated altitude

UAP estimated altitude:

⁴ A specific study on spherical UAP was published by NARCAP in 2010 “Spherical UAP and Aviation Safety: A Critical Review”, Haines, R.F., et al., NARCAP TR-14, April 2010.

⁵ A study of multiple UAP was published by Haines, “Project Delta: A study of multiple UFOs”, LDA Press, 1994.

The pilot gave an estimation of the UAP altitude in 332 cases (55%). UAP Estimated altitudes are distributed as follows:

Table 10 : UAP Estimated Altitude (in feet)	
< 2,000 ft	14 cases
Between 2,000 ft and 4,999 ft	51 cases
Between 5,000 ft and 9,999 ft	89 cases
Between 10,000 ft and 19,999 ft	64 cases
Between 20,000 ft and 29,999 ft	48 cases
Between 30,000 ft and 49,999 ft	53 cases
Between 50,000 ft and 100,000 ft	11 cases
> 100,000 ft	2 cases
Altitude not mentioned	268 cases

In 305 cases, a little more than half of the cases (51%), the UAP estimated altitude was between 2,000 feet and 50,000 feet.

The lowest estimated altitude reported by a pilot was 500 feet. The highest UAP altitude reported was 246,000 feet by Major Joe Walker, who was flying the X-15 rocket powered aircraft during a test flight at more than 2,000 mph when his rear-view movie camera captured five disc-shaped or cylindrical objects flying in echelon formation (case 854 April 1964).

13. UAP behavior – “Vallée classification”

Using the classification created by Jacques Vallée⁶, adapted to the AIRPANC Database, the UAP motion could be divided into three categories:

- (1) Stationary phenomena (one light or one object appearing motionless),
- (2) Phenomena following a uniform/constant trajectory and/or a speed,
- (3) Phenomena with a variable trajectory and/or speed (UAP performing various maneuvers).

The application of the Vallée Classification to the 600 cases gives the following results:

Table 11: Distribution by UAP Behavior (Vallée classification)		
Type of UAP behavior	No. of cases	%
Anomaly (AN)	39 cases	7%
Flyby (FB)	222 cases	37%
Maneuver (MA)	339 cases	56%

This classification enables us to attribute a “level of strangeness” or unconventionality to the phenomenon. Maneuver cases have the highest level of strangeness; they are the most numerous and represent more than half (56%) of the 600 selected cases.

Example: The crew of a Varig C-47 cargo plane observed a luminous object. After a fast maneuver the disc-shaped object was ahead of them and crossed to the right side, following a horizontal trajectory. It stopped for

⁶ French American astrophysicist, Jacques Vallée has been studying UAP for almost 50 years. He is on NARCAP’s Executive Advisory Committee and a member of the GEIPAN College of experts.

a moment and then abruptly went into a dive and was out of sight in the cloud-bank below. When the object reached the right side of the aircraft, the engines began acting up, coughing and missing, and the lights in the cabin dimmed and almost went out. It seemed like the whole electrical system was going to collapse. When the object dived into the clouds, everything became normal again. (Case 742, Brazil 1957)

14. Interaction between the UAP and the aircraft:

“Interaction” cases are the cases in which the UAP seems to react to aircraft presence. In 299 cases (almost 50%), there are reported interactions between UAP and aircraft. These cases concern these events: (1) UAP performs maneuvers to approach, to chase or to escape from the aircraft, (2) dogfight with military aircraft, (3) UAP circles the aircraft or performs maneuvers close to it. Cases in which alleged electromagnetic effects on aircraft systems were reported belong to this category. These 299 cases were distributed as follows:

Table 12: Distribution of interaction cases by type of aircraft	
Military aircraft (M)	141 cases
Commercial aircraft (C)	86 cases
Private aircraft (P)	66 cases
Commercial and Military (C+M)	4 cases
Commercial and private (C+P)	2 cases

The above-mentioned results confirm those published in 2008 in the book “*Phénomènes Aérospatiaux Non-identifiés : un défi à la science*”⁷ and in the Analysis of 300 cases published in 2010⁸.

Factors “behaviour” and “interaction” are connected, 244 “interaction” cases are also “maneuvers” cases in Vallée’s classification. These “interaction” cases are those with the highest level of strangeness.

Example: The pilot of a B-727 on landing approach saw in front of his aircraft a white light which was bearing down on him at high speed before it halted at about 300 feet. The pilot maneuvered to avoid the object, which made a strange turn and flew parallel to the B-727. The object looking like an inverted saucer had the size of an airliner. As the pilot came to land on his final approach, all lights of the runway and airport suddenly went out. The pilot had to climb to 9,000 feet still accompanied by the object. The pilot asked the tower about any other traffic in the area and was told that the only other plane was a Military Piper aircraft flying 1,800 feet above the B-727. When the lights came back on the ground, the pilot again began his descent and the object disappeared at a fantastic speed. During the blackout, instruments in the control tower were affected. All the airport radio system was cut off and there was a blackout in the whole city. The pilot of the Military Piper aircraft saw the orange light following the B-727 which stopped abruptly, climbed vertically at high speed, stopped again then disappeared toward the mountain. (Case 1269, Argentina 1995)

15. Impact on flight safety:

The entire set of UAP sightings reported by pilots and crews, that is the subject of this analysis, could be considered as having an impact on flight safety, only because they attracted their attention and could distract them from their task. Meanwhile, some cases have had a real impact on flight safety (near-collision, collision course, trajectory deviation, maneuvers to avoid collision). In a few cases, the pilots were forced to take evasive actions, sometimes abruptly, and passengers or crew members were injured.

⁷ Unidentified Aerial Phenomena: A challenge to science, Chapter III by Dominique Weinstein, collective book written under Yves Sillard’s leadership, 2007.

⁸ NARCAP International Technical specialist Report ITR-1, February 16, 2010, by D. F. Weinstein.

Among the 600 cases, a possible impact on flight safety was noted in 290 cases (48%). These 290 cases are distributed by type of aircraft (Commercial, Private, Military, Multiple aircraft cases) as follows:

Table 13: Distribution of 290 cases with impact on flight safety by type of aircraft		
Type of aircraft	Nb of cases	%
Commercial aircraft (C)	125 cases	43%
Military aircraft (M)	95 cases	33%
Private aircraft (P)	65 cases	22%
Multiple aircraft : C+M (3) / C+P (2)	5 cases	2%

In some cases, electro-magnetic or other effects on aircraft systems were reported when the UAP was close to the plane. For 108 cases (37%), pilots estimated that the impact on the flight safety was high enough to submit an Airmiss/Airprox report.

15.1. Type of events with possible impact on flight safety

According to pilots testimonies and/or reports, 18 types of event, which have had (or could have had) an impact on flight safety, have been selected. These 18 events are distributed as follows:

1. Aircraft approaches UAP
 2. UAP approaches aircraft
 3. UAP approaches aircraft on a collision course
 4. Near-collision with UAP
 5. UAP crosses aircraft's flight path
 6. UAP circles aircraft and/or maneuvers close to aircraft
 7. UAP follows aircraft
 8. UAP follows aircraft (despite pilot changes altitude or speed)
 9. UAP chases aircraft
 10. UAP maneuvers close to airport or runway
 11. Pilot reports alleged Electro-magnetic effects on aircraft systems
 12. Pilot has to make an evasive action to avoid collision
 13. Passengers injured following an evasive action
 14. UAP collides with aircraft
 15. Aircraft and pilot disappearance (following pilot's report of UAP)
 16. Cockpit lighted by intense light emanating from UAP
- Military aircraft cases only:
17. Pilot chase UAP
 18. "Dogfight" between Aircraft and UAP

The above last two events (N° 17 and 18) concern only military aircraft cases. In these two types of events, pilots react to the encounter with a UAP in an action which could have an impact on their flight safety.

The events of impact on flight safety are distributed by type of aircraft (Commercial, private and military) as follows:

Table 14: Distribution of the events of impact on flight safety by type of aircraft

Type of events with possible impact on flight safety (**) (according to witness)		Number of cases			
		C	P	M	Total
1	Aircraft approaches UAP	1	1	2	4
2	UAP approaches aircraft	25	8	10	43
3	UAP approaches aircraft on a collision course	38	17	23	78
4	Near-collision with UAP	5	1	0	6
5	UAP crosses aircraft's flight path	20	4	12	36
6	UAP circles aircraft and/or maneuvers close to aircraft	24	17	18	59
7	UAP follows aircraft	2	7	0	9
8	UAP follows aircraft (Despite pilot changes altitude or speed)	1	0	0	1
9	UAP chases aircraft	1	0	2	3
10	UAP maneuvers close to airport or runway	2	0	1	3
11	Pilot reports alleged Electro-magnetic Effects on aircraft systems	19	35	26	80
12	Pilot has to make an evasive action to avoid collision	15	6	10	31
13	Passengers injured following an evasive action	3	0	0	3
14	UAP collides aircraft	2	0	0	2
15	Aircraft and pilot disappearance (following pilot's report of UAP)	0	1*	2	3
16	Cockpit lighted by intense light emanating from UAP	3	0	0	3
17	Pilot chase UAP (military cases only)			5	5
18	« Dogfight » between Aircraft and UAP (military cases only)			9	9
	Official report (Incident / Airmiss / Airprox)	50	15	43	108

(*) Valentich Case (Australia, 1978)

(**) In several cases more than one type of event has been reported during the same case (ex: UAP approached aircraft on collision course, then circled aircraft and EM effects are reported in same time)

In 78 cases, the phenomenon approached the aircraft on a collision course and in six more cases there was a quasi-collision with the aircraft. In 31 cases, the pilot was forced to take evasive action to avoid a collision with the UAP, including three cases (all commercial aircraft cases) in which passengers were injured during the maneuver.

Example: An American Airlines pilot had a near-collision with an object “at least the size of a B-747”. To avoid a head-on collision, the pilot made his aircraft dive under the object in such a sharp maneuver that many of the eighty-five passengers were thrown from their seats. Ten passengers were injured. The pilot radioed the nearest airport and requested an emergency landing. A full report was sent to the Civil Aviation Authority (CAA). (Case 1432, USA 1957)

In 59 cases, the UAP circled the aircraft and/or maneuvered close to it. This type of event has the greatest number (20 cases) of reports on alleged E-M effects on aircraft systems, especially for commercial aircraft (8 cases) and private aircraft (8 cases).

The impact on flight safety should not be neglected but rather taken seriously by the authorities. The number (108 cases among the 290 aviation safety cases (37%)) of official reports of Airprox, Airmiss or Incident is relatively small, due to the difficulty and/or reluctance of the pilots and crews, more especially commercial pilots, to report them officially.

15.2. Distribution of the 290 cases with possible impact on flight safety by type of aircraft

- Commercial aircraft cases:

Among the 290 cases with a possible impact on flight safety, the 125 commercial aircraft cases (43%). The commercial pilots filed an official report (Airmiss, Airprox or Incident reports) in 50 cases (40% of the 125 cases). These commercial aircraft cases are distributed as follows:

Table 15: Distribution of events of impact on flight safety by Commercial aircraft (125 cases)			
Type of event with possible impact on flight safety (according to witness)	No. of cases	EME	Report
Aircraft approaches UAP	1	1	
UAP approaches aircraft	25	5	7
UAP approaches aircraft on a collision course	38	1	18
Near-collision	5		4
UAP crosses aircraft's flight path	20	1	6
UAP circles aircraft and/or maneuvers close to aircraft	24	8	9
UAP follows aircraft	2		2
UAP follows aircraft (Despite pilot changes altitude or speed)	1		1
UAP chases aircraft	1		
UAP maneuvers close to airport or runway	2		
UAP collides aircraft (*)	2		1
Electro-magnetic Effects on aircraft systems (only)	2	2	1
Cockpit lighted by intense light emanating from UAP	3		1
Total	125	19	50
Consequences			
Pilot has to make an evasive action to avoid collision	15		
UAP maneuvers to avoid aircraft			
Pilot chases UAP			
Pilot reports alleged EM effects on aircraft system	19		
Passengers injured following pilot's evasive action	3		
Aircraft damaged (case 1451)	1		
Aircraft destroyed (or disappeared)			
Official report (Incident / Airmiss / Airprox)	50		

(*) Cases: 1341 (UAP collided with propellor, no damage); 1284 (UAP struck top of cockpit cracking windshield)

Regarding the type of event with possible impact on flight safety, the most reported by commercial pilots is "UAP approaches aircraft on a collision course" (38 cases). It is also the most reported type of event in official reports prepared by commercial pilots: 18 cases.

Example: The three crew members of a B747-300 observed a very fast white rocket-like object that overflew their plane between 200 and 400 feet above in the opposite direction. They saw no wing on the object, which they described as cylindrical. There was no TCAS⁹ alert. The object passed overhead very quickly. It was close enough that the Flight officer ducked his head because he thought it would hit them. It was white and had a round shape. There was no smoke or fire visible from the object. No radar echo was detected in the aircraft opposite direction by ARTCC. The National Transportation Safety Board has no conclusion concerning the identity of the object but considers the case officially closed. (Case 1293, USA 1997)

⁹ This refers to an automated collision-avoidance system used on-board commercial aircraft.

The type of event “UAP circles aircraft and/or maneuvers close to aircraft” represents 24 cases). It is in this type of event that pilots most frequently (8 cases) reported alleged electro-magnetic effects on their aircraft systems.

In 15 cases, the pilot had to take evasive action to avoid a collision with the object that resulted in passengers injured in three cases.

One type of event with possible impact on flight safety was only reported by commercial pilots “cockpit lighted by intense light emanating from UAP” (3 cases). The result of such an event had been or could have been a temporary blinding of the pilot and crew.

- Private aircraft cases:

Among the 291 cases with a possible impact on flight safety, the 65 private aircraft cases (43%) are distributed as follows:

Table 16: Distribution of events of impact on flight safety by Private Aircraft (65 cases)			
Type of event with possible impact on flight safety (according to witness)	No. of cases	EME	Report
Aircraft approaches UAP	1	1	
UAP approaches aircraft	8	4	2
UAP approaches aircraft on a collision course	17	4	3
Near-collision	1		1
UAP crosses aircraft's flight path	4	2	1
UAP circles aircraft and/or maneuvers close to aircraft	17	8	3
UAP follows aircraft	7	5	2
UAP follows aircraft (Despite pilot changes altitude or speed))			
UAP chases aircraft			
UAP maneuvers close to airport or runway			
UAP collides aircraft			
Electro-magnetic Effects (only)	11	11	3
Cockpit lighted by intense light emanating from UAP			
Total	65	35	15
Consequences			
Pilot has to make an evasive action to avoid collision	6		
UAP maneuvers to avoid aircraft	1		
Pilot chases UAP	1		
Pilot reports alleged EM effects on aircraft system	35		
Passengers injured following pilot's evasive action			
Aircraft damaged (Case 391)* (case 1004)	2		
Aircraft destroyed (or lost) (case 1104)	1		
Official report (Incident / Airmiss / Airprox)	15		

Among the 290 cases with a possible impact on flight safety, there are 65 cases (22%) reported by private pilots. The private pilots filed an official report (Airmiss, Airprox or Incident reports) in 15 cases (23% of the 65 private aircraft cases), a percentage that is less than commercial aircraft cases (40%) and military aircraft cases (45%).

The two types of event with possible impact on flight safety the most reported by private pilots is “UAP approaches aircraft on a collision course”, as for commercial aircraft cases, and “UAP circles aircraft and/or maneuvers close to aircraft” (both with 17 cases). It is also the type of event officially reported most often by commercial pilots (18 cases).

Example: A private pilot saw a “flashing object” approaching him on a collision course and it was closing in extremely fast. The pilot hardly had time to bank to avoid it and it hovered for a second about 20 feet off his left wingtip and then it continued on its course. It was gone out of sight in a second. It was about the size of a large truck inner tube that was covered with tiny mirrors. (Case 1122, USA 1979)

Example: The pilot of a Cessna 170 was flying at 8,000 feet when his Magnesyn electric compass suddenly moved around a slow 360° swing (a complete revolution) in about four to five second sweeps. Looking at his other standard magnetic compass, he saw it spinning crazily. About this time, he saw three small grey elliptical objects in close echelon formation passing across in front from left to right and on around to his plane at a distance about 150 to 200 yards and a speed of about 200 mph. The Magnesyn compass was following their exact speed indicating their position as the objects circled laterally around the plane. They began another circle and disappeared to the rear of the plane. Both compasses settled down their normal reading. (Case 814, USA 1959)

Private aircraft cases with possible impact on flight safety represent the biggest number of cases, 34 among the 65 cases, in which pilots reported alleged Electro-magnetic effects on aircraft systems: 54% of the private aircraft cases (compared with commercial aircraft cases: 15% and military aircraft cases: 27%).

- Military aircraft cases:

Among the 290 cases with a possible impact on flight safety, the 95 military aircraft cases (33% of the 290 cases) are distributed as follows:

Table 17: Distribution of events of impact on flight safety by Military aircraft (95 cases)

Type of event with possible impact on flight safety (according to witness)	No. of Cases	EME	Report
Aircraft approaches UAP	2	1	
Pilot chases UAP (military cases only)	5	2	3
UAP approaches aircraft	10	1	6
UAP approaches aircraft on a collision course	23	4	11
Near-collision			
UAP crosses aircraft's flight path	12	1	6
UAP circles aircraft and/or maneuvers close to aircraft	18	4	6
« Dogfight » between Aircraft and UAP (military cases only)	9		4
UAP follows aircraft			
UAP follows aircraft (Despite pilot changes altitude or speed))			
UAP chases aircraft	2		
UAP maneuvers close to airport or runway	1		
UAP collides aircraft (*)			
Electro-magnetic Effects (only)	12	12	7
Cockpit lighted by intense light emanating from UAP			
Consequences	94	25	43
Pilot has to make an evasive action to avoid collision	10		
UAP maneuvers to avoid aircraft	1		
Pilot chases UAP	5		
Pilot reports alleged EM effects on aircraft system	25		
UAP « answers » to aircraft light signals	1		
Passengers injured following pilot's evasive action			
Aircraft damaged			
Aircraft destroyed or lost	2		

Official report (Incident / Airmiss / Airprox)	43		
Aircraft weapon systems and radar malfunction or cease to function	4		

Among the 290 cases with a possible impact on flight safety, there are 95 cases (33%) reported by military pilots. The military pilots have filled in an official report (Airmiss, Airprox or Incident reports) in 43 cases (45% of the 95 military aircraft cases) which is higher than commercial aircraft cases (40%) and private aircraft cases (23%).

The two types of event with possible impact on flight safety reported the most by military pilots is “UAP approaches aircraft on a collision course” (23 cases) and “UAP circles aircraft and/or maneuvers close to aircraft” (18 cases). This result is similar to those of commercial and private aircraft cases.

Example: A French Air Force T-33 pilot on a training night flight saw a sort of green "rocket" climbing vertically in front of him, 1,500 meters above the aircraft then coming down and stabilizing at the plane's altitude. The collision seemed unavoidable, and instinctively the pilot tried to protect himself with his arms. Meanwhile, he saw rapidly but clearly, a glowing green ball (diameter: 3 to 6 feet) which passed at one foot over his right wing at head level. When the ball was at its closest position, all the plane was illuminated in green. Radar station confirmed that no other "traffic" was in the area at that time, except the two trainee pilots on their T-33. The other pilot flying in front ahead had also seen the green "rocket", but not the near-collision which followed. (Case 1047, France 1976)

In 25 cases (26% of the military aircraft cases), pilots have reported alleged Electro-magnetic effects on aircraft systems.

Two types of event with possible impact on flight safety concerned only military aircraft cases when the pilot decided to chase the UAP (5 cases) and/or engaged in a dogfight with UAP (9 cases).

Example: A French Air Force pilot and his navigator were practising night navigation exercise at 32,000 ft when they saw a powerful white light coming near the Mirage IV right rear. They first thought of a fighter's interception light but ground control informed that it had nothing (else) on its screen. It stopped several times. The pilot banked to the right, flying at Mach 0.98. The UAP speed was estimated at Mach 1.4 or 1.5. At the time the intruder found itself just behind the bomber. The pilot reversed his banking, and saw the thing moving away to the North-West at an estimated speed higher than Mach 2. He just had the feeling that a dark mass (as large as a B-747) was behind the luminous source, according to the turn made by the phenomenon (which was estimated at 30 G by the pilot). After 30 seconds, the object came back on his right, and the pilot operated the same maneuver. A Gendarme (military police) observed both Mirage IV and UAP from the ground. (Case 1061, France 1977)

16. Electro-Magnetic Effects on aircraft systems:

These are cases in which permanent or transient electro-magnetic (EM) effects occurred on aircraft systems during flight allegedly as a direct or indirect result of the relatively near presence of one or more unidentified aerial phenomena. Among the 600 selected cases, alleged electro-magnetic effects were noticed and reported in 81 cases (14%)

The distribution of the 81 EM effects cases according to the type of aircraft shows that private aircraft are more affected, which could be explained by the fact that their electronic systems are less shielded against magnetic/radio frequency interference or ionizing radiation than military or

commercial aircraft¹⁰. The distribution is as follows: private aircrafts (33 cases – 40%), commercial aircrafts (28 cases – 35%) and Military aircrafts (20 cases – 25%).

In these 81 cases, UAP were reported more often as objects (55 cases – 68%) than as luminous phenomena (26 cases – 32%).

The distribution of the 81 EM effects cases by ambient illumination is not considered to be significant:

- Daylight: 38 cases,
- Night: 39 cases,
- unspecified: 4 cases.

These 81 cases involving EM effects have occurred in almost all cases during cruise phase of flight (79 cases). In 50 cases (62%) the UAP performed flight maneuvers.

The distribution of the 81 EM effects cases by type of affected systems and symptoms is as follows (*):

Table 18: Distribution of EM effects cases by affected systems			
Affected Systems	E-M Symptoms	Type of Aircraft	Total (*)
Radio	Lost all frequencies UHF + VHF (17) Lost UHF (1) Lost VHF(1) Interferences (14)	M(14) P(11) C(8)	33
Magnetic Compass	Needle(s) rotated rapidly and continuously (3) Rapid needle(s) rotation and jamming (8) Aimed toward UAP (3) Two compasses indicating different direction (2) Compass indicating wrong direction (1)	P(7) M(6) C(4)	17
Aircraft control	Lost or Gained altitude (2) Lost control of aircraft (4) Turbulences when closed to UAP (2)	P(4) M(2) C(2)	8
ADF** (Automatic Radiocompass)	Two needles oscillate violently (3) Rapid rotation (4) Pulsing (1) Other (1)	C(5) P(3) M(1)	9
Power Plant	Engine runs roughly (5) Aircraft experienced buffeting (4) Partial lost of power (3) Engine stalled (2) Engine stopped and restarted « automatically » (4)	P(11) M(5) C(2)	18
Weapon System	Total failure (2) Gun radar failure (2)	M(4)	4
General electrical system	Total failure (radio, lights, ...) (6) Cabin lights extinguished completely (1) Cabin lights dimmed (2) Burned or partially burned (1)	P(4) C(6) M(4)	14

¹⁰ Confirmed results obtained in an analysis conducted by NARCAP in 2001: “A Preliminary Study of Sixty-four Pilot Sighting Reports involving Alleged Electro-Magnetic Effects on Aircraft Systems”, NARCAP Technical Report n°3, 2001/20), Haines, R.F., and D.F. Weinstein.

	Transponder stopped functioning (2) Electronic equipment jamming (2)		
Autopilot system	Failed to operate normally (3)	C(2) M(1)	3
DME***	Failed to operate normally (1)	P(1)	1
Radar system	Radar system inoperative (2) Radar jamming (1)	M(3)	3

(*) Several systems could be affected during the same UAP observation.

(**) ADF: Automatic Direction Finder.

(***) DME: Distance Measuring Equipment

Radio system was the most affected system (33 cases). The various symptoms reported by the pilots are: loss of all frequencies UHF or/and VHF (19 cases); interferences or static (14 cases). The radio system on military aircraft (14 cases) was affected more than on private aircraft (11 cases) or on commercial aircraft (8 cases).

Example: The crew of a Cessna 337 notified to have in sight an unidentified flying object looking like an ovoid nebula with a brilliant disk in the center. The phenomenon was observed jointly by pilots of another Cessna 337 and captains of the fishing schooners in the area. The object moved at great height. The pilot of Cessna informed the air traffic controller that when the object passed vertical over the position which he was flying, he lost radio contact with all the fishing vessels, the control tower and the other airplanes, both in HF and VHF. As the object moved away he slowly recovered these radio contacts. (Case 1380, Chile 1983)

Example: The pilot of a DC-4 was approached rapidly by a first object from a distance of about eight miles. It passed over the top of the airplane and took up a position several miles on the other side. It looked like a huge funnel with its wide opening at the top with a red flashing light on the bottom. There was a blue light emanating from the wider top. As long as it remained near the airplane the cabin lights remained dimmed and the radio did not work. When the object departed, the lights and radio returned to normal. Soon the object returned to pace the DC-4 briefly with a second similar object. Again the lights dimmed. Then both objects shot up vertically until they were out of sight. (Case 984, Peru 1966)

Magnetic compasses were affected in 17 cases. The different symptoms noted by the pilots were: needles continuous and rapid rotation (3 cases); rapid needle rotation and jamming (8 cases); compass aiming toward UAP (3 cases); two compasses indicating different direction (2 cases); compass indicating wrong direction (1 case). Magnetic compass system was more affected on private aircraft (7 cases) than on military aircraft (6 cases) or on commercial aircraft (4 cases).

Example: The pilot of a Caravelle flying at 25,000 feet observed a formation of odd lights flying northeast on a 30° heading. Inside the formation, there were three cigar-shaped dark bodies, ten round bodies and ten other bright round bodies. When passing the Caravelle, the objects made the plane's compass comparator light to show that there was a magnetic disturbance, which made the two separate compasses to show different readings. (Case 912, Finland 1966)

ADF (Automatic Direction Finder) radio electric compass was affected in 9 cases. The symptoms described in those cases were: the two needles oscillating violently (3 cases); needles rapid rotation (4 cases); pulsing (1 case); unspecified (1 case). ADF was more affected on commercial aircraft (5 cases) than on private aircraft (3 cases) or on military aircraft (1 case).

Example: The pilot of a DC-9 was flying at 20,000 feet when suddenly, the direction finding system experienced a breakdown and warning lights flashed in the cockpit. The two ADF compasses were simultaneously 8 degrees wrong - both on opposite sides. The pilot looked up out his cockpit window and saw to his left a "huge funnel" in the sky. At first motionless, then it seemed headed toward the airplane on a collision course. It was traveling at an unbelievable speed, its color changing from white to red. Suddenly, the object swerved in a horizontal direction away from the DC-9 to the west. The crew saw a luminous path of whitish-reddish gas for 20 minutes after it disappeared. At about the same time and in same location, the crew of a Boeing 737 encountered the same phenomenon. Two other airliners also saw the object. Ground observers witnessed the phenomenon too. (Cases 989, Austria 1972)

Power plant of the aircraft was affected in 18 cases. The following symptoms were described by the pilots: Engine running roughly (5 cases); Aircraft experiencing buffeting (4 cases); Partial lost of power (3 cases); Engine stalling (2 cases); Engine stopped and restarted « automatically » (4 cases). Power plant was most affected on private aircraft (11 cases) than on military aircraft (5 cases) or commercial aircraft (2 cases).

Example: The pilot of a private aircraft was flying at 3,000 feet when his ADF radio began “pulsing” the squelch circuit, instead of the ordinary rushing sound. It began a pulsing “quieting” routine. Shortly after that, the aircraft experienced buffeting. The pilot immediately looked down at the engine gauges on the instrument panel. As soon as he looked down, the cockpit was brilliantly lit up with a greenish-white light. The pilot looked up and out at his 11 o’clock position he saw a round reddish-orange object, but longer than wide (approximately 50 feet long), at a distance about ¼ mile away. It appeared to be the size of a semi trailer. It had twin trails merging into one distinct trail extending one and a half mile behind the object at all times. The object crossed the aircraft flight path descending rapidly. The pilot radioed ATC but they had nothing on radar. (Case 1264, USA 1995)

General electrical system was affected in 14 cases. The various symptoms reported by pilots were: total failure (6 cases); cabin lights dimmed (2 cases); complete extinction of cabin lights (1 case); transponder stopped functioning (2 cases); electronic equipment jamming (2 cases); electrical system burned or partially burned out (1 case). General electrical system was more affected on private aircraft (4 cases) than on commercial aircraft (6 cases) or military aircraft (4 cases).

Example: The pilot of a small private plane flying at 1,000 feet altitude saw a glowing object coming at a very high rate of speed. It was long in shape and pointed on both ends. The object separated into two parts and the back section moved into a position directly under the front section and the two objects passed the plane. They were both the same intensity of light. As the pilot watched the objects their glow disappeared and his engine stalled and all of its lights went out. A few seconds later the glow around the objects reappeared. The plane's engine started by itself and its lights came on. Both objects then dropped to a lower altitude and moved away. Five additional witnesses on the ground observed the objects. (Case 1150, USA 1980)

Aircraft control was affected in 8 cases. Pilots have described several symptoms: pilot lost control of aircraft (4 cases); aircraft lost or gained altitude (2 cases); turbulences when closed to UAP (2 cases). Aircraft Control was more affected on private aircrafts (4 cases) than on commercial (2 cases) or military aircrafts (2 cases).

Example: The pilot of a Piper Arrow PA-28 flying at 3,500 feet encountered a very bright yellow, oval-shaped object. Suddenly the Piper went into two rapid 360° clockwise rolls from which the pilot had to recover manually. He discovered that he had dropped about 500 feet during the roll and recovery maneuver. When he next checked his instrument panel, he discovered that his magnetic compass was spinning in a clockwise direction so fast that he couldn’t read the number in its square window. Looking outside again, he saw that the UAP was still behind him, suggesting that he too had lost the same amount of altitude. The pilot climbed back to his cruise altitude and called on the radio to Flight control. The air traffic controller told him that the radar showed both his airplane and another object nearby him. The controller said that aircraft would be sent to investigate. Little more than four minutes later, two F-4 Phantom jets arrived on either side of him travelling between 400 and 500 mph. Just as the jets arrived, the UAP accelerated forward and then upward at about a 30° angle above the horizontal and turned right, passing in front of his aircraft. The compass eventually returned to normal operation after the UAP departed. (Case 1053, Germany 1976)

Radar system was affected in 3 cases. The following symptoms were reported by the pilots: radar system inoperative (2 cases) and radar jamming (1 case). These three radar cases were involving military aircraft.

Example: The pilot of a U.S. Coast Guard C-130 sighted a V formation of nine glowing white objects flying at an estimated 35,000 feet altitude. The objects approached from above and to the right side. After a short time

they flew above the C-130 and took up position above and to the left side. The pilot attempted to radio ground control but the radio was dead and the radar stopped working. The pilot tried to switch to auxiliary power which too was not functioning. At one point the airplane's engines stopped (the oil began to congeal in the very cold air). Instead of losing altitude it maintained a steady altitude and course. The airplane allegedly continued flying in complete silence. Then it entered a « strange haze » (likened to a white-out) with air filled with static electricity. There was electrical arcing from one's body to metal inside the fuselage. The haze vanished after about 20 minutes. The power suddenly returned and the crew was able to restart the engines in sequence. The airplane had covered a distance of 265 nautical miles during the 45-50 minute period while travelling at from an indicated airspeed of from 160-190 knots. (Case 873, Antarctic, 1964)

Autopilot system failed to operate normally in 3 cases: two commercial aircraft cases and one military aircraft.

Example: The pilot of a DC-10 airplane was under the control of autopilot system #2 and was flying at 37,000 feet altitude. Suddenly and unexpectedly, the airplane began to turn left, making a 15 degree bank. Within a few seconds, the Captain and First Officer looked to the left side of their plane and saw an extremely bright, round white light at about their own altitude. The pilot then noticed that two of the three cockpit compasses (that use sensors in the plane's wingtips) were each giving different readings although the comparator circuit did not signal a mismatch. At this point, the co-pilot turned off the autopilot and took manual control of the airplane. Upon landing, the compasses were checked and found to be in normal operating condition. (Case 1062, USA 1977)

Weapon systems were affected in 4 military cases. The pilots have reported the following symptoms: gun radar failure (2 cases) and total failure (2 cases).

Example: The pilot of a Finnish Air Force F-18A Hornet saw five disc-shaped objects surrounded by an orange glow. He radioed his base to report the situation and was ordered to intercept them. The five objects veered sharply. The pilot reported to Flight control that the discs were breaking formation and received permission to fire at them. The pilot got behind one glowing object and lined it up with the reticule on his windshield "head-up" display. But instead of picking up the "target acquisition tone" in his earphones, he heard the raucous honk of an alarm. All at once, the targeting computer went off-line. The "heads up" display disappeared. The F-18's firing system for the 20 mm gun was also inoperative. Instantly the pilot hit the "arming" switch for his air-to-air missiles. The red malfunction light began blinking on the dashboard. The objects regrouped and flew away to the East at Mach 4 or 5. The objects were last seen heading for Russia. The F-18 computers were tested for days but they could find nothing wrong with them. (Case 1288, Finland 1997)

In 29 cases two or more systems were affected during the same encounter with a UAP. These 29 cases were distributed more or less equally between private aircraft (11 cases), commercial aircrafts (10 cases) and military aircrafts (8 cases)

Example: The pilot (a police officer) and the passenger of Cherokee Warrior aircraft were flying at 4,000 feet altitude. Suddenly, the pilot's watch stopped at 21h00 and then the wings of the aircraft became red and the control jammed. Out the right window the pilot saw a gigantic red ball of energy (diameter: 300 feet) close to the right wing which appeared stationary first. Then it sped away rapidly and as it did it appeared to be white light on the reverse side. It disappeared into a large dark grey cloud and reappeared in the same cloud showing its red radiant side then its white radiant side. When it sped away, the witnesses had a falling sensation and the aircraft control was returning to normal. The pilot realised that the aircraft had been drawn upwards 2,000 feet at least (from 4,000 to 6,000 feet and then back to 4,000 feet). (Case 1218, Canada 1989)

Furthermore, it is important to notice that in 74 cases (91% of the 81 cases), EM effects on avionic systems were transient and happened only when the UAP was visually seen by the witnesses.

Example: An instructor pilot and his student noticed two spheres approaching them on a collision course. The pilot went into an evasive action to avoid the collision. After he had levelled off, the two objects turned around and started to follow the plane. The pilot tried his radio but it was inoperative due to heavy static. One sphere

was on one side of the wing and the second sphere on the other side. The two objects accelerated at phenomenal speed heading due west at which the radio became operative again. (Case 1257, USA 1986)

In seven cases (9%) the effect was permanent and systems had to be repaired or replaced. Among these 7 cases with permanent effects, the electrical system was affected in six cases and radio in one case.

Example: A triangular-shaped object with very bright strobe lights began to circle a B737 at the same altitude and a short distance in front. The crew experienced a power drain on their aircraft. Flying in the area, the crew of an Airbus A330 observed a purplish glow surrounding the B737. Air Traffic Control gave the pilot an eight-degree vector to avoid the unknown object, as ATC also had it on radar. The B737 pilot filed a "Near-miss" report with ATC. The object angled off to the port side and a huge wake turbulence was experienced as the B737 was violently shaken and the outside air temperature rose to plus 164 degrees centigrade, as the huge UAP scorched through the air, as shown on the systems display digital readout. The only other known phenomenon that can cause this effect is lightning. When the B737 crew landed, they could not raise their speed brakes (spoilers), on the wings, more than a quarter distance up. The aircraft was examined and the wings found to be badly damaged, as if dented by a hammer. There was also aircraft skin damage and hydraulic damage to the speed brakes, caused by the UAP wake. The B737 was taken out of service. (Case 1451, Ireland 2004)

The above mentioned analysis of EM effects cases shows the specificity found in military cases. Military aircraft are less affected probably because they are more specially shielded against magnetic/radio frequency interference or ionizing radiation than are commercial or private planes. At the other extreme, private light planes are the most affected type of aircraft due to the fact that their systems are less shielded. This analysis shows also that in four cases, when the pilot locked on his gun radar and/or weapon system on the UAP, all systems became ineffective and anti-jamming devices failed to operate normally. In those four cases, a complete check of the affected systems following landing showed no failure or anomaly.

Whatever the nature(s) of UAP, the fact that they are capable of making weapon systems ineffective, when the pilot has locked on his gun or missile radar on them, seems to indicate that some of these phenomena use electronic detection or counter-measure systems.

Sightings involving EM effects are of great interest due to the fact that they could possibly provide some technical information about the nature of the phenomena.

17. Physical effects on witnesses (pilot, co-pilot) and passengers:

"Physical effects" were reported by the witnesses in 13 cases (2%). They are of very different natures. In five cases (14/04/1954, 19/10/1953, 09/03/1957, 17/07/1957, 24/07/1957), passengers were injured when the pilot had to make a rapid evasive action to avoid a collision with the UAP. In another case (05/05/1958), the pilot felt an intense heat inside the cockpit when the UAP was at a distance of 900 feet from the aircraft. In one case (11/1972), a commercial pilot had his vision disturbed by the brightness of the UAP. In two other cases (11/02/1953 and 20/04/1964), the pilots were not able to hear any sound, all sound seemed to dissipate (even the sound of the aircraft's engine). In two military cases (09/01/1956 and 03/1967) the aircraft exploded while approaching or chasing the UAP.

In one case (21/10/1978, Australia) pilot and aircraft have disappeared as the UAP was close above the plane.

Frederick Valentich (20 years old) pilot of Cessna 182 took off from Melbourne at 18h19 (local time) en route to King Island in the Bass Strait. At 19h06, he radioed to Air traffic control inquiring about an elongated object with a green light and shiny metallic appearance that confronted his plane and circled above his Cessna.

According to radio communication, the pilot declared: "It seems to me that it is playing some sort of game. It is flying over me two, three times at speeds I could not identify". Just after 19h10 the pilot reported: "It seems like it is stationary; I am orbiting and the thing is just orbiting on top of me also; it's got a green light and is sort of metallic; it's all shiny on the outside". At 19h12, he reported that his engine was running roughly. Seconds later, his last transmission was: "That strange aircraft is hovering on top of me again . . . It is hovering and it's not an aircraft". This was followed by fourteen seconds of a strange metallic sound through the open microphone. Valentich and his aircraft vanished. No trace was ever found of him despite an extensive search. Australian investigators subsequently located numerous witnesses to UAP sightings in the same vicinity just before and after the Cessna's disappearance, including several who saw a green light over Bass Strait. (Case 1104, Australia 1978)

Conclusions

This preliminary study of 600 UAP cases reported by civilian and military pilots has shown a number of key points.

- The distribution of cases comes from the whole Earth (Continental and maritime zones);
- There are slightly more nocturnal cases (54%) than daylight cases;
- Witnesses were two or more in 69% (more than two thirds) of the cases;
- Pilots have officially reported their sightings in 197 cases (33% of the 600 cases);
- Commercial pilots have reported their sightings officially in 35% among 233 cases;
- Most of the sightings occurred during cruise phase of flight (85%);
- Visual sightings are confirmed by radar detection in 27% of the cases;
- More UAP are described as « objects » (74%) than point sources of lights. Circular (disc) is the most reported shape (42%);
- UAP perform maneuvers in more than half of the cases (56%) and their behaviours seem to reflect an interaction with the aircraft in almost 50% (299) of the 600 cases;
- In 48% (almost half) of the 600 cases, UAP have had or could have had an impact on flight safety, including 31 cases in which pilots had to make an evasive action to avoid a collision with UAP;
- Electro-magnetic effects were reported in 14% of the 600 cases, radio and compass systems were the most affected;
- Private aircrafts are more affected by the E-M effects allegedly caused by UAP;
- Weapon systems were momentarily ineffective when targeting UAP;

Most of the results (in percentages) found in this analysis of 600 cases are very close to those obtained in the 300 cases analysis published by the author in 2010¹¹, indicating that regardless of the total number of cases analyzed more or less the same patterns are found.

This analysis confirms the potential impact on aviation safety and the need for a serious study of these phenomena by governmental aviation departments and the International Civil Aviation Organization of the United Nations. Pilots must be informed about the flight characteristics of these phenomena and motivated to report them on a detailed basis. In too many cases, basic data, such as time of sighting, aircraft-UAP separation distance, altitude, etc., are missing in reports.

Only a systematic collection of detailed testimonies from pilots and crews will enhance the scientific research on these phenomena and will contribute to aviation safety.

¹¹ NARCAP International Technical Specialist Report ITR-1, February 16, 2010

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Annex 1 : AIRPANC Database – List of Factors

FACTOR	COLUMN	CODE	FIELD DESCRIPTION
1	A	CN	CASE N° (from OLD ACUAPE Database)
2	B	DT	DATE (YYYYMMDD)
3	C	YR	YEAR
4	D	MO	MONTH
5	E	TM	TIME
6	F	AL	AMBIENT LUMINATION (Night: NT, Day: DY)
7	G	LC	LOCATION (COUNTRY CODE)
8	H	AC	TYPE OF AC (Military: M / Commercial: C / Private: P)
9	I	AP	AC PROPULSION (Jetliner: JT / Propliner: PL)
10	J	PF	PHASE OF FLIGHT (Take off: TO / Climb: CL / Cruise: CR / Descent: DC / Approach: AP)
11	K	AS	AVIATION SAFETY
12	L	EM	ELECTRO-MAGNETIC EFFECTS (Yes: YE or No: NO)
13	M	EP	PHYSICAL EFFECTS (Yes: YE or No: NO)
14	N	RD	RADAR DETECTION (Ground Radar: GR / Airborne Radar: AR / Airborne + Ground Radar: AGR / No Target: NR / Unspecified: UN)
15	O	TU	TYPE OF UAP (Object : OB / Light: LT)
16	P	AN	VALLEE CLASSIFICATION (Anomaly : AN / Flyby: FB / Maneuver: MA)
17	Q	IT	INTERACTION (Yes: YE or No: NO)
18	R	NU	NUMBER OF UAP
19	S	NW	NUMBER OF WITNESSES
20	T	GW	GROUND WITNESSES (Yes: YE or No: NO)
21	U	MA	MULTIPLE AIRCRAFT (Yes: YE or No: NO)
22	V	NF	NUCLEAR FACTOR (Yes: YE or No: NO) Sighting above a nuclear site of AC carrying nuclear weapons
23	W	SO	SOURCE QUALITY (S1: Official report military or civilian / S2: First hand testimony / S3: Second hand Testimony)
24	X	PR	PROVISIONNAL RESULT (Unidentified: UI / Probably Identified: PI / Lack of Data: LD)
25	Y		AVIATION SAFETY (cross flight path, near-collision, collision course, closed AC, chase AC, Evasive action taken, injured passengers, EME, AC lost,)
26	Z		AVIATION SAFETY REPORT (Airprox/Aimiss, Incident Report)
27	AA		EME SYSTEMS AFFECTED (Radio, Compass, Aircraft control, ADF, Propulsion system, Weapon system, General Electric system, Autopilot, DME)
28	AB		EME SYMPTOMS
29	AC		UAP SHAPE TYPE (Circular / Oval / Sphere / Cigar / Missile / Half-spherical / Triangle / cylindrical / Bullet / Cone /Rectangle / Changing / Various
30	AD		UAP SHAPE DESCRIPTION
31	AE		UAP COLOR
32	AF		TYPE OF INTERACTION (chase AC / chase by AC / Evasive action / Circlod / dogfight / EME /
33	AG		DISTANCE (between AC and UAP - in feet)
34	AH		DURATION (in minutes)
35	AI		COMPANY
36	AJ		Type of AC
37	AK		UAP altitude (in feet)
38	AL		UAP speed (in mph)
39	AM		Miscellaneous (UAP estimated size,)