

Dust-Cloud Moons of the Earth

Two naturally occurring dust clouds orbit the earth. Their approximate positions have been predicted for almost 200 years, but they were observed for the first time only in 1956. Now observations from the western hemisphere confirm the existence of these "moons."

by J. Wesley Simpson

THE EARTH HAS three moons, two of them very different from the familiar one. They are cosmic dust clouds first reported in 1961 by Kazimierz Kordylewski, the Polish astronomer. The clouds are found at two of the five points in the earth-moon system where a small mass is expected to be in dynamic equilibrium with the massive earth and moon revolving about their common center of mass. The existence of such points is most simply understood when viewed from the rotating coordinate system of the two heavy masses. Then the five equilibrium positions, known as libration points, are the places at which the gravitational forces just balance the centrifugal force on the small mass. We have been studying the two clouds for nearly three years to determine experimentally the dynamic behavior of matter at the libration points. Recently we have successfully developed techniques for photographing the libration clouds.

Libration points

Existence of the clouds was suggested by considerations of the restricted

three-body problem, the most tractable formulation of the many-body problem. In this version one of the three masses is assumed to be so small that its gravitational force does not affect the motions of the other two. Analysis shows that for this case there are five points in the plane of rotation of two heavy masses where a small mass can exist in dynamic equilibrium with them. (The spaces around these libration points are often called Lagrange libration areas after the first expounder of the three-body problem, Joseph Louis Lagrange.) Two of the five points lie at apexes of the two equilateral triangles that can be formed with heavy masses at the other apexes. Because they lie on a 60-deg triangle these two points are known as the *sextile* libration points. The other three libration points are called *colinear* because they lie on the axis joining the centers of the two large masses.

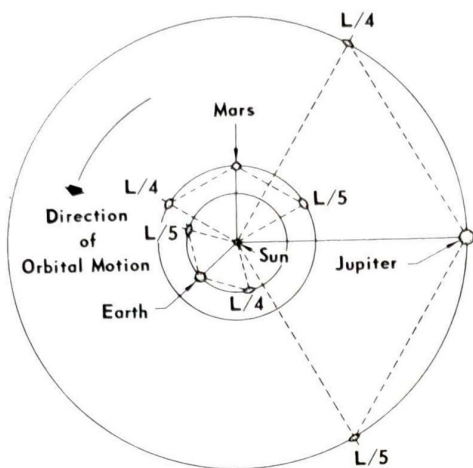
Around each of the points there are two classes of infinitesimal orbits in which a body arriving with some momentum of its own might revolve—namely those with short period (near-

ly equal to that of the large masses) and those with long period (dependent on the ratio of the large masses). Each class consists of concentric, coaxial ellipses with major and minor axes in the ratio 2:1 for the short-period class and a larger ratio for the long-period group.

If the ratio of the two large masses is smaller than 1:27, both classes of orbits around the sextile libration points can be described with trigonometric functions. The sextile libration points are therefore considered (in theory) stable—a mass put in the neighborhood of one of the points will perform damped oscillations about it. On the other hand for the same mass ratio only one class of orbits around

J. Wesley Simpson is founder and director of the Locksley Observatory of Lockheed Missiles & Space Co. Originally in engineering, his longstanding avocation in astronomy is now his vocation.





SEXTILE libration points of three sun-planet systems.
—FIG. 1

the colinear points can be represented by trigonometric functions. The other class requires hyperbolic functions, and the colinear points are therefore said to be unstable—masses will not necessarily stay at them.¹

The five libration points referred to above have been designated L/1 through L/5. The first three are the unstable colinear points. The sextile points are denoted L/4 and L/5. L/4 precedes a heavy mass along its trajectory by 60 deg, and L/5 follows by the same angle (figure 1). Because they are located at the apexes of equilateral triangles they are equidistant from the heavy masses.

It is interesting to note that there is a difference of opinion among some investigators as to the stability of L/4 and L/5. During the past decade more than 100 papers have been written primarily concerned with the stability of these two points. Most of these are based on lengthy mathematical and computer analyses. It seems, however, that many of the unstable solutions come from computer analyses in which round-off errors are not taken into account. When this important factor is adequately considered, opinion seems to favor stability. Until actual observational data are obtained, however, the true nature of the L/4

and L/5 libration points will remain unknown.

Observed libration points

There has been much speculation whether natural bodies could be found at the sextile libration points of the sun-Jupiter system or the earth-moon system. For 134 years efforts to locate such bodies at these points were futile. Then on 22 Feb. 1906 Maximilian Wolf discovered asteroid no. 588 (Achilles) in the L/4 position of Jupiter. Within the same year August Kopff discovered asteroid no. 617 (Patroclus) in the L/5 Jupiter position² (see figure 1). Since then a total of 14 asteroids has been discovered in these positions—nine at L/4 and five at L/5. Subsequent observations of these bodies have provided some knowledge of the behavior of a body in a Lagrange libration area. Possible sextile libration points for some of the sun-planet combinations in the solar system are shown in figure 1. In each case the point leading the planet along its trajectory is labeled L/4 while the trailing point is denoted L/5.

A detailed diagram of earth-moon libration points is shown in figure 2 along with the gravitational equipotentials of this system. The three colinear points are at the intersections of

the equipotentials. L/1 is the point between the earth and moon; L/2 is the point on the far side of the moon; L/3 is located opposite the side of the earth away from the moon.

Discovery in Poland

Although the first observational proof of the existence of libration points was obtained in 1906 and although the locations of the libration points were predictable, 50 years passed before further confirmation was obtained.

Starting in 1951, Kazimierz Kordylewski of Cracow Observatory in Poland began a search for small solid bodies in the earth-moon L/4 and L/5 positions. For five years he scanned the probable areas for objects as faint as the 12th magnitude—approximately 255 times as faint as a 6th magnitude star, which is considered the faintest star the naked eye can discern on a clear night.^{3,4} His results were negative. From December 1953 to June 1956 Clyde Tombaugh, discoverer of the planet Pluto, attempted to find small solid bodies in the L/4 and L/5 positions with the same approximate limiting magnitude. Although the press erroneously reported that Tombaugh had found several objects, the results of his search were also negative.

In 1956 Josef Witkowski suggested that Kordylewski change his search methods. Witkowski advised discontinuing the search for small solid bodies and looking for faint luminous patches or "clouds." Witkowski reasoned that the clouds could consist of a tremendous number of dust-like or micron-size particles that, although not individually visible, would reflect sunlight. Shortly thereafter Kordylewski found the clouds. He continued to observe them until he had gathered enough information to prove his claim. In July 1961 he announced his discovery of the two new moons—giant cosmic dust balls, completely unlike the solid moon that we have known from antiquity.

Discovery in California

After Kordylewski's announcement, many professional and amateur astronomers tried without success to find the libration clouds. The United States Coast and Geodetic Survey sent a mission to Mt. Chacaltaya, Bolivia in

1961 and 1962 to observe and photograph the libration clouds. Their efforts failed.⁵ At the same time other staff members of the Locksley Observatory and I began planning an attempt to locate these elusive patches of light. Interest was heightened by receipt of a letter from Kordylewski, dated 30 Sept. 1961.⁶ This brief communication announced further confirmation of his earlier discovery by observations of the L/5 clouds on 3 and 4 Sept. On 16, 17 and 18 Sept. 1961 he also detected the existence of a new cloud-like satellite near the L/4 point. These clouds were also visible to the naked eye. In addition to his visual sightings, he obtained photographs that contained images too faint to reproduce.

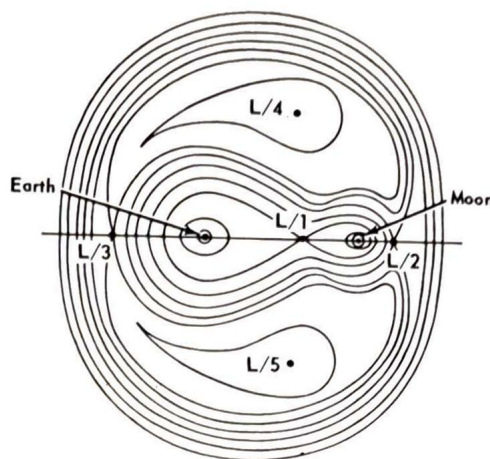
Starting in November 1961 Locksley Observatory personnel made attempts to locate the libration clouds whenever weather permitted. Through the remainder of 1961 and throughout 1962, all attempts to locate the clouds failed in spite of excellent weather and skilled and experienced observers. The search points were calculated by using the moon's position taken from the *American Ephemeris and Nautical Almanac* and adjusting for points 60 deg in front of and behind the moon along its path.

During 1963 we calculated the libration-cloud positions from an existing lunar-ephemeris computer program. (An ephemeris is a tabulation of the position of any celestial object at regular intervals.) The observations with this new ephemeris were unsuccessful also. Additional ephemerides generated by Kordylewski and the Cracow Observatory were used without success.

Not until the fall of 1963 did I establish definitive parametric constraints governing the location and observation of these elusive clouds. The existing Lockheed ephemeris was corrected to allow for the applicable constraints and was used on 4 Jan. 1964. On that date, R. G. Miller, G. Gardner and I made the first successful western-hemisphere sightings of the L/5 libration cloud. Each observer independently located the cloud and recorded the pertinent information. Three positive sightings were made during the five-day "window" (a period when the libration point was in

EARTH-MOON libration points and gravitational equipotentials. The colinear points L/1, L/2 and L/3 lie at the indicated intersections of the equipotentials, and the sextile points L/4 and L/5 lie on the orbit of the moon, respectively 60 deg ahead and 60 deg behind it.

—FIG. 2



position to be seen) around the 4th. Observations were made on 4, 6 and 7 Jan. (on 5 Jan. the weather prevented observation). *During this period, the cloud changed its daily position by an amount closely approximating the daily motion of the moon.* Since that time observations have been made and recorded during numerous windows when weather and personal schedules permitted. The most recent observations were made last November.

Brightness of the clouds

For a better understanding of the appearance and nature of the libration clouds a discussion of the zodiacal light and gegenschein is helpful. The zodiacal light is best seen on cloudless and moonless spring evenings and autumn mornings for a few weeks before and after the equinoxes. As twilight fades the sky remains bright in the region adjacent to the sun, and a tapering cone of faint light, broader and brighter at its base than the Milky Way, rises from the point of sunset with a slight inclination to the south (as seen in the northern hemisphere). This light gradually fades out at its apex and along its edges. The central line of this luminous area coincides with the ecliptic or zodiac; hence it is called the "zodiacal light." Although many people have not seen it, the zodiacal light has been known from ancient times, and in clear air away from city lights, it is quite conspicuous.

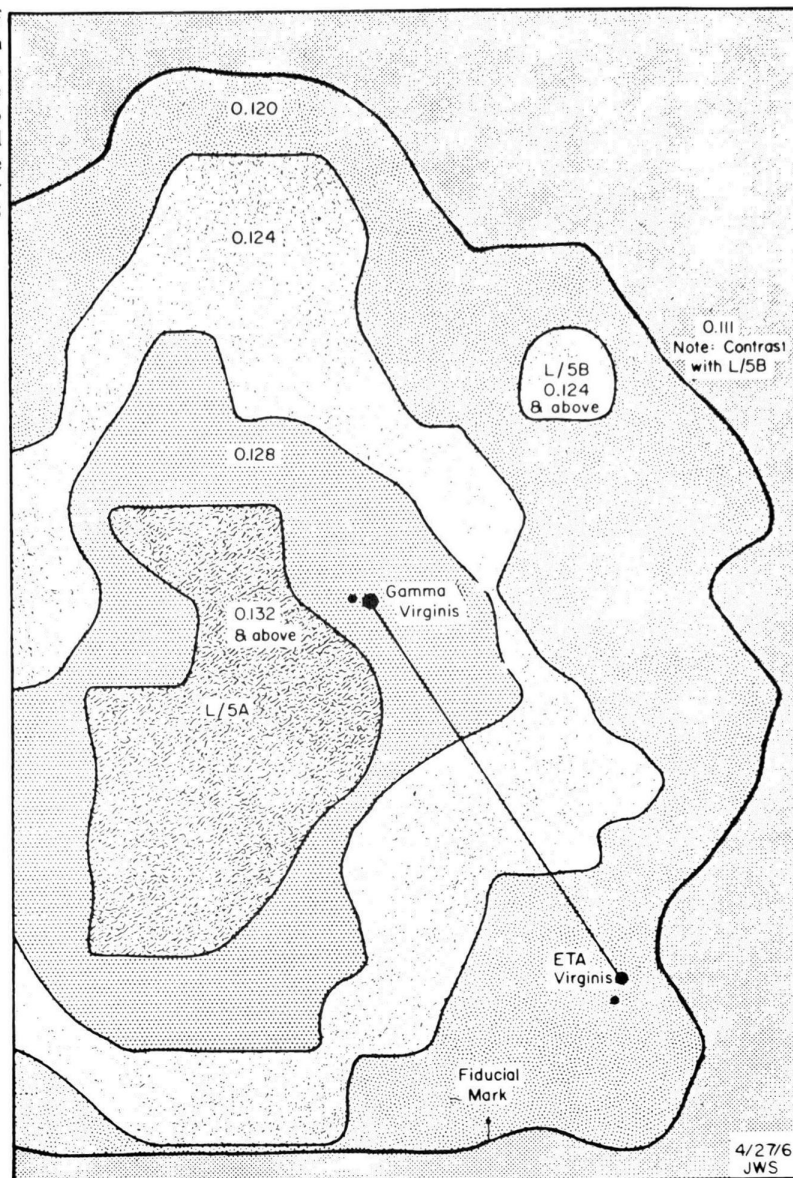
The zodiacal light is not fixed

among the stars. Observations spread over several weeks show that it moves among the stars at the same rate as the sun. In the fall of the year, an early riser will notice a similar inverted cone as the zodiacal light is exposed to view before the rising sun. Once again the cone is widest and brightest near the sun and diminishes gradually as it points westward along the ecliptic. In actuality a faint band extends from the apex of the evening zodiacal light to the apex of the morning zodiacal light. The band extends across the entire sky, but absorption and light scatter by the earth's atmosphere make it very difficult to see.

This luminous band is thought to be an extended and exceedingly thin cloud of micrometeorites (or specks of dust) surrounding the sun. Some theorists consider the zodiacal-light cloud to be shaped like a thick double-convex lens with its edge in the plane of the planetary orbits. Each particle is thought to pursue its own orbit around the sun, but nevertheless the group moves as a whole maintaining the size, shape and concentration that we know as the zodiacal light. The individual particles, though sunlit, are far too small to be seen individually, but with proper spatial distribution they present an area that reflects enough sunlight to be visible as a luminous region.

Directly opposite the sun is an oval patch of light located in the band of zodiacal material. In much the same way that the moon is brightest when

DENSITY-GRADIENT contour plot of the L/5 lunar libration-cloud photograph taken from the ground 13 Feb. 1966. The number in each shaded band is the ratio of the differential image density to background density. The vertical and horizontal scales are different and the angular area of the diagram is 10 deg by 10 deg.
—FIG. 3



in opposition or full, this large patch is brighter than the adjacent zodiacal-band material but still faint and extremely difficult to see. This area is called the "gegenschein" or "zodiacal counter glow." (Its German name was given by its discoverer, T. Brorsen, in 1855.) Even fewer observers have seen the gegenschein than have seen the zodiacal light. It appears as an ill defined, roundish glow, which according to frequent naked-eye observations measures some 8–12 deg across the major axis of its oblate shape.

The gegenschein is best seen at its maximal elevation above the observer's horizon at approximately midnight and is largest and brightest during September and October each year.⁷ At other times of the year and at hours before and after midnight, the gegenschein's brightness diminishes until it is not recognizable to the average observer even under optimal conditions. The integrated brightness of the gegenschein has been established as approximately the 6th magnitude, the limiting magnitude for the normal eye under the best conditions. C. T. Elvey⁸ of Yerkes Observatory was the first person to make isophotometric maps of the gegenschein. His contour maps, showing lines of equal luminosity gradient, extend from the area visible to the naked eye to a diameter of more than 30 deg.

If the interested observer first views the zodiacal light, then progresses successfully to the more difficult gegenschein, he is then ready to attempt observations of the libration clouds. This last step requires clear dark skies, very good eyesight and considerable observing experience of the sort suggested above. The libration clouds are also thought to consist of countless particles, similar to the gegenschein and are also visible by reflected sunlight.

Kordylewski estimates the libration clouds to be a magnitude or so fainter

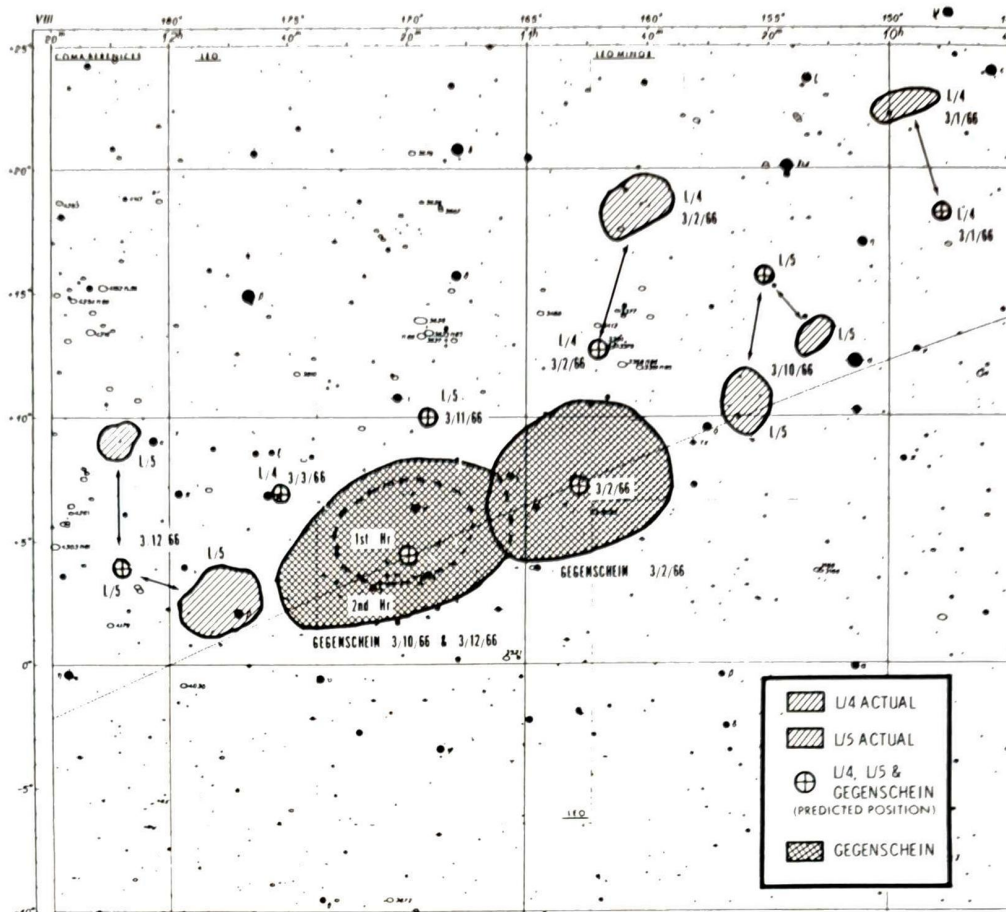
than the gegenschein. I do not agree, because this estimate would make the clouds range in brightness from magnitude 7 to 8, that is, below the visual capability of the most experienced and trained observers. In practice I have found the clouds to range from about magnitude 5.5 to 6.5. The size of the clouds is much smaller than the gegenschein, ranging from a degree to approximately 4 deg long the major axis, depending on the aspect angle. The problem of seeing these faint and elusive patches of light is formidable to even the most experienced observers. A few nonprofessional observers, however, have seen the clouds under

exceptional conditions when told where to look. For them an averted vision technique was required. (This technique is tantamount to viewing the objects out of the corner of the eye.)

Constraints on viewing

The solution to the problem of finding and observing the libration clouds is based on application of certain parametric constraints to the lunar ephemeris and the observing times, so that only optimal seeing conditions are considered. Some of these conditions were established by Kordylewski⁹ in his ephemeris for 1963. I developed

LIBRATION CLOUDS and gegenschein as observed from an altitude of 12 000 meters in March 1966. The background is a standard star map. Predicted locations are indicated by a cross in a circle labeled with the name of the object and the date it was expected there. Shapes and positions of the observed libration clouds are shown by diagonal shading; the gegenschein is indicated by cross hatching. —FIG. 4



the remainder and they have been successfully applied during numerous successful sightings to date. For optimal seeing the following minimal conditions must be met:

Sun's position. The sun must be at an adequate distance below the horizon to assure total darkness.

Moon's position. The moon must be at an adequate distance below the horizon to assure total darkness.

Lunar declination. The position of the moon relative to the observation location on earth has a profound effect on the success of locating the libration clouds. This parameter is especially important for observers located at high latitudes (that is, 40 deg north). The libration clouds are best observed at maximal declination of the moon, which occurs during the winter months. Therefore the best time to observe the libration clouds is during October, November and December for L/4 and December, January, and February for L/5.

Atmospheric absorption. Atmospheric absorption must be reduced to an absolute minimum. Therefore, the elevation angle or altitude of the libration clouds above the observer's horizon should be as large as compatible

with a reasonable time span for the observational window.

Proximity of Milky Way. No observations should be attempted when the libration cloud is in or adjacent to the Milky Way. It is well known that the gegenschein can not be observed if within or near the Milky Way. This condition is even more critical for the libration clouds since they are not only fainter, but considerably smaller than the gegenschein.

Proximity to gegenschein. No observations should be attempted when the libration cloud is in, or adjacent to, the gegenschein. Where the gegenschein is larger and brighter than the libration clouds, all traces of the libration cloud will be overshadowed.

Proximity to bright celestial object. No observations should be attempted when the libration clouds are in the immediate vicinity of bright objects such as the observable planets or first-magnitude stars. Considerable confusion is presented to the observer's eye by the contrast between such bright objects and a faint libration cloud.

Aspect or phase angle. The maximum brightness of the moon, planets, and gegenschein occur at opposition.

In the same manner, the most favorable time for observation of the libration clouds will occur at opposition when their phase angle is zero.

Presence of noctilucent or other clouds. No observations should be attempted during periods of intermittent cloudiness, especially if faint cirrus clouds are present or suspected of being present. Absolutely cloudless skies are required.

Photographic observations

The first photographs of the libration clouds were taken by Kordylewski in Poland. On 13 Feb. 1966 at Locksley Observatory I took the first western-hemisphere photographs and located the L/5 cloud about 10.5 deg from our guide star Iota Virginis at an azimuth angle of approximately 135 deg. Exposures of 4, 5 and 8 min all produced detectable images. Control exposures of the same area were taken a month later when L/5 was absent.

Successful photography required development with a specially devised technique of chemical film-speed enhancement. The ASA rating of Eastman Plus-X panchromatic film was increased from 120 to more than 4000. Normally grain size increases

with film speed, but our chemical hypersensitization produced very small grain size with uniform distribution, thus enhancing resolution. *These factors were essential to our success.*

Careful analysis showed all negatives are free from scratches or emulsion defects and that negatives exposed to the libration clouds exhibit definite and measurable variations of silver density in the area where libration clouds were visually sighted.

Both visual and photographic observations reveal structure in the L/5 cloud. Two components were discerned in the photographs taken 13 Feb. They can be seen clearly in a contour map, shown in figure 3, of the density gradient of the image recorded on the photographs. The brighter component is labeled L/5A and the other L/5B. (On this date the gegenschein was 42 deg away from the L/5 area.) The numbers in the contour bands indicate the smallest differential density change above background in that band.

The tests included projection of the negative and examination by four separate teams of specialists who identified images of the clouds. With careful processing photographic prints showed the images, but, like Kordylewski's photos, they are too faint for newspaper or magazine reproduction.

Up to the present time we have taken nearly 100 libration-cloud photographs at Locksley Observatory with a wide variety of lenses, cameras, film types, exposure lengths and development processes. These photos are still being analyzed both quantitatively and qualitatively.

Airborne observations

In early 1966 NASA/Ames research center contacted Lockheed with regard to five flights they had planned for their Convair 990 airborne science laboratory to observe visually and to attempt to photograph the libration clouds. Knowing of the Locksley Observatory work on the libration clouds, NASA/Ames invited Miller and me to accompany them on all five flights (28 Feb., 1, 9, 10 and 11 March). The program called for all flights to be made in the vicinity of 25 deg north latitude and 125 deg west longitude, at an altitude of 12 000 meters. This altitude was chosen by NASA scien-

tists so that observers would be above 85% of the earth's atmosphere and all clouds. The flight was several hundred miles off the coast of lower California, far from all city lights.

I computed the observation window for these days and the planned observation points. In meeting with NASA scientists we found the first three dates would be good for L/4 observation, and the latter two dates were scheduled when L/5 would be visible. The 11 March date was changed to the 12th as it was believed that the gegenschein would seriously interfere with L/5 observations on the 11th. The first flight was unsuccessful because of equipment failure. The remaining four flights went as scheduled, and the L/4 or L/5 libration cloud was observed each time.

A composite chart of observations made by Miller and me during the four successful flights is shown in figure 4. From the predicted and observed positions for L/5 and the gegenschein, it is easy to see that observation on 11 March would have been impossible. The results of the four nights' observations present a striking portrayal of the size, shape and position of the clouds and the gegenschein.

The structure of the L/5 cloud was seen again during these observations as figure 4 clearly reveals. Both on 10 and 12 March we saw two components and observed that they moved relative to each other and to their predicted position.

The dotted-line contour in the gegenschein refers to observations made during the first hour of observation. As it rose higher in the sky, the gegenschein became brighter and increased in size because of reduced atmospheric extinction. The solid contour line in figure 3 refers to the size and shape of the gegenschein during the second hour of observation. (On one night the zodiacal light was a spectacular sight, with its apex rising to some 60 or 70 deg above the observers' horizon.)

Prospects

At present we have a considerable number of confirmed multiple observations of both L/4 and L/5. We have found that they do not fall precisely at the lunar sextile libration

points but are displaced from these points by varying distances and directions. We do know that they can not be seen at the time of the new moon or when in conjunction with the earth and moon. This reaffirms the previously stated opposition or phase-angle criterion. It is quite possible that the orbit of the libration points around the earth is not identical with that of the moon, and orbit analysis is now under way. The intent is to refine the ephemeris from the new orbital elements determined from observational data and use the new information in subsequent observations. A continual refinement is expected until all of the unknowns are eliminated or reduced to a minimum.

The size of the particles and the dynamics of the individual areas are presently unknown. These properties are of interest because they will determine what mechanisms could inject particles into the cloud and how stable they are. The answers to these questions will in turn determine to what extent the libration areas are reservoirs of interesting cosmic rubble. There is thus the prospect that direct sampling of their contents, when we are able to visit them, may provide information about our local cosmic history. At present, however, despite educated guessing, the true nature of the clouds still remains to be determined. □

References

1. L. S'g, J. P. De Vries, Earth-Moon Libration Points: Theory, Existence, and Application. *Space Science Review* 5, 212 (1966).
2. G. Stracke, Veröffentlichungen des Astronomischen Rechen-Instituts zu Berlin-Dahlem, Nr. 45, p. 18 (1926).
3. New Natural Satellites of the Earth, *Sky and Telescope* 22, 10 (1961).
4. More About the Earth's Cloud Satellites, *Sky and Telescope* 22, 63, 83 (1961).
5. US Geol Survey Astrogeologic Studies Ann. Prog. Rpt. Aug '61-Aug '62, pt. A p. 64-67.
6. Private communication, K. Kordylewski to B. Martin, Lockheed Missiles and Space Co., 30 Sept. 1961.
7. *Norton's Star Atlas and Reference Handbook*, 15th Edition, p. 37, (1964).
8. C. T. Elvey, *Astrophys. J.* 77, 56 (1933).
9. M. Marik, Geozentrische Oppositions-Ephemeride der Librationspunkte L/4 und L/5 im System Erde-Mund für das Jahr 1963, *Acta Astronomica* 13, no. 1, 85, (1963) (Cracow Observatory Reprint 52).

Since the press had some questions about the motives behind releasing the Grudge Report, it received very little publicity while the writers put out feelers. Consequently in early 1950 you didn't read much about flying saucers.

Evidently certain people in the Air Force thought this lull in publicity meant that the UFO's had finally died because Project Grudge was junked. All the project files, hundreds of pounds of reports, memos, photos, sketches, and other assorted bits of paper were unceremoniously yanked out of their filing cabinets, tied up with string, and chucked into an old storage case. I would guess that many reports ended up as "souvenirs" because a year later, when I exhumed these files, there were a lot of reports missing.

About this time the official Air Force UFO project had one last post-death muscular spasm. The last bundle of reports had just landed on top of the pile in the storage case when ATIC received a letter from the Director of Intelligence of the Air Force. In official language it said, "What gives?" There had been no order to end Project Grudge. The answer went back that Project Grudge had not been disbanded; the project functions had been transferred and it was no longer a "special" project. From now on UFO reports would be processed through normal intelligence channels along with other intelligence reports.

To show good faith ATIC requested permission to issue a new Air Force-wide bulletin which was duly mimeographed and disseminated. In essence it said that Air Force Headquarters had directed ATIC to continue to collect and evaluate reports of unidentified flying objects. It went on to explain that most UFO reports were trash. It pointed out the findings of the Grudge Report in such strong language that by the time the recipient of the bulletin had finished reading it, he would be ashamed to send in a report. To cinch the deal the bulletins must have been disseminated only to troops in Outer Mongolia because I never found anyone in the field who had ever received a copy.

As the Air Force UFO-investigating activity dropped to nil, the press activity skyrocketed to a new peak. A dozen

people took off to dig up their own UFO stories and to draw their own conclusions.

After a quiet January, *True* again clobbered the reading public. This time it was a story in the March 1950 issue and it was entitled, "How Scientists Tracked Flying Saucers." It was written by none other than the man who was at that time in charge of a team of Navy scientists at the super hush-hush guided missile test and development area, White Sands Proving Ground, New Mexico. He was Commander R. B. McLaughlin, an Annapolis graduate and a Regular Navy officer. His story had been cleared by the military and was in absolute, 180-degree, direct contradiction to every press release that had been made by the military in the past two years. Not only did the commander believe that he had proved that UFO's were real but that he knew what they were. "I am convinced," he wrote in the *True* article, "that it," referring to a UFO he had seen at White Sands, "was a flying saucer, and further, that these disks are spaceships from another planet, operated by animate, intelligent beings."

On several occasions during 1948 and 1949, McLaughlin or his crew at the White Sands Proving Ground had made good UFO sightings. The best one was made on April 24, 1949, when the commander's crew of engineers, scientists, and technicians were getting ready to launch one of the huge 100-foot-diameter skyhook balloons. It was 10:30 A.M. on an absolutely clear Sunday morning. Prior to the launching, the crew had sent up a small weather balloon to check the winds at lower levels. One man was watching the balloon through a theodolite, an instrument similar to a surveyor's transit built around a 25-power telescope, one man was holding a stop watch, and a third had a clipboard to record the measured data. The crew had tracked the balloon to about 10,000 feet when one of them suddenly shouted and pointed off to the left. The whole crew looked at the part of the sky where the man was excitedly pointing, and there was a UFO. "It didn't appear to be large," one of the scientists later said, "but it was plainly visible. It was easy to see that it was elliptical in shape and had a "whitish-silver color."

IMMEDIATE RELEASE

March 27, 1958

James C. Hagerty, Press Secretary to the President

O.F.
146-F

THE WHITE HOUSE

As part of the United States program of space technology and exploration, the President has approved several projects for launching a number of small unmanned space vehicles, to be carried out by the Advanced Research Projects Agency of the Department of Defense. Certain additional details will be made available today at the Office of the Secretary of Defense. #

X OF 3-XX

Programs authorized include both scientific earth satellites and efforts to determine our capability of exploring space in the vicinity of the moon and to obtain useful data concerning the moon. In technical terms these programs are called "lunar probes".

X OF 146-F-2

These undertakings are part of an orderly program for space exploration and scientific investigation from outer space -- a program determined on the basis of an analysis of proper and worthwhile objectives given to the President by his scientific advisors.

Since numerous test rocket launchings will probably be required in the lunar probe effort, it is not intended to offer a timetable for successful accomplishment of these undertakings, or to speculate on probable dates. Work in preparation for these "lunar probes" has been proceeding for some time.

In approving these projects, the President indicated that when and if a civilian space agency is created, the projects will be reviewed to determine which would be under the direction of the Department of Defense and which would be under the direction of the new agency.

The President directed the Department of Defense, in proceeding with these projects, to coordinate their activities with the National Advisory Committee for Aeronautics, the National Academy of Sciences, and the National Science Foundation.

#####

November 13, 1959

MEMBERSHIP OF THE SPACE SCIENCE BOARD

Dr. Lloyd V. Berkner, Chairman
President, Associated Universities, Inc.
New York 19, New York

Dr. Harrison S. Brown
California Institute of Technology
Pasadena, California

Dr. Leo Goldberg
University of Michigan
Ann Arbor, Michigan

Dr. H. Keffer Hartline
The Rockefeller Institute
New York 21, New York

Dr. Donald F. Hornig
Princeton University
Princeton, New Jersey

Dr. Joshua Lederberg
School of Medicine
Stanford University
Palo Alto, California

Dr. Richard W. Porter
General Electric Company
New York 22, New York

Dr. Bruno B. Rossi
Massachusetts Institute of Technology
Cambridge, Massachusetts

Mr. Alan H. Shapley
Central Radio Propagation Laboratory
National Bureau of Standards
Boulder, Colorado

Dr. John A. Simpson
University of Chicago
Chicago, Illinois

Dr. S. S. Stevens
Harvard University
Cambridge, Massachusetts

Dr. Harold C. Urey
University of California
La Jolla, California

Dr. James A. Van Allen
State University of Iowa
Iowa City, Iowa

Dr. O. G. Villard, Jr.
Stanford University
Stanford, California

Dr. Harry Wexler
U. S. Weather Bureau
Washington 25, D. C.

Dr. George P. Woollard
University of Wisconsin
Madison, Wisconsin

Dr. Hugh Odishaw, Executive Director
Space Science Board
National Academy of Sciences
Washington 25, D. C.

Mr. R. C. Peavey, Secretary
Space Science Board
National Academy of Sciences
Washington 25, D. C.

gov of Reserve Bank of
pptd Chief Min of Travancor
3:1
ee Immunization Ag 25 par
See: Hoover, H Jr, Ag 11,
3 Dist par

ee: Cooking D 14,15. Flour
2:5
eproduction (Biological),

3. See Maritime Exch,

See Ships—Gt Lakes S 26
cy. See French Indochina,

topology Je 27, JI 1, N 15
ate Sec, JI 2,3:5
See: Internal Relations—
111. NATO—EDC Ag 24,

Gambling, Japan par D 21
alifornia Texas Oil
e Mental Health—Gen Ap S
ee US—Const O 12

all of Our History My 1
ee stumps yield product
s; uses discussed, Ag 15,

See Sewing Machines

ply Co. See Adhesives

—US Ag 29
3 Hawaiian Pineapple Co
ns contract talks with
rs get wage rise, Ja 30,
its to Belgian Congo as
3:3. Minute Maid signs with
n concentrates, JI 16,31:4
on. See NATO—EDC Ag 13
See Honduras, armament

e Honduras, pol par My 14
See Synagogues, B'nai

anes—US—Gen, labor par

ending 3 pubs, Je 16,47:6
(Gen). See Stocks—Frauds,
21

—US—TV Programs F 15
h named bd pres; suc-
thm, Mr 28,32:1
n Conditions, aid par JI 30.
Ap 16 par. Near East
13

ee Prisoners Aid Society,

ective Agency. 9 revolvers

Internal Security, Un-Amer

ink J. Re-elected; tabula-

en's Wear JI 24
y, Ont & Western RR, D 21
See Abortion Ap 5 par, Je 18

Internal Security, atomic

cs. See NY, Ontario 6

ee Puerto Rico, pol pars
5 through O 13, O 27,30.
g incident par Mr 3

ee Airlines—US—Gen,

Educ—NYC—Gen, trans-

ent Co. See Housing—US,

u. Sinclair Oil gets 3 bids
8,35:1; accepts bid, JI 9,
18:7

ee. Acquired by H K Porter

(Ifton, NY). Season prepara-

Standards Bur Mr 23, Ap 21,
3, S 9

e '54 outlook good for
Ja 1,30:8; Naugatuck
lastic pipe and fittings at
material's advantages,
pe Co. vp H van Rensselaer
rete pipe plant completed
as 2 more there, Mr 25,
ee Brazilian seamless
id, Ag 16,26:1; US Steel
plans elec weld pipe
21,37:1; Olin Mathieson
l of creating tubing inside
screen pattern, heat and
at stage results noted,

PIPELINES. See: Alaska JI 27. Coal—US, transpor-
tation par Ap 21. Gas, Oil. Co names

PIPER, Alexander R Jr. See Stock Exch, NY, Je 18

PIPER, (Prof) Dan. See France—Econ Je 25

PIPER, Wm T. See Aircraft Industries Assn Ja 9

PIPER Aircraft Corp. See Airplanes—US—Private

F 3, My 7

PIPES, Smoking. See Smoking and Smokers Articles

PIPING Rock Club (Saratoga Springs, NY). De-

stroyed by fire, Ag 18,31:1

PIQUET, Howard S. See Commerce—US, tariff par

F 16,17,22

PIRACY. See: Fish—Peru Mr 23. Ships—Internat'l

Incidents O 1,6,7,14,16,20, N 3, D 10,14,16 par.

Tobacco, US cigarettes par Ja 22

PIRROTTA, (Dr) Nino. See Princeton U Ag 19

PIRZADA, (Chief Min) Abdus Sattar. See Pakistan,

pol par N 9,10

PISA, Leaning Tower of. See Leaning Tower, etc

PISA, Univ of. Dr Kirk, Prof Williamson, Dean Ar-

naud hon, N 2,21:7

PISANI, (Dr) Antonio. See Med—NYC, S 3,4 Dies, 81;

later named 'Outstanding Gen Practitioner of Yr' by

NYS Med Soc which was unaware of his death;

career, O 15,23:3

PISANO, 'Little Augie'. See Labor—US, racketeer-

ing pars Mr 17, JI 3

PISK, (Pfc) George M. See Ger—Foreign Forces

S 21, O 2 par

PISSARRO, Camille (1830-1903). See Art—Sales D 23

PISTON, Walter. See Music—Awards JI 10

PITARO, (Assemblyman) Vincent L. Defeated for

re-election; tabulation, N 4,27:6

PITCHER, Ralph M. See West Side Assn of Com-

merce

PITHART, Vilem. Apptd Amb to Yugoslavia, JI 31,

2:6

PITMAN-Moore Co. See Infantile Paralysis, preven-

tion par Ja 18

PITNEY, James C. See US—Justice Dept, US Attys

par Ja 3

PITOVRANOV, E P. See Ger—Occupation, person-

nel (USSR) par Ja 2

PITT, Courtney. See Radio & TV—US—Equipment,

production par Mr 24

PITT, Edwin T. See Teachers Assn of NYC, Prot,

My 22

PITTI Palace (Florence). See Art—Misc News Ap 25

PITTMAN, (Dr) Franklin K. See US—Employees F 26

PITTMAN, Ralph R. See Atomic Energy—US, Padu-

cah par D 14

PITTMAN, Vail. Wins Dem Gov primary, Nev, Je 3,

21:4; defeated in election, N 3,25:3; N 4,13:5

PITTS, C A. General Contractor Ltd. See Merritt-

Chapman & Scott O 15,4 W Denny, L M Schott made

dirs, N 14,111,4:3

PITTSBURGH, Pa. See Ports—US

A B VanBuskirk named '53 Man of the Yr, Ja 24,

69:2; Council votes 1% wage tax for residents and

non-residents effective Mar 1, Ja 26,10:4; PRR pays

\$1,396,682 in taxes, '53, F 2,35:5

Mayor Lawrence visits Israel; made hon citizen

of Jerusalem; presents hon scroll from Pittsburgh

citizens to Israeli Min Eshkol, JI 19,4:4. S Lorant

gets comm to edit 'The History of Pittsburgh' to be

pub before bicentennial, '58, JI 25,24:2

PITTSBURGH (USS). See US Armament—Navy,

maneuvers par Ja 28

PITTSBURGH, Univ of. See: Allergies My 9. De-

bating D 11,12,4 3 Mellon family foundations give

\$15 million to Med School; Pres Eisenhower, Cham-

cancellor Fitzgerald hall gift; latter cites Vice Cham-

cancellor Moore plans to expand med educ, Ja 19,1:6;

2-yr test program to improve undergrads liberal arts

educ planned; urged by Coll Self-Study Com, rept

sponsored by Ford Foundation div, Ap 25,14,11:1;

Chancellor Fitzgerald to retire, JI 13,7:2

PITTSBURGH & Lake Erie RR Co. See: NY Central

My 15. Ports—Gt Lakes D 24,4 Hon H S Vanderbilt

for completing almost 40 yrs as dir, Ja 14,39:6; NY

Central pres White holds R R Young comparison of

C&O and Pittsburgh rr qtrly divs not valid, Mr 11,

39:7; Aug income rept shows \$83,298 operating loss

but \$768,186 gain on freight car rentals, S 30,47:5

PITTSBURGH & West Virginia Ry Co. See: Ports—

Gt Lakes D 24. RRs—US—Freight, truck-trailer

haulage par D 23

PITTSBURGH Consolidation Coal Co. See Jamison

Coal & Coke Co S 6

PITTSBURGH Crushed Steel Co. See Abrasives N14

PITTSBURGH Forgings Co. Buys rights to mfr and

sell Farm Tools Inc products, N 20,20:5

PITTSBURGH Hotels Inc. E C Eppley buys Donner

Trusts' interest, F 16,38:2

PITTSBURGH Plate Glass Co. See: Columbia-

PITTSBURGH Steel Co—Cont

par Ap 29; prices par JI 3,4 A C Adams to succeed

J H Carter as chmn; A R Maxwell named dir, Ja 27,

41:8

PITTSBURGH Stock Exchange. See Phila-Baltimore

Stock Exch

PITTSBURGH Sun-Telegraph. See US—Pol Mr 12 in

'29,4 New high-speed presses in use, JI 13,40:3

PITTSBURGH Thrift Corp. See Amer Investment Co

PITTSFIELD, Me. Efforts to revive indus after

Amer Woolen Co plant abandonment described; illus,

Ap 4,111,1:1

PITTSFIELD & North Adams RR Co. See NY Central

N 24, D 18

PITTSFIELD (Me) Improvement Assn. See Amer

Woolen Co D 25

PITTSFORD Co. See: Allegheny Corp My 20. Sierra

Ancha Mining Co Je 16,4 W G Buckner new dir,

Ag 7,17:7; Coal sales units merged as Pittston

Clinchfield Coal Sales Corp, S 21,42:2

PITUITARY Glands. See: Cancer, treatment par

Je 27. Hormones. Paleontology Mr 28. Pancreas

Ap 16. Weight Je 27

PITZ Foundry. To expand Bklyn facilities, JI 8,16:3

PITZELE, Marilyn S. See: NYC Transit—Labor N 17.

Stevedoring—NY Port Ja 1,4,5,16,22, Mr 1,20,21,

Ap 7,8

PITZER, (Dr) Kenneth. See US—Internal Security,

atomic par Je 17(21:6)

PIUS IX (1792-1878). See RC Ch

PIUS X (1835-1914). See RC Ch—Pope

PIUS XII. See RC Ch

PIVNEY, (Lt Col) Leonid E. See USSR—Foreign

Service JI 6 par

PLA y Deniel, (Cardinal) Enrique. See: News—

Spain Je 28, N 9. Spain, ch-state par JI 2

PLACEBOES. See Med—GB, Natl Health Service par

Ag 14

PLACENTA. See Arthritis My 16

PLACZEK, (Dr) George. See US—Internal Security,

atomic par JI 1(14:3)

PLAFSON, (Dr) Peter. See Agr—Near East, Israel

par N 28

PLAGIARISM. See: Motion Pictures—Revs, Riot in

Cell Block 11 par Mr 17; Seven Sweethearts par

Mr 2. Music—USSR My 7, Je 30

PLAGUES. See disease names, eg, Bubonic

PLAINEDGE, NY. PO Dept refuses to recognize

town as postal address, F 3,25:1

PLAINFIELD, NJ. 270th anniv, JI 6,17:3

PLAINFIELD-Union Water Co. See Water—NJ Ja 14,

JI 18,21, N 7

PLANETARIUMS. See Princeton U My 13

PLANETS

Mythical and natural attributes of Jupiter dis-

cussed, Ja 10,14,8:4; Hamilton Watch Co shows

clock developed by Dr Levitt that simultaneously

records time on Earth and Mars, Ja 15,21:7; plans for

observing Mars in forthcoming close opposition to

Earth discussed, Ja 17,14,9:6; Internat'l Mars Com

to meet, Washington, Mr 14,43:1; J G Vaeth article

on facts and fancy about Mars; illus, My 30,14,14;

O Marcus Jr, Je 20,14,4; Mars is 40.3-million mi

from earth, closest since '41, Je 25,23:7

Prof Freeman suggests dumping radioactive

wastes on planets, Ap 18,14,9:6

Drs Menzel and Whipple advance theory Venus is

covered by oceans, Amer Astronomical Soc; W

Koempfert on Internat'l Mars Com plans for '55 ob-

servations; on expected difficulties in making

photos; on astronomers views on 'canals' and life

on planet; on Dr McLaughlin, late Prof Lowell

views, JI 7,14,7:5,6

Dr McLaughlin offers theory that Martian 'canals'

are caused by winds; illus, S 15,37:2; Dr Slipper

holds photographic studies show Mars is 'alive,'

O 24,23:5. Indiana U Astronomy Dept rediscovers

Athalia asteroid 'lost' for 50 yrs, N 2,27:2

Prof Ramsey and other Brit physicists theorize

that some planets are composed of gases trans-

formed into metallic state by gigantic atmospheric

pressure, D 5,142:2; G Abell sights new asteroid,

D 8,44:1; rediscovers of minor planet Athalia by Dr

Hergert through use of elec computer noted, D 12,

14,9:5

PLANK, (Prof) Emma N. See Educ—US—Kinder-

gartens and Nursery Schools Ja 15

PLANKINGTON Packing Co. See Meat, US labor

par S 21

PLANKTON. See Atomic Energy—US, hydrogen par

D 21,4 UN pub rept scientists spur study on use

as food; says Thailand uses 5,000 tons yrly, Mr 8,

29:4; W Koempfert committe, Mr 14,14,11:6

PLANNED Parenthood. See Birth Control

PLANNING and Civic Assn, American. Maj Gen U S

Grant 3d, H M Albright re-elected pres and chmn,

My 21,25:2

PLANNING Assn, National. See: Agr—US Ag 30

In Ag 18 par. Atomic Energy—US, S 27. China—

Foreign Relations, US par D 10,11. Commerce—US,

D 10. Econ Conditions, aid par D 10. Far East

econ par D 10. Internat'l Relations—US, bipartisan-

ship par D 10. Labor—US, discrimination pars My 24,

D 6,9; supply pars JI 4, D 27. Near East D 10 in D 2

par. Peru, econ pars N 29, D 18. US—Econ, misc

see D 20; NE par O 18; production pars JI 4, D 27.

US—Employee, recruiting par

Finances, acctg par D 20

Internat'l Policy Com head

statement on 'Amer Policy 1

War'; urges realistic accord

bipartisan foreign policy, re-

econ policies; signers liste

says he did not wish to sign

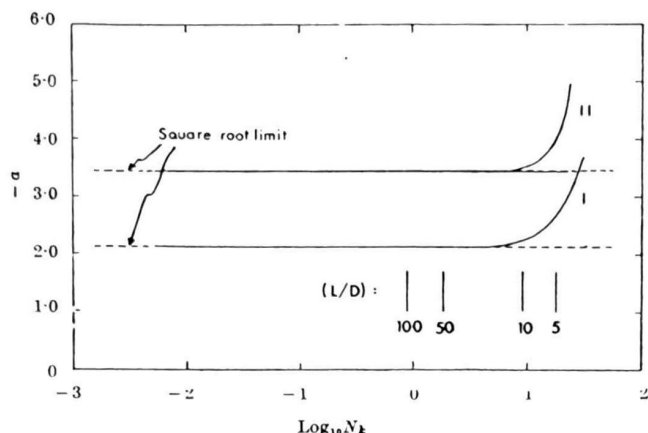


Fig. 2. Overall flux ratio for capillary of typical dimensions; helium-argon (I) and hydrogen-argon (II) at 1 atm., 300° K

than at extreme conditions of pressure or temperature—in which case selective surface migration would probably be an important transport mechanism and flux ratios would be determined by other considerations.

J. B. BUTT
R. N. FOSTER

Department of Engineering and Applied Science,
Yale University,
New Haven, Connecticut.

¹ Dullien, F. A. L., and Scott, D. S., *Chem. Eng. Sci.*, **17**, 771 (1962).

² Wicke, E., and Kallenbach, R., *Kolloid Z.*, **97**, 135 (1941).

³ Butt, J. B., *Amer. Inst. Chem. Eng. J.*, **11**, 106 (1965).

⁴ Foster, R. N., and Butt, J. B., *Amer. Inst. Chem. Eng. J.*, **12**, 180 (1966).

ASTRONOMY

Evidence of an Ephemeral Earth Satellite

THE possibility that the Earth could acquire natural satellites from the debris of large meteoritic impacts on the Moon has been discussed by O'Keefe¹. A possible capture mechanism for bodies into temporary Earth orbit has been investigated by Baker². On February 9, 1913, a widely observed, long duration procession of meteors and fireballs gave rise to the suggestion by Chant, Mebane, and others³ that they actually were such ephemeral Earth satellites which were finally consumed at perigee. More recently, a long, extremely narrow field of both craters and meteorites in Argentina was investigated by Kohman *et al.*⁴ and they suggested that these were the end-result of a captured Earth satellite finally spiralling into the denser atmosphere.

During the mid-fifties I analysed evidence of two swarms of such objects in retrograde orbits⁵. However, it has never been conclusively proved that such an ephemeral satellite, with a perigee in the upper atmosphere, has been observed while in orbit and before its final revolutions. I now suggest that the Earth has had such a satellite and that it was observed at least eight times during the period 1956–65. Fortunately, these eight known observations were recorded with sufficient accuracy to permit the determination of an orbit. These observations are listed in Table 1.

The first three observations were accidentally made by Metcalfe and forwarded to me⁶ as possible evidence of an inner planet. The brilliance of the objects to the naked eye caused most persons contacted to doubt that they were astronomical despite the fact that this was confirmed with optical aids. However, when Kayser and I made the fourth observation (also with optical aid) I computed an approximate orbit, assuming all four observations to be of an Earth satellite. Continued surveillance over the next 60 days during every possible evening twilight period resulted in the fifth and sixth observations being made.

Table 1

Long.	Lat.	Date	Time	Azi- matn	Eleva- tion	Magni- tude	Observer
87.7 W.	39.6 N.	Nov. 17	01:20	248	20		E. Metcalfe
		1956	01:35	242	0		E. Metcalfe
87.7 W.	39.6 N.	May 24	01:20	291	20		E. Metcalfe
		1957	01:37	291	0		E. Metcalfe
87.7 W.	39.6 N.	Nov. 10	23:30	287	40		E. Metcalfe
		1957	23:58	287	0		E. Metcalfe
118.5 W.	34.0 N.	Dec. 9	03:32	233	19		B. Kayser
		1964	03:35:40	260	3.5	3	J. P. Bagby
118.5 W.	34.0 N.	Dec. 29	02:20:39	250	12.5	2	J. P. Bagby
		1964	02:22:24	280	5	2	J. P. Bagby
118.5 W.	34.0 N.	Jan. 10	02:16:48	278.5	5.5	3	J. P. Bagby
		1965	02:16:56	280	5	3	J. P. Bagby
118.5 W.	34.0 N.	Oct. 25	02:08	231	23	2	R. M. Hartmann
		1965					
			02:11	281	4.5	2	J. P. Bagby
118.5 W.	34.0 N.	Dec. 14	02:57:09	303.5	30	3.5	J. P. Bagby
		1965	03:00:10	296	13	3.5	J. P. Bagby

Table 2

	Nov. 17.0, 1956– Dec. 29.0, 1964	Dec. 29.0, 1964– Oct. 25.0, 1965	Oct. 25.0, 1965– Dec. 14.0, 1965
a	14,600–0.109 t	14,300–0.109 t – 1.52 × 10 ⁻⁴ t^2	12,900–9.24 t – 1.03 t^2
e	1.00 – (6,600/ a)	1.00 – (6,600/ a)	1.00 – (6,600/ a)
i	137.4°	137.4°	137.4°
R.A. Node	86° + 0.820 t – 6.38 × 10 ⁻⁴ t^2	52° + 0.858 t + 3.56 × 10 ⁻⁴ t^2	342° + 1.071 t + 9.40 × 10 ⁻⁴ t^2
π	27 – 0.130 t – 1.52 × 10 ⁻⁴ t^2	347 – 0.139 t – 5.50 × 10 ⁻⁴ t^2	300 – 0.172 t – 1.52 × 10 ⁻⁴ t^2
Period	294 – 3.03 × 10 ⁻³ t	285 – 3.03 × 10 ⁻³ t – 4.45 × 10 ⁻⁴ t^2	244 – 0.270 t – 2.70 × 10 ⁻⁴ t^2
Epoch	Nov. 17.0, 1956	Dec. 29.0, 1964	Oct. 25.0, 1965

In the equations: the semimajor axis (a) is in km; the eccentricity (e) would be 0.00 for a circular orbit and 1.00 for a parabolic orbit; the inclination (i) exceeds 90° due to the retrograde sense of the orbit; the longitude of perigee (π) is the algebraic sum of the right ascension (R.A.) of the node and the argument of perigee; the anomalistic period is in mean solar minutes; and the symbol t is the number of mean solar days elapsed since the epoch.

The fifth observation was made with optical aid, but the sixth was by naked eye only. These further observations made it possible to improve the determination of the orbits, and osculating orbits were distributed to about twenty individuals and astronomical agencies.

During most of 1965, no one else reported to me that they had seen the object. Then Hartmann and I made the seventh observation, and this further extended the orbit description. It also led to another period of evening twilight surveillance, which resulted in an eighth observation being made and further orbital refinement. These new results on orbits were recently distributed to thirty individuals and astronomical agencies, but so far no one else has reported an observation to me. It is probable that the object decayed in the Earth's atmosphere during January 1966. The orbital elements are given in Table 2.

JOHN P. BAGBY

Research and Development Division,
Hughes Aircraft Co.,
Culver City, California.

¹ O'Keefe, J. A., *Sci. Amer.*, **210**, 2, 50 (1964).

² Baker, jun., R. M. L., *Science*, **128**, 1211 (1958).

³ Chant, C. A., *Roy. Astro. Soc. Canad.*, **7**, 145, 404, 438 (1913). Mebane, A. D., *Science*, **118**, 725 (1953). Pickering, W. H., *Popular Astro.*, **30**, 632 (1922); *ibid.*, **31**, 96 (1923).

⁴ Kohman, T. P., *et al.*, *Science*, **149**, 1055 (1965).

⁵ Bagby, J. P., *Planet. Obs. Bull.*, **3**, 11 (1955). Bagby, J. P., *Twentieth Century Obs.*, **1**, 7 (1956).

⁶ Metcalfe, E. (personal communication).

GEOPHYSICS

Temperature and Fractional Melting in the Upper Mantle

THE velocities of compressional (V_P) and distortional (V_S) seismic waves, through the Earth's upper mantle, were computed with much detail by Gutenberg¹, who found the existence of a low-velocity layer at depths greater than about 70 km.

At least in the lower mantle, where the thermal gradient is expected to be nearly constant, Bullen² found that the bulk modulus (κ) and the rigidity (μ) have a reasonably linear variation with depth, or with pressure which may be considered proportional to depth. Therefore, it was

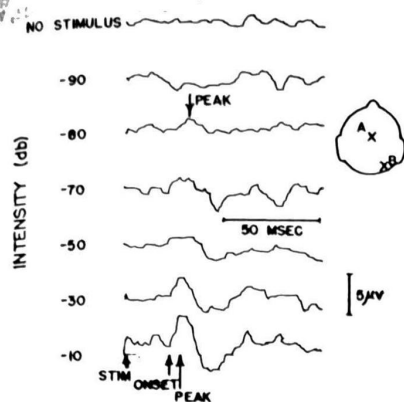


Fig. 1. Computed average responses to monaural, periodic clicks obtained from scalp electrodes for several stimulus intensities. Each trace represents the waveform of the average response to 400 individual presentations of identical click stimuli; the stimuli were presented at a rate of 1.5 per second. Upward deflection indicates that electrode A is positive with respect to electrode B. (Subject W.P., awake, eyes open, 10 Sept. 1957.)

the ongoing activity and are usually too small to be seen by direct inspection of the electroencephalogram (EEG). However, by use of different optical and electronic techniques, "average responses" to somatosensory (1), visual (2, 3), and auditory stimuli (4) have been obtained.

By the use of two different electronic averaging devices (5, 6) we have obtained responses to acoustic clicks from ordinary scalp electrodes in man. These average responses (see Fig. 1) are characterized by onset latencies of approximately 20 msec and peak latencies of approximately 30 msec and by response amplitudes and latencies that depend upon the intensity and the rate of presentation of the stimulus. The threshold for the appearance of a detectable average response agrees closely with the minimum intensity at which the subject reports that he hears clicks. Other response components with much longer latency [which may be identical with the so-called K-complex (7)] have been observed but are not described in this report (8).

Average responses with the latencies that we have given have been obtained from many of our experimental subjects. A given subject, under comparable conditions, yields similar average responses when he is tested repeatedly. The experiments were all performed in a sound-proof room, and the clicks were introduced to the subject through an earphone. Controls have been run that rule out eyeblinks as a source of artefactual responses. Responses are obtained from locations that are widely distributed over the scalp. The response to monaural

clicks is bilateral: electrodes placed symmetrically about the midline record virtually the same response. Our onset latencies are comparable to those measured by Dawson (1) for evoked responses to somatosensory stimuli and to those determined by Brazier (3, 5) for the visual system. These data, and the latency of the surface-negative component of evoked responses to clicks, in cats and monkeys, suggest that the responses which we obtain are cortical in origin. The fact that these responses can be obtained from many places on the scalp may reflect the deep location of the auditory cortex in man.

Figure 1 illustrates that, as the click intensity is increased, the peak amplitude of the response increases, while the peak latency tends to decrease. In other experiments we have varied the rate of presentation of the stimulus. Responses have been obtained for click rates as high as 10 per second, although the peak-to-peak amplitude of the most prominent component of the response tends to decrease with increasing rate.

It is interesting to compare, for a given subject, the psychophysical threshold with the stimulus intensity at which an extracranial response can first be detected with the aid of our averaging device. In subject W.P., the response is present, first, at -80 db (Fig. 1). Subject W.P.'s psychophysical threshold, as determined during the same experiment, is approximately -85 db. Other subjects have exhibited a similar correspondence between psychophysical thresholds and extracranially detectable responses.

C. D. GEISLER

L. S. FRISHKOPF*

W. A. ROSENBLITH

Research Laboratory of Electronics,
Massachusetts Institute of Technology,
Cambridge

References and Notes

1. G. D. Dawson, *J. Neurol. Neurosurg. Psychiat.* 10, 134 (1947).
2. W. Cobb and G. D. Dawson, "The form and latency in man of the occipital potentials evoked by bright flashes," *Intern. Physiol. Congr. 20th Congr. Abstr. Commun.* (1956), p. 182.
3. M. A. B. Brazier, "Studies of evoked responses by flash in man and cat," in *Reticular Formation of the Brain* (Little, Brown, Boston, Mass., 1958), pp. 151-168.
4. M. Abe, *Tōhoku J. Exptl. Med.* 60, 47 (1954).
5. J. S. Barlow, *Electroencephalog. and Clin. Neurophysiol.* 9, 340 (1957).
6. W. A. Clark, Jr., "Average response computer (ARC-1)," *Quart. Progr. Rept.*, Research Laboratory of Electronics, Massachusetts Institute of Technology (15 April 1958), pp. 114-117.
7. P. A. Davis, *J. Neurophysiol.* 2, 494 (1939).
8. This work was supported in part by the U.S. Army (Signal Corps), the U.S. Air Force (Office of Scientific Research, Air Research and Development Command), and the U.S. Navy (Office of Naval Research).
- * Present address: Rockefeller Institute for Medical Research, New York, N.Y.

6 October 1958

Ephemeral Natural Satellites of the Earth

Abstract. A discussion is presented of transient or short-lived natural satellites of the earth, which result from meteoroids that only graze our atmosphere. Preliminary calculations show that only about 1 percent of the total number of the porous stony meteorites which strike the earth will result in natural satellites. It is noted that such satellites also would be difficult to detect observationally.

In 1957 and 1958, the United States and the Soviet Union, in conjunction with the International Geophysical Year, have established several small artificial terrestrial satellites. The fascinating question arises as to whether these objects may be accompanied in their journey through space by certain "natural" satellites—that is, satellites that nature itself is continually contributing to the earth.

These natural satellites, if they do in fact exist, would originate from "near miss" meteoritic trajectories that only graze the atmosphere of the earth, the meteorites being slowed sufficiently to enter onto a geocentric elliptical orbit. The natural satellite will not, of course, remain in its orbit indefinitely but, under the dissipative effects of drag, will spiral down to the surface of the earth or be consumed in flight. It is noted that there are other mechanisms for capture of natural satellites involving the attraction of the moon, the Poynting-Robertson effect, and so on; these processes are not analyzed in this report.

When first confronted by the suggestion of the existence of natural meteoritic satellites, one might hastily compute that the energy per gram that must be dissipated in order to slow a meteorite of any mass from escape speed to surface circular-satellite speed would be 31.2×10^{10} erg/g; moreover, reference to tables of heats of vaporization indicates that at most 10×10^{10} erg/g could be removed by vaporizing meteoritic material. However, then, could a meteorite become slowed sufficiently to assume a satellite orbit without becoming annihilated by aerodynamic heating?

In order to answer this question, one must recognize the fallacy of accounting for only the initial and the final energy of the meteorite. Actually, the whole meteoritic system, including the vaporized material, must be analyzed, and the conservation of energy must be applied in greater generality. In this connection the question can be clarified most directly by recourse to a simplified meteoritic model.

Let us assume that the meteorite loses no energy by radiation, conduction, sputtering, or any process other than direct vaporization, and that it moves in transitional flow. In order to account for the energy input to the meteorite, let us em-

remained still for an instant, swaying slightly.... After a few seconds' pause, it wobbled like the first four and took off like a flash toward the north.... During this time the luminosity of the cigar had faded, and the gigantic object, which may have been 300 feet long, had sunk into darkness. The spectacle had lasted for about three quarters of an hour" (Michel, 1958). Two police officers and an Army engineer separately observed the strange spectacle.

A similar event—though this time in daylight—occurred three weeks later, on September 14, in the department of Vendee 250 miles southwest of Paris. The witnesses numbered in the hundreds, scattered over small towns and farms in the region. At 5 P.M., according to farmer Georges Fortin, "all at once, emerging from the thick layer of clouds that looked like a storm coming up, we saw a sort of luminous blue-violet mist, of a regular shape something like a cigar or carrot. Actually, the object came out of the layer of clouds in an almost horizontal position, slightly tilted toward the ground and pointing forward (like a submerging submarine). This luminous cloud appeared rigid. Whenever it moved (and its movements had no connection with the movement of the clouds themselves) it did so all of a piece, as if it were actually some gigantic machine surrounded by mists." The luminous cloud dropped suddenly from the ceiling of clouds, and then "it stopped, and the point rose quickly until the object was in a vertical position." Then white smoke reminiscent of a vapor trail extended from the lower end of the cloud cigar. The trail fell toward the ground, then turned around, ascended, and circled the vertical cigar in an upward spiral, then did the same as it descended. The exhaust trail vanished, and now, Fortin reported, the witnesses could see the "object that was 'sowing' it: a little metallic disc." The disc flew away and passed over the valley at a low altitude, darting in various directions before returning to the cigar and disappearing into its lower section. The cigar then assumed a horizontal position and flew away, vanishing into the distance (*ibid.*).

These sightings and others like them took place during the great French UFO wave of the late summer and fall. Such phenomena were not confined to France, however. As Jacques Vallee has written, these kinds of sightings "have been associated with every

important phase of UFO activity and have been reported in every country, from Portugal to Greece and the U.S.S.R. as well as Australia, New Zealand, South America and the United States" (Vallee, 1965). In one of the most famous cases, on October 4, 1960, the Rev. Lionel Browning, an Anglican minister and Tasmanian Secretary of the World Council of Churches, and his wife saw a 300-foot-long, dull-gray cigar just under a bank of clouds over Cressy, Tasmania. From those clouds, just behind the ship, five or six small discs shot with great speed, coming "towards the ship like flat stones skipping along water"—exactly how the UFOs were described in **Kenneth Arnold's sighting**. Another observer, Doris Bransden, said, "It was a fantastic sight—like a lot of little ships flocking around a bigger one" ("Flying Saucers," 1961; McDonald, 1968).

Sources:

"Flying Saucers Over Tasmania." *Flying Saucer Review* 7,2 (March/April 1961): 27-28.

Hall, Richard H., ed. *The UFO Evidence*. Washington, DC: National Investigations Committee on Aerial Phenomena, 1964.

McDonald, James E. *UFOs—An International Scientific Problem*. Tucson, AZ: The Author, 1968.

Michel, Aimé. *Flying Saucers and the Straight-Line Mystery*. New York: Criterion Books, 1958.

—. *The Truth About Flying Saucers*. New York: Criterion Books, 1956.

Vallee, Jacques. *Anatomy of a Phenomenon: Unidentified Objects in Space—A Scientific Appraisal*. Chicago: Henry Regnery Company, 1965.

CLYDE TOMBAUGH SIGHTING

In January 1930 astronomer Clyde W. Tombaugh discovered the planet Pluto. At 10:45 on the evening of August 20, 1949, he, his wife, and his mother-in-law saw something potentially as important to science. The three observers were gazing at the stars from the backyard of the Tombaughs's Las Cruces, New Mexico, home when the event occurred. According to Tombaugh:

I happened to be looking at the zenith ... when suddenly I spied a geometrical group of faint bluish-green rectangles of light similar to the "Lubbock lights" As the group moved south-

southeasterly, the individual rectangles became foreshortened, their space of formation smaller (at first it was about one degree across, twice the diameter of the full moon), and their intensity duller, fading from view at about 35 degrees above the horizon. Total time of visibility was about three seconds. I was too flabbergasted to count the number of rectangles of light, or to note some other features I wondered about later. There was no sound. I have done thousands of hours of night sky watching, but never saw a sight so strange as this. The rectangles of light were of low luminosity; had there been a full moon in the sky, I am sure they would not have been visible....

My wife thought she saw a faint connecting glow across the structure. The illuminated rectangles I saw did maintain an exactly fixed position with respect to each other, which would tend to support the impression of solidity ("Dr. Clyde Tombaugh," 1957).

In 1953 astronomer and UFO debunker Donald H. Menzel "hazard[ed] [a] guess ... that a low, thin layer of haze or smoke reflected the lights of a distant house or some other multiple source" (Menzel, 1953). Tombaugh rejected his colleague's suggestion, however, writing, "I doubt that the phenomenon was any terrestrial reflection, because in that case some similarity to it should have appeared many times... [but] nothing of the kind has ever appeared before or since" ("Dr. Clyde Tombaugh," *op. cit.*).

Over the years Tombaugh expressed radically conflicting opinions about the significance of what he had observed. In January 1957 Associated Press quoted him as explicitly endorsing the reality of interstellar visitation: "Although our own solar system is believed to support no other life than on earth, other stars in the galaxy may have hundreds of thousands of inhabitable worlds" ("Celestial Visitors," 1957). When interviewed soon afterwards by Jim and Coral Lorenzen of the **Aerial Phenomena Research Organization (APRO)**, Tombaugh complained about all the mail the story had generated; he said he would talk with them only if he was not quoted. The Tombaughes entertained the Lorenzens at their home on the evening of May 5, again on condition that the as-

tronomer not be quoted. The Lorenzens reported only that Tombaugh "feels that the subject [of UFOs] warrants sincere scientific investigation but feels compelled to steer clear of the situation himself since previous commitments prevent him from doing a thorough job" ("Lorenzens Guests," 1957). That same year Tombaugh told ufologist **Leonard H. Stringfield**, "I think that several reputable scientists are being unscientific in refusing to entertain the possibility of extraterrestrial origin and nature. It is yet too early for any decision of finality" (Stringfield, 1957).

A few years later Tombaugh produced a statement which, his earlier rejection of the theory notwithstanding, in effect endorsed Menzel's atmospheric-reflection idea. Entirely reversing a prior statement, he contended that the fact that he had never seen anything like it before or since suggested it was a natural phenomenon, albeit a "comparatively rare" one. For logistical reasons he considered visitation from other solar systems virtually impossible (Menzel and Boyd, 1963). Then 12 years later, in yet another reversal, Tombaugh said that he had no explanation for what he had seen; it was "still a very open question" (Stuckey, 1975).

Tombaugh had a second sighting, apparently at some point a year or two after the first, and confided it to astronomer and **Project Blue Book** consultant J. Allen Hynek, who wrote in a classified memo: "[W]hile at Telescope No. 3 at White Sands [Proving Ground], [Tombaugh] observed an object of -6 magnitude (four times brighter than the planet Venus at its brightest) travelling from the zenith to the southern horizon in about three seconds. The object executed the same maneuvers as the nighttime luminous object" he had seen earlier (Hynek, 1952).

Sources:

- "Celestial Visitors May Be Invading Earth's Atmosphere." *Alamogordo Daily News* (January 27, 1957).
- Darrach, H. B., Jr., and Robert E. Ginna, Jr. "Have We Visitors from Space?" *Life* (April 7, 1952): 80-96.
- "Dr. Clyde Tombaugh Provides Details on His Own Famous Sighting." *CSI News Letter* 10 (December 15, 1957): 27.
- Hall, Richard H., ed. *The UFO Evidence*. Washington, DC: National Investigations Committee on Aerial Phenomena, 1964.

Hynek, J. Allen. *Special Report on Conferences with Astronomers on Unidentified Aerial Objects to Air Technical Intelligence Center, Wright-Patterson Air Force Base* (August 6, 1952).

"Lorenzens Guests at Tombaugh Home." *The A.P.R.O. Bulletin* (May 1957): 1.

Maney, Charles A., and Richard Hall. *The Challenge of Unidentified Flying Objects*. Washington, DC: The Authors, 1961.

Menzel, Donald H. *Flying Saucers*. Cambridge, MA: Harvard University Press, 1953.

Menzel, Donald H., and Lyle G. Boyd. *The World of Flying Saucers: A Scientific Examination of a Major Myth of the Space Age*. Garden City, NY: Doubleday & Company, 1963.

Michel, Aimé. *The Truth About Flying Saucers*. New York: Criterion Books, 1956.

Stringfield, Leonard H. *Inside Saucer Post ... 3-0 Blue*. Cincinnati, OH: Civilian Research, Interplanetary Flying Objects, 1957.

Stuckey, W. "The Man Who Discovered Planet X." *Science Digest* 78 (August 1975): 54-61.

"Tombaugh—Satellites and Spaceships." *The A.P.R.O. Bulletin* (January 1957): 1-2.

CRASHES OF UFOs IN THE NINETEENTH CENTURY

Though reports and rumors of crashed UFOs have circulated widely since the beginning of the modern era, following **Kenneth Arnold's sighting** in 1947, it is less well known that comparable stories were being told over a century ago.

Giants from another world. The earliest known crash-landing of an extraterrestrial spacecraft is said to have taken place in 1862. The report was published as a letter to the editor in the *Houston Daily Post* for May 2, 1897, just as a wave of turn-of-the-century reports of mystery **airship sightings** (usually though not always assumed to be of secret terrestrial inventions) was winding down. The letter, written by John Leander of El Campo, Texas, and dated April 29, reads in part:

There is an old sailor living now in El Campo with his daughter who has proclaimed that he had not only seen the vessel but had actually seen people from another world. His immediate relatives have known of the circumstances for some years, but he says the story has never

been published. The name of the old gentleman is Mr. Oleson, and for many years he was a boatswain in the Danish navy, but at the time he saw the airship he was a mate on the Danish brig *Christine*.

In September 1862, the *Christine* was wrecked in the Indian ocean on a desert rock or island several miles in size. This rock is set down on charts of the ocean, but is not mentioned in geographies.

A furious storm had raged for hours and the ship was swept far from her course when this immense rock loomed ahead amid the deafening roar of the breakers. A great wave dashed Mr. Oleson high on the rocks and for a long time he was insensible. When he recovered he found five of his companions had been saved, though they were more or less injured, and one man died of his injuries.

They collected their faculties and found themselves confronted by starvation, since there was not a vestige of vegetation or animal life on the rock. They found plenty of fresh rain water in holes, which revived them very much.

They had given up all hope and had clustered at the base of a cliff waiting for the awful end, while the wind howled and the furious waves dashed on the rock.

Suddenly another terror was added to the horrors of the scene, for high in the air they saw what seemed to be an immense ship driven, uncontrolled in the elements. It was driving straight toward the frightened mariners, who cried aloud in their despair. Fortunately, however, a whirl of wind changed the course of the monster and it crashed against the cliff a few hundred yards from the miserable sailors.

Speechless with fear, they crept toward the wreck. It seemed a vessel as large as a modern battleship, but the machinery was so crushed that they could form no idea as to how the power was applied to the immense wings or sails, for they could plainly discern the fact that it was propelled by four huge wings. Strange implements and articles of furniture could be

LAUREL PLANTATION, I think I must have been, startled. At Christmastime his spirit rose
led up every word of his eccentric and
I remember passed along in such a
long for the pleasure of knowing
I then voice were being heard all the
into the valley.

Misery & Miranda P's last week it was they who had won the first round in the Battle of Castelpoint. Between six and ten people were attending daily. Since a second one came on Sunday. A day nursery has been organized, a social assistance program had been set up by landowner for the village poor, a television set from Benevento was functioning and a social hall, a sewerage system and a street tree were in the planning stage.

The Dominicans reacted in a story comprising him to Don Camilla Humarides Cassano, Carmichael funny little Communist fighter who has often found real life counterparts in postwar Italy. "This is very comical," says Don Dominico. "Here we must deal with real Communists and you outsiders. In the year of Our Lord past, we no longer content with misery here because they want progress and this is America, it is just it is Christian."

Universal Pope

No Pope in modern history has so perfectly cultivated the universality of the Roman Catholic Church as Pius XII. No Pope since the church began has been so well served by so many people.

During the past year, the Vatican and the Holy See have separated. Pope Pius XII and his people, his audience, delivered his message of human speech and understanding, and to mention minor details. The visitors comprised all ages, colors, and faith. Before his presence, the Pope discussed problems of child labor, the forced marriage, and the role of the Italian automobile club on the road. He received Germany's Foreign Minister, Bishop Otto Disler, and the American Foreign Commissioner, Lawrence, the secretary of Lombardy, the American secretary of the U.S. government from the U.S. and officials of the U.N. Chief of the International League on President John F. Kennedy, who he met him as did the new President, Nehru of India. The Pope's personal Italian Ambassador, Amato, during the month International Automobiles, I mentioned to whom he said that he would to explore the situation and help. (The Italian Club)

[illegible][illegible]

No Satellite in Sight

[illegible]

Approved: _____

[illegible][illegible][illegible]

1. The first group of people who are interested in the study of the history of the United States are the people who are interested in the history of the United States.

Since we have a Schmidt telescopic camera is sensitive that it could photograph a tennis ball, half in by the sun, 5000 miles away on a V-2 rocket at the distance of the moon. It covered a 15° field of view; the apparent diameter of the full moon and a complicated focusing mechanism serving to freeze the sky, fast for nearly crystalline elements for crystalline further away. For its class the camera showed as sharp. A negative of one had been found might have shown a dot or a short track.

Flows & Asteroids In three years of patient searching, covering most of the space near the apex 10 to 15 million miles from the surface only a few comets were first spotted in the near constant phase. Most of these passed in the days in the place no small asteroids causing good the earth. There is still a chance that the remainder may have been available some time in the a good picture and Dr. Tamm might have not.

Last summer the apparatus was transported and shipped to Santa Barbara where since then the equator can be observed between the parallels of just a few miles. This region which cannot be photographed from beyond a distance of twenty miles is the most interesting and rare of the solar system in being crossing low over the

The Young in Space

The first condition considered here is
as it went into the production and demand
for the three good causes together. Does
it look like the kind of an increase is
shown in the demand for the three
causes and for the three and three
causes but the three and the three
have not been considered as the
of the three and the three and the
three and the three and the three
three and the three and the three
three and the three and the three

There is no doubt that the above mentioned "Threats" are serious and that they are a real danger to the life of the people of the United States. It is the duty of the Government to take the necessary steps to protect the people from these threats. The Government should take the following steps:

1. To increase the number of troops in the United States.
2. To increase the number of troops in the United States.
3. To increase the number of troops in the United States.
4. To increase the number of troops in the United States.
5. To increase the number of troops in the United States.
6. To increase the number of troops in the United States.
7. To increase the number of troops in the United States.
8. To increase the number of troops in the United States.
9. To increase the number of troops in the United States.
10. To increase the number of troops in the United States.

The Government should take the necessary steps to protect the people from these threats. The Government should take the following steps:

1. To increase the number of troops in the United States.
2. To increase the number of troops in the United States.
3. To increase the number of troops in the United States.
4. To increase the number of troops in the United States.
5. To increase the number of troops in the United States.
6. To increase the number of troops in the United States.
7. To increase the number of troops in the United States.
8. To increase the number of troops in the United States.
9. To increase the number of troops in the United States.
10. To increase the number of troops in the United States.

[illegible][illegible]

Terrestrial Satellites: Some Direct and Indirect Evidence

JOHN P. BAGBY

Research and Development Division, Hughes Aircraft Company, Culver City, California 90230

Communicated by A. G. Wilson

Received July 2, 1968

Several telescopic and photographic observations have been accumulated since 1947 which suggest that the Earth has at least ten close natural moonlets which broke off from a larger parent body in late 1955. A series of puzzling disturbances in the orbits of many artificial satellites now appear to be explainable as due to perturbations by these natural bodies.

INTRODUCTION

Several investigators (Baker, 1958; Pohle, 1964; O'Keefe, 1964) have attempted to show theoretically how the Earth might capture small natural satellites. Some workers (Tombaugh, 1961; Bagby, 1956) have conducted searches for natural satellites. Others (Chant, 1913; Mebane, 1953; Kordylewski, 1961; Bagby, 1960, 1966, 1967) have suggested that such objects exist or have even been observed. The existence of such objects has never been generally accepted, however, except for the Kordylewski cloud satellites believed to reside at the two LaGrange points in the Moon's orbit (60 degrees ahead of and behind the Moon). Research that I have been engaged in since 1956 now suggests that there may be several substantially large natural objects orbiting the Earth in similar orbits. These all appear to be fragments of a larger parent satellite which broke up about mid-December 1955.

DIRECT OBSERVATIONS

Originally, the orbits of the suspected natural satellites were computed from the first few direct observations alone. These first observations are summarized in Table I. A simple and direct approach to orbital solution from a minimum number of observations for Earth satellites has been proposed by Briggs and Slowey (1959). The particular orbital computation

method that I use, however, is an original graphical and analytical trial-and-error solution previously discussed (Bagby, 1960) for circular Earth orbits. It has been further refined for elliptical Earth orbits as a result of studying Kozai (1959b, pp. 14-15) and Baker and Makemson (1960). At first, there were several different possible orbits for the bodies. As more observations were accumulated, the number of possible orbits was finally reduced to three particular sizes and shapes with minor differences in orientation between the orbits of the individual bodies.

A thorough photographic and visual search for the first of these three orbit sizes and shapes was made by myself with the aid of others during the period 1957 to 1963, and the results were decisively negative. The entire periphery of this first orbit was covered three times over. The second possible orbit is theoretically and practically implausible. This leaves only the third orbit as a probable solution. Before a search for this orbit could be organized, new information came from an unexpected source, discussed below, which not only indicated the proper orbit size and shape but made it possible to further refine the orbital elements of the individual objects. I now propose that the first two observations listed in Table I are of a parent body, that the third and fifth observations and the fourth and sixth

TABLE I
DIRECT OBSERVATIONS OF PROPOSED NATURAL SATELLITES^a

Observation:	I	II	III	IV	V	VI
Year	1947	1952	1956	1956	1957	1957
Date, UT	Sep 23 $\pm$ 1	Jan 21	Jan 31	Jan 31	May 4	May 4
Universal Time (hr)	06.0 $\pm$ 1.0	15.78	11.63	11.73	03.83	03.83
Latitude, N (degrees)	47.58	33.96	42.33	42.33	42.03	42.03
Longitude, W (degrees)	122.33	118.35	83.12	83.12	87.75	87.75
Right ascension (degrees)	304.5	302.76	180.51	180.56	194.3	197.5
Declination (degrees)	-24.7	-20.04	-5.55	-5.57	+17.5	+14.3
Position angle (degrees)	No record	57.8 $\pm$ 5	45 $\pm$ 8	45 $\pm$ 8	Ambiguous	Ambiguous
Rate of motion (deg/min)	2.0 $\pm$ 1.0	0.5 $\pm$ 0.1	1.6 $\pm$ 0.3	1.6 $\pm$ 0.3	0.9 $\pm$ 0.1	0.9 $\pm$ 0.1
No. of objects	1	1	6	4	4	4
Aperture of instrument (cm)	8.9	10	15.2	15.2	8.4	8.4
Observer	J. M. Hammond	T. A. Cragg	D. Craig	D. Craig	J. P. Bagby	J. P. Bagby

^a The position angle (of travel) is the stellar direction in which the objects appeared to be moving, where stellar "north" would be 0 degrees and stellar "east" would be 90 degrees, etc.

observations are of two distinct groups (A and B, respectively) of the objects, with four or more members in each group. Finally, I suggest that the new information discussed below indicates the existence of further subgroups (C through F) consisting of one or more members each. When projected backward in time, the orientation of the orbits of groups A and B, as derived from the data in Table I, converge on about December 18, 1955. It is assumed that this is the date when the parent body broke up.

INDIRECT EVIDENCE

From an analysis of the considerable amount of published data on the orbits of artificial satellites, I have recently found that many sudden anomalies have been occurring in the orbital elements of a large number of the artificial bodies. These changes are often quite drastic and of a semipermanent nature. To my knowledge, they have not been previously noted or discussed. Inclinations have changed by up to tenths of a degree, apogees and perigees have fallen and increased from tens to hundreds of kilometers, and the lines of nodes and apsides have changed their orientation by up to $\pm 50\%$ of the normal

rate. These anomalies are most easily seen by plotting the published tabular data. A typical example is shown in Fig. 1 for the orbit of Telstar 1. The curious thing about such sudden anomalies is that so far as is

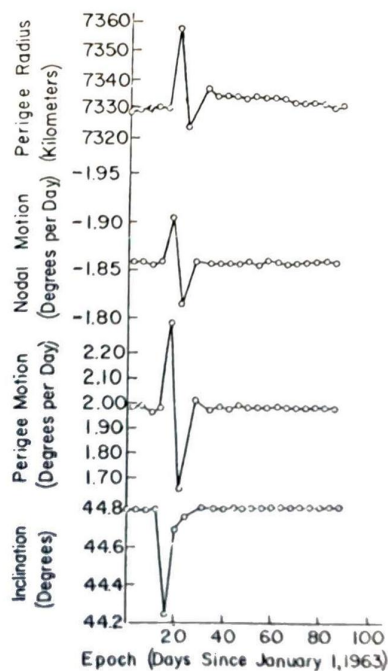


FIG. 1. Behavior of some Telstar 1 orbital parameters in early 1963.

known over 90% epochs when one or proposed natural intersecting the bodies affected. U one or more close artificial bodies c would be possibl artificial satellites to reach the comm the same time.

When the orbit surate with each such as 1:3, 1:2, 3: passages could ta period of time. If is possible betwee objects, then for very serious pertu the orbit of the les. Such a resonant ef case of the gaps ir caused by its larg p. 25; Russell *et al* known in the ca asteroid belt caus (Brandt and Hodg 1956, pp. 18-19). I perturbing force i. In the present ca may be gravitatio to be electrostatic discussed further perturbations of t lites affected app from a consider accepted perturb Earth space.

METHOD

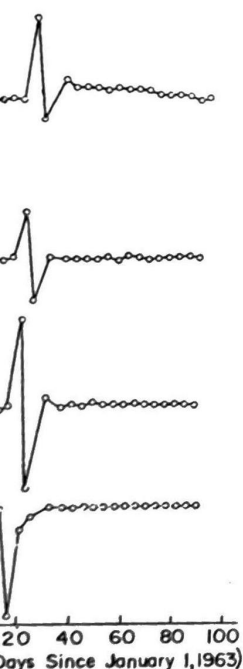
A study of the c anomalies in the o bodies has even p the orbital eleme groups of propos anomaly data we Smithsonian Ins Observatory Spec When the best k of the natural b direct observation be correct, and a

SATELLITES^a

V	V	VI
56	1957	1957
31	May 4	May 4
73	03.83	03.83
33	42.03	42.03
12	87.75	87.75
56	194.3	197.5
57	+17.5	+14.3
± 8	Ambiguous	Ambiguous
± 0.3	0.9 ± 0.1	0.9 ± 0.1
	4	4
.2	8.4	8.4
J. P.	J. P.	J. P.
aig	Bagby	Bagby

objects appeared to be moving.
degrees, etc.

anomalies are most easily seen
published tabular data. A
is shown in Fig. 1 for the
1. The curious thing about
anomalies is that so far as is



of some Telstar 1 orbital
1963.

known over 90% have taken place at epochs when one or more of the orbits of the proposed natural satellite subgroups was intersecting the orbits of the artificial bodies affected. Under these conditions, one or more close passages of natural and artificial bodies could take place. This would be possible if the natural and artificial satellites in their own orbits were to reach the common intersection point at the same time.

When the orbit periods are commensurate with each other in simple ratios, such as 1:3, 1:2, 3:8, 5:7, etc., several close passages could take place within a short period of time. If an accelerative coupling is possible between natural and artificial objects, then for commensurate orbits a very serious perturbation could result in the orbit of the less massive artificial body. Such a resonant effect is well known in the case of the gaps in Saturn's rings that are caused by its largest moons (Baker, 1960, p. 25; Russell *et al.*, 1945, p. 391). It is also known in the case of the gaps in the asteroid belt caused by the planet Jupiter (Brandt and Hodge, 1964, p. 287; Watson, 1956, pp. 18-19). In both of these cases, the perturbing force is gravitational coupling. In the present case, the perturbing force may be gravitational, but it is more likely to be electrostatic or electromagnetic, as discussed further below. These sudden perturbations of the many artificial satellites affected appear to be unaccountable from a consideration of the generally accepted perturbing conditions in near-Earth space.

METHOD OF ANALYSIS

A study of the circumstances of over 150 anomalies in the orbits of different artificial bodies has even permitted a refinement of the orbital elements of the several subgroups of proposed natural bodies. These anomaly data were found in the series of Smithsonian Institution Astrophysical Observatory Special Reports (1960-1967). When the best known orbital parameters of the natural bodies—derived from the direct observations alone—are assumed to be correct, and a less well defined element

(such as the argument of perigee) is allowed to vary, then the circumstances of intersection give a unique solution for the less well defined parameter. In this manner, successive approximations can be made until a unique set of orbital elements is derived. I have thus derived the boundaries of the entire family of natural objects as to spread in inclination, right ascension of the node, argument of perigee, and eccentricity. Also derived were mean orbital elements for the six subgroups in particular. This study also indicated that the breakup from the parent body took place about December 18, 1955.

The semimajor axis can be pinpointed best from a resonance study. Taking the 16 artificial objects undergoing the most extreme perturbations, I assumed and computed the commensurability between their period of revolution and that of the natural objects. One of the answers common to this investigation is 4.622 hr, which gives a semimajor axis of 14 065 km for the natural bodies. This is very close to the value of 14 138 km derived from direct observations alone. The artificial satellites used for this resonance analysis were Centaur parts 1963-47E and 1963-47H, Relay 1 rocket, Relay 2 and Relay 2 rocket, Telsar 1 and Telstar 1 rocket, Telstar 2 rocket, Explorer 15, 1962 Kappa 1, 1962 B Kappa 1, 1963-14B, 1963-14H, 1961 Sigma 3, 1963-30B, and 1965-34B. Almost all of these extreme anomaly data came from a study of the semimonthly Goddard Satellite Situation Reports (Goddard, 1964, 1965, 1966, 1967). See Figs. 2 through 7.

RESULTS

Combining all of these data with the required interrelationships of all of the various orbital elements from celestial mechanics theory, I suggest the following elements for the natural satellites. For the parent body before breakup on or about December 18, 1955:

$$\begin{aligned}a &= 14\,065 \text{ km} \\e &= 0.500 \\i &= 42.35\end{aligned}$$

$\Omega = 214 + 0.816(n)$
 $\omega = 95 - 0.954(n)$
 $\tau = \text{December 18, 1955.}$

Here n is the number of days before December 18, 1955.

For the orbital envelope containing all of the known bodies since the breakup on or about December 18, 1955:

$$a = 14\,065 \text{ km}$$

$$e = 0.497 \pm 0.003$$

In these equations, the plus and minus tolerances indicate the spread in the limits in the orbital envelope containing all of the objects rather than the customary probable errors. The letter d represents the number of days since December 18, 1955.

$$i = 42.24 \pm 0.75$$

$$\Omega = 214 - (0.814 \pm 0.011)(d)$$

$$\omega = 95 + (0.963 \pm 0.031)(d)$$

$$\tau = \text{December 18, 1955.}$$

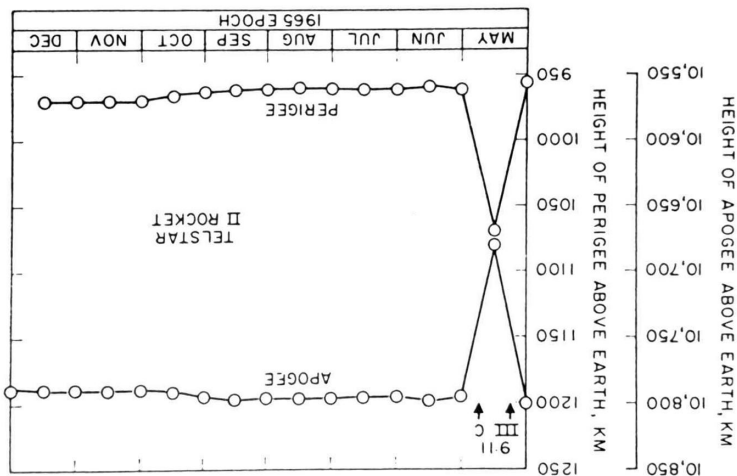


Fig. 2. Orbital parameters of Telstar 2 rocket during part of 1965.

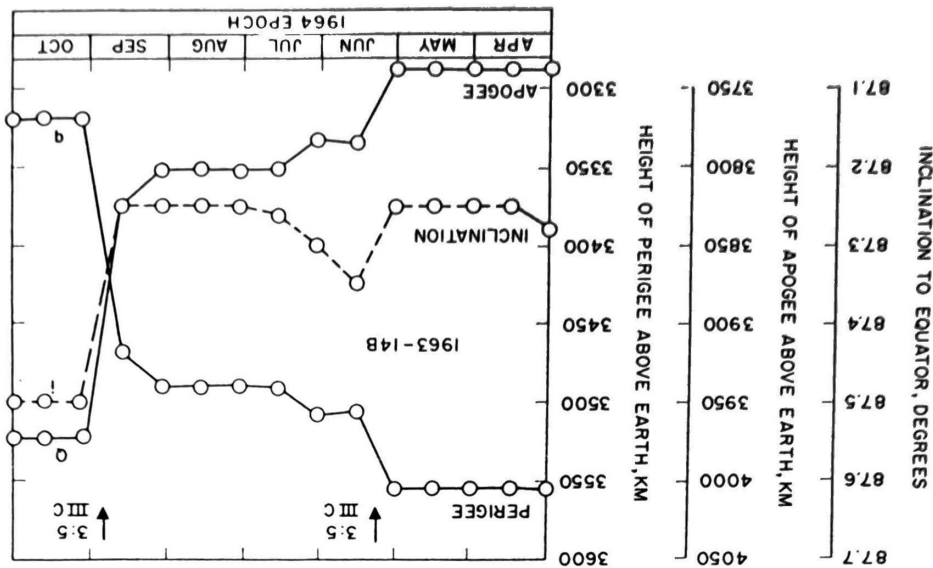


Fig. 3. Orbital parameters of Satellite 1963-14B during part of 1964.

Fig. 1

For all of the

$$a = 14$$

$$e = w$$

$$i = x$$

$$\Omega = 21$$

$$\omega = 93$$

$$\tau = D$$

In these equations
 z are given in
of days since De

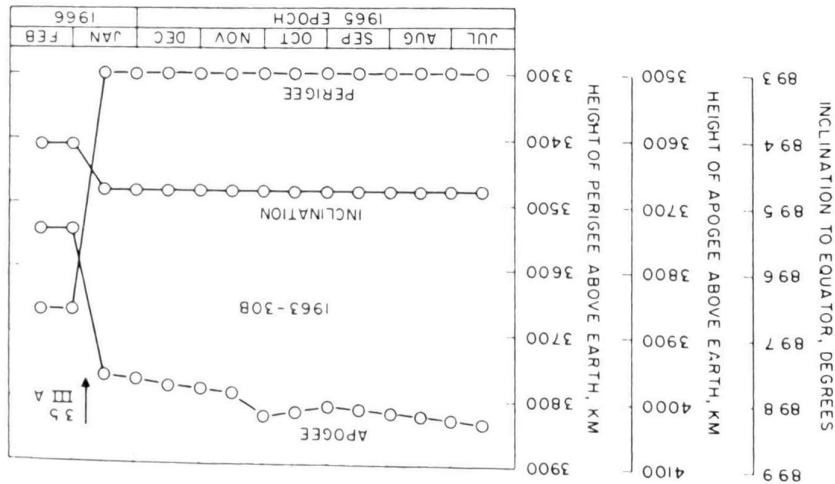


FIG. 4. Orbital parameters of Satellite 1963-30B during late 1965 and early 1966.

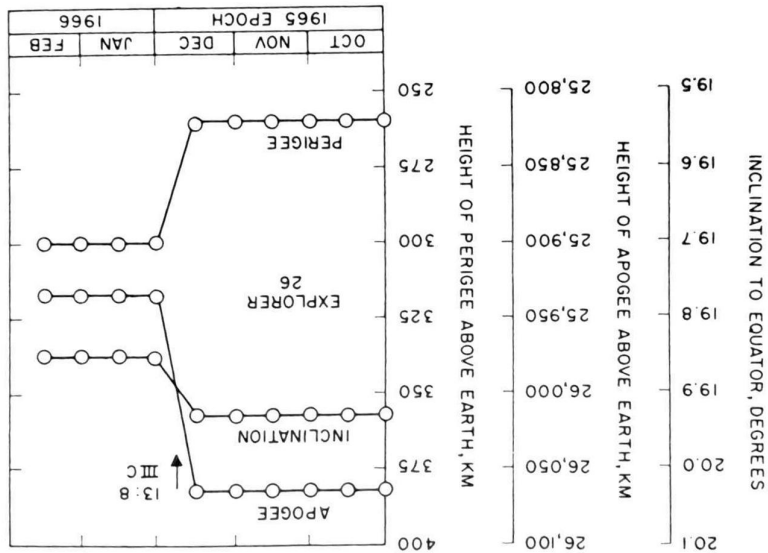


FIG. 5. Orbital parameters of Explorer 26 during late 1965 and early 1966.

TABLE II
PARAMETERS FOR THE ELEMENTS OF THE
VARIOUS SUBGROUPS

Subgroup	w	x	y	z
A	0.500	42.35	0.816	0.954
B	0.498	42.99	0.810	0.932
C	0.495	41.70	0.816	0.979
D	0.493	42.50	0.804	0.937
E	0.498	42.00	0.816	0.967
F	0.498	41.50	0.825	0.994

In these equations, the values w, x, y , and z are given in Table II and d is the number of days since December 18, 1955.

$$\begin{aligned}
 a &= 14\,065 \text{ km} \\
 e &= w \\
 i &= x \\
 \Omega &= 214 - y(d) \\
 \omega &= 95 + z(d) \\
 \tau &= \text{December 18, 1955}
 \end{aligned}$$

For all of the various subgroups:

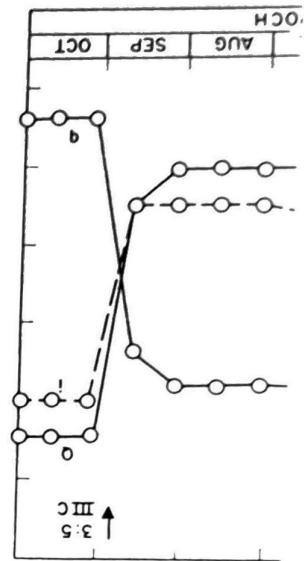
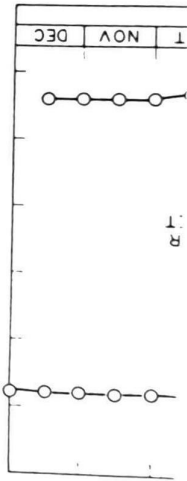


Fig. 6. Orbital parameters of Explorer 26 during late 1965 and early 1966.



ions, the plus and minus to the spread in the limits of the customary probability, the letter d represents the number of days since December 18, 1955.

$$\begin{aligned}
 24 \pm 0.75 \\
 + (0.963 \pm 0.031)(d) \\
 - (0.814 \pm 0.011)(d)
 \end{aligned}$$

December 18, 1955.

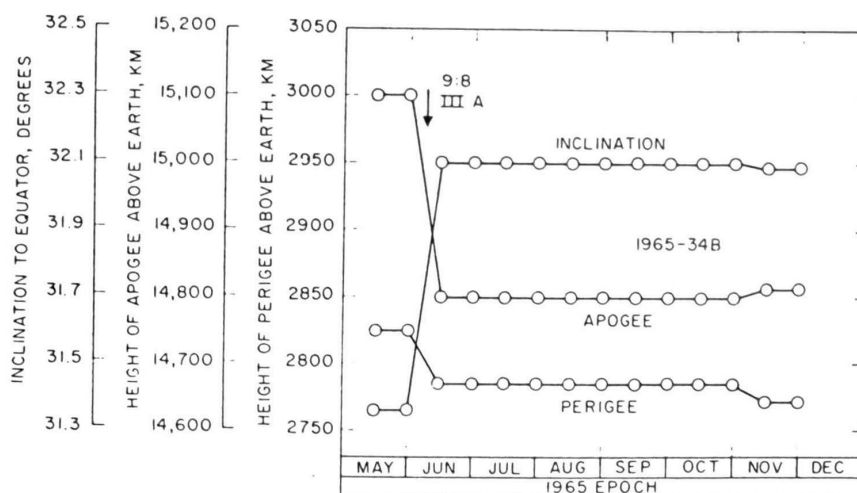


FIG. 6. Orbital parameters of Satellite 1965-34B during 1965.

POSSIBLE MECHANISMS OF INTERACTION

It is of interest to consider the possible mechanisms by which the proposed natural satellites might cause the orbital anomalies of the many artificial satellites so affected. The various anomalies all took place at times of intersection of the orbital paths of the artificial satellites with the paths of one

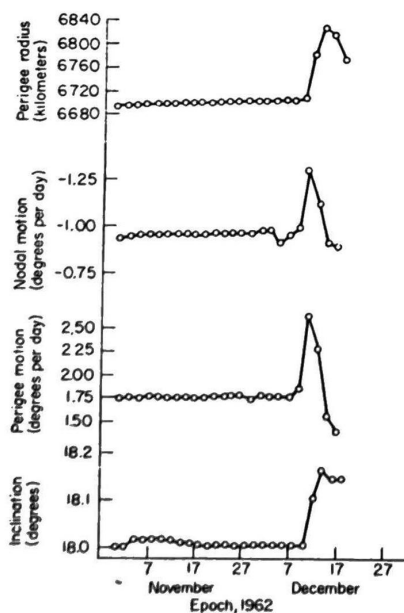


FIG. 7. Behavior of some Explorer 15 orbital parameters in late 1962.

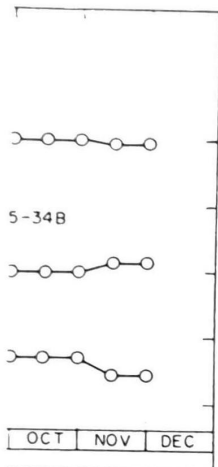
of the natural object subgroups. This would place one or more of the natural bodies in close proximity to an artificial body if both were near the intersection point at the same time. If the periods of the respective orbits were harmonics of each other, then several successive close passages would be possible. Actual physical contact between natural and artificial bodies is most unlikely, of course, but I have considered three possible perturbing mechanisms between the bodies at close-miss distances. The direct observational information suggests a mean diameter for the natural objects of from 7.6 to 30 meters. To illustrate the possible perturbing mechanisms, I will assume a natural body 30 meters in diameter having a specific gravity of 4.0 that reacts with an artificial body 1 meter in diameter having a mass of 45.5 kg.

The first perturbing mechanism considered is gravitational. A close passage (i.e., one in which the separation is no more than 30 meters center to center) of the bodies would give rise to a gravitational interaction of 19.5 dynes. As far as this artificial body is concerned, this amounts to 6.27×10^{-7} of the Earth's pull in orbit. A passage in which the bodies are 1.6 km apart would cause a pull 2.25×10^{-10} that of the Earth on this artificial satellite in orbit.

The second suggested is electrostatic and artificial satellites are charged, as many artificial satellites are in the case, then force would exist between the bodies. This force would exist in the ambient solar length region. The strength of the force could be more or less at any time. Assuming a charge equal to 3.19 e.s.u. per centimeter, I find that a 30 meter separation would give rise to a force of 8.4×10^{-2} of the Earth's pull on an artificial body separation between the bodies would cause a perturbation of the Earth's pull on the satellite in orbit.

The third suggested is electromagnetic. If the objects were electrically charged, an acceleration would be produced by the natural body. The numerical results of the magnetic force are in degrees of constant instantaneous enhancement or reduction.

Using the electrostatic first-order elements of a satellite have been estimated.



ring 1965.

object subgroups. This or more of the natural proximity to an artificial are near the intersection time. If the periods of the were harmonics of each several successive close possible. Actual physical a natural and artificial unlikely, of course, but I three possible perturbing between the bodies at close- The direct observational ests a mean diameter for s of from 7.6 to 30 meters. he possible perturbing ill assume a natural body diameter having a specific t reacts with an artificial diameter having a mass of

urbing mechanism con-ational. A close passage the separation is no more center to center) of the e rise to a gravitational 5 dynes. As far as this concerned, this amounts the Earth's pull in orbit. ch the bodies are 1.6 km e a pull 2.25×10^{-10} that this artificial satellite in

TABLE III
ESTIMATE OF PERTURBATIVE EFFECTS

Exposure (sec)	Range (meters)	Δi	Δq (km)	$\Delta \Omega$	$\Delta \omega$
60	30	0.25°	100	1.4°	1.0°
30	60	0.03°	12	0.17°	0.12°
10	30	0.04°	17	0.23°	0.16°
60	60	0.06°	24	0.34°	0.24°

The second perturbing mechanism suggested is electrostatic. If both natural and artificial satellites are electrostatically charged, as measurements of numerous artificial satellites indicate (Jen, 1965) is the case, then an electrostatic repulsive force would exist between the two types of bodies. This force would be affected by the ambient solar flux in the short-wave-length region. Thus, depending on the strength of the solar radiation, the bodies could be more or less charged at any given time. Assuming a charge on both bodies equal to 3.19 electrostatic units per square centimeter, I find that a close passage (i.e., 30 meters separation center to center) would give rise to a repulsive electrical force of 8.4×10^5 dynes. This amounts to 2.70×10^{-2} of the Earth's pull on this artificial body. A passage in which the separation between the bodies is 1.6 km would cause a repulsive force of 9.70×10^{-6} of the Earth's pull on this artificial satellite in orbit.

The third perturbing mechanism suggested is electromagnetic. If the natural objects were either magnetic themselves or ferrous enough to cause a local anomaly in the Earth's magnetic field, then since it is charged, an artificial satellite would experience an acceleration while passing near a natural body. I have not yet computed numerical results for this case. The electromagnetic force would be subject to varying degrees of coupling, depending on the instantaneous solar flux, which could enhance or reduce such an effect.

Using the forces computed for the electrostatic mode of perturbation, the first-order effects on various orbital elements of a 45.5-kg artificial body have been estimated. These are given in Table

III as a function of average separation distance near the intersection point and the duration of such proximity. The artificial body orbit chosen for this estimate lies midway between Explorer 15 and Telstar 2. The duration times indicated in the table can arise from either a grazing intersection, as is possible in the case of the Telstars or Relays ($i \approx 42^\circ$) or from a resonance condition wherein the natural and artificial bodies arrive simultaneously and repeatedly at the intersection point. Both of these conditions are enhanced when the nodal and apsidal motions of the natural and artificial bodies are related to each other in such a manner as to maintain the intersection circumstances for several days.

EVALUATION

To date no satisfactory alternate explanation has been found for the sudden step changes discovered in the orbits of some 55 of all the artificial Earth satellites for which elements are published. The principal perturbative conditions known to affect close Earth satellites are the atmosphere and its variation with season and latitude (Harris and Spencer, 1965), the Sun and Moon as third bodies (Murphy and Felsentreger, 1965; Kozai, 1959a), the zonal and tesseral harmonics of the Earth's geopotential (Kaula, 1965), and the solar radiation spectrum—both directly (Musen and Squires, 1965, pp. 518–520) and as it affects the atmosphere (Jacchia and Slowey, 1963). All of these influences cause measurable secular or cyclic changes in artificial satellite orbits. In addition, irregular changes in atmospheric drag arise from variations in the decimetric solar

flux. None of these influences cause large step changes, however. Even the Earth's gravitational potential in the case of near-synchronous orbits (having periods that are some multiple of 24 hr) does not cause such perturbations (Blitzer, 1966). Such drastic step changes as are discussed here are usually associated in astronomy with resonance, or a very close passage, to a third body. Many comets which come close to Jupiter, for example, have had their orbits altered repeatedly (Watson, 1956, pp. 50-54).

It might be presumed that the sudden anomalies are due to infrequent or delayed orbit recomputation. In such a case an otherwise smoothly varying parameter would appear to jump occasionally. This can be the case for balloon satellites whose orbits often change quite rapidly. However, most of the artificial body anomalies were found in the Smithsonian Special Reports (1960-1967). For all of these bodies the orbits were recomputed every few days. The orbital parameters of Explorer 15 shown in Fig. 7, for example, were computed every 2nd day, using 8 consecutive days of observations for each orbit recomputation. Thus the anomalies would appear even less intense than they were. As another example take the orbital elements of Telstar I in Fig. 1. Here the elements were computed every 4th day; using 8 consecutive days of observations for computation before January 24, 1963 and using 6 days of observations for each set of elements thereafter. Occasionally artificial satellites have suffered very severe orbital perturbations which have even altered their semimajor axes. Some examples are 1963-30B (Fig. 4), Explorer 26 (Fig. 5), and 1965-34B (Fig. 6). Although the data are from the Goddard Satellite Reports (Goddard, 1964-1967), which are computed every 14 days, such extreme changes could hardly be due to infrequent or delayed computation. Only a close passage to a third body would give rise to a change in the semimajor axis for near Earth orbits. Resonance, or near resonance with the third body would enhance this effect. The particular subgroup associated with a given disturbance and the commensurate

ratio of the natural and artificial bodies' periods are indicated in Figs. 2 through 6.

To date no artificial satellite having an apogee height of less than about 700 km has been drastically perturbed in the manner being discussed. Here (below 700 km) in the most probable region for atmospheric and geopotential disturbances, no sudden step changes have ever occurred. Note, however, that this 700-km boundary height lies approximately at the level of perigee of the natural body subgroups. Thus only artificial satellites exposed to some part of the natural bodies' orbits have been affected. In this study I have excluded artificial objects having apogees exceeding 5 Earth radii or semimajor axes exceeding 3.5 Earth radii. Beyond these distances, bodies are subject to ever increasing lunisolar perturbations. I have also excluded all Soviet satellites and those U.S.A. objects known to have on-board orbit changing capability.

Lest the casual reader assume the bodies under discussion are the only natural Earth satellite suspects, I call attention to evidence of another, but retrograde, natural satellite that has been recently discussed (Bagby, 1966, 1967). Interestingly enough, nearly all of the 10% of the anomalies that are not linked to an intersection with subgroups A through F have been found to be so linked to the orbit of this retrograde satellite on those occasions.

CONFIRMATION OF ORBIT OF NATURAL SATELLITES

Despite the remarkable results obtained using the anomaly circumstances of the 55 different artificial objects so far perturbed, it would be most desirable to confirm the orbits of all the natural bodies by means of further direct observations. Since some 15 artificial Earth satellites and an equal amount of associated hardware have inclinations between 37° and 47°, some filter must be employed to rule them out of consideration in any search plan. The large apogee of the natural bodies makes such a discrimination possible. Of the 30 properly inclined artificial bodies, only Telstar 2 and its rocket approach such a large apogee.

Observation

Date, UT
Year
UT (hr-min-sec)
Latitude, N
Longitude, W
R.A. (hr-min)
Dec. (degrees-min)
Magnitude
SAO 1950
Webb 1920

Even these two short of the subg

A schedule w:
transits of the
near apogee but
Recently, a pho
along the orbit
satellites' subgr
consecutive cle
required to guar
any one orbit
for 1 hr each ex
two sequential
orbit F were re
three sequential
orbit C were rec
fit of these obje
within 0.125%
inclination, ran
range rate.

The camera
aperture Schmi
The field of vie
was +8.5 magn
physical Observ
using Verichro.
Ethol 90 for 21
were 11 sec each
on March 26. J
recent observa
IV.

The orientati
and its rocke
season were s
possible confus
F.

TABLE IV
RECENT OBSERVATIONS

Observation:	1	2	3	4	5
Date, UT	Mar 27	Mar 27	Apr 21	Apr 21	Apr 21
Year	1968	1968	1968	1968	1968
UT (hr-min-sec)	06:14:00	06:21:00	05:40:42	05:46:57	05:54:27
Latitude, N	34.0	34.0	34.0	34.0	34.0
Longitude, W	118.5	118.5	118.5	118.5	118.5
R.A. (hr-min)	10:52	11:17	11:29	11:53	12:22
Dec. (degrees-min)	+34:45	+37:20	+21:30	+25:45	+28:20
Magnitude					
SAO 1950	6.5	7.0	6.0	6.5	6.5
Webb 1920	7.5	8.0	7.0	7.5	7.5

Even these two objects fall some 3700 km short of the subgroups' apogees.

A schedule was prepared for near zenith transits of the various orbit planes while near apogee but out of the Earth's shadow. Recently, a photographic search was made along the orbit planes of two of the natural satellites' subgroups, C and F. Some five consecutive clear moonless nights were required to guarantee complete coverage of any one orbit periphery, photographing for 1 hr each evening. On March 26, 1968 two sequential positions of an object near orbit F were recorded. On April 20, 1968 three sequential positions of an object near orbit C were recorded. When reduced, the fit of these objects to orbits C and F was within 0.125% in both cases as to node, inclination, range, and (for April 20 only) range rate.

The camera employed was an 8.4-cm-aperture Schmidt of 5.7-cm focal length. The field of view was 22°. The plate limit was +8.5 magnitude (Smithsonian Astrophysical Observatory, Epoch 1950, charts) using Verichrome-Pan film developed in Ethol 90 for 21 min at 68°F. The exposures were 11 sec each on April 20 and 5 sec each on March 26. The circumstances of these recent observations are given in Table IV.

The orientations of the orbits of Telstar 2 and its rocket during this observing season were such as to rule out their possible confusion with subgroups C and F.

ACKNOWLEDGMENTS

I thank R. D. Lines and E. Mohr for help with observing; H. McKinlay and the Plymouth Products Company for help with photoprocessing; the Hughes Aircraft Company for sponsoring related educational studies; and C. W. Macomber, the Bell and Howell Company, L. Skora, R. Kebo, and R. B. Bagby for the loan of photographic equipment.

REFERENCES

- BAGBY, J. P. (1956). "The Holpuch Satellite Ring." Twentieth Century Observations 7 and 9, Elgin Astronomical Society, Elgin, Illinois.
- BAGBY, J. P. (1960). "Evidence of Meteoric Material Circling the Earth." Chicago, Illinois.
- BAGBY, J. P. (1966). Evidence of an ephemeral Earth satellite. *Nature* **211**, 285.
- BAGBY, J. P. (1967). Radio anomalies associated with an ephemeral satellite still in orbit. *Nature* **215**, 1050.
- BAKER, R. M. L., JR. (1958). Ephemeral natural satellites of the Earth. *Science* **128**, 1211.
- BAKER, R. M. L., JR., AND MAKEMSON, M. W. (1960). "An Introduction to Astrodynamics." Academic Press, New York.
- BLITZER, L. (1966). Satellite resonances and librations associated with tesseral harmonics of the geopotential. *J. Geophys. Res.* **71**, 3557.
- BRANDT, J. C., AND HODGE, P. W. (1964). "Solar System Astrophysics," p. 287. McGraw-Hill, New York.
- BRIGGS, R. E., AND SLOWEY, J. W. (1959). An iterative method of orbit determination from three observations of a nearby satellite. *Res. Space Sci.* **27**, 1-8. (Smithsonian Astrophysical Observatory, Cambridge, Massachusetts.)

- CHANT, C. A. (1913). *J. Roy. Astron. Soc. Canada* 7, 145, 404, 438.
- GODDARD (1964-1967). Satellite Situation Reports 4, No. 1-24; 5, No. 1-24; 6, No. 1-24; 7, No. 1-24. Goddard Space Flight Center, Greenbelt, Maryland.
- HARRIS, I., AND SPENCER, N. W. (1965). The Earth's atmosphere. In "Introduction to Space Science" (W. N. Hess, ed.), pp. 93-107. Gordon and Breach, New York.
- JACCHIA, L. G., AND SLOWEY, J. (1963). Accurate drag determinations for eight artificial satellites; atmospheric densities and temperatures. *Smithsonian Contribs. Astrophys.* 8, 1 (Smithsonian Institution, Washington).
- JEN, N. C. (1965). Satellite potential in an ionized atmosphere. *Am. Inst. Aeronaut. Astronaut.* 3, 714.
- KAULA, W. M. (1965). The shape of the Earth. In "Introduction to Space Science" (W. N. Hess, ed.), pp. 297-313. Gordon and Breach, New York.
- KORDYLEWSKI, K. (1961). *Acta Astron.* 11, 165-169.
- KOZAI, Y. (1959a). On the effects of the Sun and Moon upon the motion of a close earth satellite. *Res. Space Sci.* 22, 7-10. (Smithsonian Astrophysical Observatory, Cambridge, Massachusetts.)
- KOZAI, Y. (1959b). Note on the secular motions of the node and perigee of an artificial satellite. *Res. Space Sci.* 30, 14, 15.
- MEBANE, A. D. (1953). The great fireball procession of 1913. *Science* 118, 725.
- MURPHY, J. P., AND FELSENTREGER, T. L. (1965). "An Analysis of Lunar and Solar Effects on the Motion of Close Earth Satellites." NASA, Goddard Space Flight Center, Greenbelt, Maryland.
- MUSEN, P., AND SQUIRES, R. K. (1965). Orbital mechanics. In "Introduction to Space Science" (W. N. Hess, ed.), pp. 518-520. Gordon and Breach, New York.
- O'KEEFE, J. A. (1964). Tektites and impact fragments from the Moon. *Sci. American* 210, (No. 2), 50.
- POHLE, F. V. (1964). A dynamical model for Kordylewski cloud satellites. *Am. Inst. Aeronaut.* 2, 1818.
- RUSSELL, H. N., DUGAN, R. S., AND STEWART, J. Q. (1945). "Astronomy," p. 391. Ginn, Boston.
- SMITHSONIAN ASTROPHYSICAL OBSERVATORY (1960-1967). *Res. Space Sci.* Nos. 50, 53, 61, 65, 71, 78, 81, 86, 93, 103, 117, 120, 126, 141, 142, 156, 158, 160, 169, 208, 209, 225, 257. Smithsonian Astrophysical Observatory, Cambridge.
- TOMBAUGH, C. W. (1961). The trans-Neptunian planet search. In "Planets and Satellites" (G. P. Kuiper and B. M. Middlehurst, eds.), pp. 28-30. Univ. of Chicago Press, Chicago, Illinois.
- WATSON, F. G. (1956). "Between the Planets." Harvard Univ. Press, Cambridge, Massachusetts.

A Model

Joi

The d
cussed,
eddy di
the Sch
effect of
constitu
electron
measure
deficien

1.

Theoretical i
upper atmosph
progress, being
ment by Marin
profile in the io
of the Cythere
the other hand
study the pho
processes in
Venus in detail
One of the
Cytherean upp
molecule is dis
the solar ult
dissociation pr
other to form
account these

¹ On leave f
Ochanomizu Uni
² Visiting Fell
³ National Ac
Research Counc
Research Asso
NASA.

.com

Resources for those who are stranded here

UFOs Paranormal Area 51 People Places Random Top 100 What's New Catalog New Books	Search... for keyword(s) 12 Area 51 Go in Page Titles ▼	Our Bookstore is <u>OPEN</u>
--	---	---

[Mothership](#) -> [UFO](#) -> [Updates](#) -> [1996](#) -> [Dec](#) -> [Here](#)

UFO UpDates Mailing List

Re: MJ-12 and Area 51

From: fsphys@brunswickmicro.nb.ca
 Date: Thu, 12 Dec 96 15:29:03 -0400
 Fwd Date: Fri, 13 Dec 1996 02:47:47 -0500
 Subject: Re: MJ-12 and Area 51

Errol: I am beginning to wonder if Ed Stewart and Kevin Randle haven't been hired by some disinformation outfit to waste my time on the net with some very strange arguments. Let me look at several:

1. Kevin's argument that since Ike would have known about Roswell, as Chief of Staff in 1947, there would have been no need for a preliminary briefing in 1952 as the president elect, is an old and faulted one. It might have held if Ike had remained as Chief of Staff through 1952. But he had already in June, 1947, announced he was stepping down to be the President of Columbia University. He was there for a couple of years and was writing his memoirs as well. Then he spent a couple of years in Europe trying to tie the devastated former enemy nations of Europe into a coalition to resist the Soviets, only coming back to the US around June of 1952 for the Republican convention. As noted in my 108 p. "Final Report on Operation Majestic 12" 1990, FUFOR, (available from UFORI, \$14. postpaid, POB 958, Houlton, ME 04730-0958), he states in "Mandate for Change" p.85, that he was briefed that summer of 1952 on National Security matters by W.B.Smith, DCI. Smith in a 2 page Jan.9, 1953, letter to Truman notes that he had arranged 4 briefings for Ike during the campaign and 4 after the Nov. 4 election. The entire letter is on pages E-9 and E10 of "Final Report..." Clearly he needed and received briefings on National Security matters after his long time out of the loop. The CIA has been unable to locate anything related to those briefings.

2. I referred to the need for access to classified files re the history of Area 51 and Kevin commented "we do have access to the public records which show no evidence of any secret facility in 1954". To the best of my knowledge public records are by definition, not classified. How could they show evidence of classified balck matters. The area is, according to one writer the size of Switzerland. A facility for collection, storage, and evaluation of bodies and wreckage need not be the size of Switzerland. Ed Stewart sets a new standard for classification when he stated as repeated by Scott Hale "Before information becomes classified, it is in the public domain and out there". Using Ed's phrase

(would I ever say any such thing?) this is "unadulterated poppycock". Many Black Programs are by definition born classified. There were no public domain releases on the Manhattan Project, the city of Los Alamos, the Stealth Fighter, the U-2 etc ad nauseum before they became classified, were there Ed?.

3. I suppose I should appreciate Kevin making me the Rupert Murdoch of the UFO publishing world by twice using the phrase "self published" with regard to my 29 papers on MJ-12 and Roswell not listed in his long list of references in "The Truth about The UFO Crash at Roswell". Sorry Kevin; all 29 were published by someone other than me such as IUR, MUFON J., FATE, UFO Universe, Proceedings of the various MUFON Symposia, etc. I have indeed distributed copies of many of these through UFORI as noted above. Here are 3 self published items "S.E.T.I., Sagan and Science" 27pg., 1993; "Roswell Incident, USAF, and the NY Times" 9/26, 1994; and, of most direct concern to our discussion, but not included in the 29, "Operation Majestic 12? YES!" 37pages 8/94. Each is only \$4. postpaid from UFORI with a special price for all three of only \$10.00 postpaid.

4. Ed I hate to tell you this, but JUST CAUS is not a refereed scientific journal. It is a newsletter going to a few hundred people. It has been known to make mistakes about MJ-12. For example, as noted on p.49 of "Final Report..." I pointed out that the December, 1985. JC article stated that the Ike Briefing was classified Top Secret Eyes Only (leaving out MAJIC), was 9 back to back pages, dated Sept. 18, 1947 and signed by Truman. It was 8 one sided pages, not signed by anybody, though the TF memo (p.8) was signed by Truman. The date is Nov. 18. for those who think that September might have been a typo, please note that it also stated "Septmber 18, 1947 is the birthdate of the CIA! Is it a coincidence or a telltale clue to the document being a phoney...."...

5. For Kevin, I am well aware of Dr. Pankratz's comments. Obviously if the Ike or Truman libraries had MJ-12 documents of their own, we wouldn't be having this discussion. That doesn't mean they don't exist. The presidential Archives do NOT get everything from that administration. The regulations about security markings are one thing, the reality is quite another again as I have noted. Dr. Pankratz was also early on in error in some of his coments about the CT memo.. as I reported in Final Report....

Enough of my time. STF

Search for other documents to/from: [fsphys](#)

[[Next Message](#) | [Previous Message](#) | [This Day's Messages](#)]
[[This Month's Index](#) | [UFO UpDates Main Index](#) | [MUFON Ontario](#)]

UFO UpDates - Toronto - updates@globalserve.net
Operated by Errol Bruce-Knapp - ++ 416-696-0304

A Hand-Operated E-Mail Subscription Service for the Study of UFO Related Phenomena.
To subscribe please send your first and last name to updates@globalserve.net
Message submissions should be sent to the same address.

.com Resources for those who are stranded here		
UFOs Paranormal Area 51 People Places Random Top 100 What's New Catalog New Books	Search... for keyword(s) 12 Area 51 Go in Page Titles v	Our Bookstore is <u>OPEN</u>
Mothership -> UFO -> Updates -> 1996 -> Dec -> Here		

UFO UpDates Mailing List

Re: MJ-12 and Area 51

From: **Ed Stewart** <egs@netcom.com>
 Date: Wed, 11 Dec 1996 19:40:53 -0800
 Fwd Date: Fri, 13 Dec 1996 02:38:26 -0500
 Subject: Re: MJ-12 and Area 51

> From: rudiak@garnet.berkeley.edu
 > Date: Tue, 10 Dec 1996 13:17:57 -0800 (PST)
 > To: UFO UpDates - Toronto <updates@globalserve.net>
 > Subject: Re: UFO UpDate: Re: MJ-12 and Area 51

> Yes, it would have been a very lousy cover story, which would have drawn a
 > lot of unnecessary attention -- sort of like Roswell base putting out a
 > captured flying disc story as a cover for a balloon crash.

Have you ever considered that the captured flying disc story may have had as its purpose something totally separate from flying discs or balloons? Can you think of a quicker way to bring to the attention of the Russians, re-emphasizing that we did indeed have an operational and ready wing capable of delivering atom bombs, the presence of the 509th in every major newspaper in the world without it looking obvious that we were trying to get their attention? I find it interesting that Richard Rhodes discloses in "Dark Sun: The Making of the Hydrogen Bomb" that in April, 1947 "in the heat of the burgeoning Cold War, the US had no assembled atomic bombs in stock" and would not have for quite a few months. The only thing we could do at that time was convince the Russians that we were ready and capable. In other words, bluff them into thinking that we could retaliate with atomic bombs should they move in Europe. A dropped story in the New York Times about the 509th would have been too obvious to an already paranoid Russia and could well have backfired and alerted them of a possible ulterior motive for the Americans to be publicizing the 509th. The Roswell flying disc context may well someday turn out to be a total non-event for ufology. It certainly didn't hurt or slow down Blanchard's career any. He went on all the way to make General. True, he was one of General LeMay's favorites and had his patronage, but doesn't the release of the Roswell crashed disc story suggest a lack of good judgement on Blanchard's part in the first place? Especially for a commander of the only atomic bomb wing in the world which we now know had no bullets to fire throughout the last half of 1947 and early 1948? Just food for thought and speculation on my part. The above is rhetorical on my part.

> More importantly, Dr. Lincoln La Paz (of N.M. green fireball fame) wrote
 > an article in the Feb., 1954 issue of the "Astronomical Society of the

> *Pacific Journal*" that astronomer Clyde Tombaugh had undertaken a telescope
> search for natural satellites.

The La Paz article had nothing to do with Tombaugh. The title of the paper was: "Advances of the Perigees of Earth-Satellites Predicted by General Relativity" and related to a suggestion made by Gilvarry for a possible test of General Relativity. La Paz suggested that a possible better test would be using earth-satellites and placed his speculation into the future by stating:

"Irrespective of whether or not satellites may be discovered at small mean distances from the Earth, the present state of satellite-vehicle research certainly justifies the belief that in the not distant future, artificial satellites can be set in motion in prescribed orbits about the Earth."

The reference to Tombaugh in La Paz's paper was a footnote to his previous sentence:

"That satellites of this sort may exist is strongly suggested by several independent lines of arguments. Furthermore, until extended systematic searches with properly designed equipment have been made at observatories not too far from the equator, failure to discover such bodies can have little significance.*"

The footnote:

"* Clyde Tombaugh has just informed me that U.S. Army Ordnance Research has agreed to sponsor a search for near-by satellites of the earth with especially designed photographic equipment."

La Paz continues in his paper with the mathematics showing his line of argument for inclusion of testing General Relativity using future earth-satellites. That is what his paper was all about. It had nothing to do with Tombaugh, or his efforts.

> *This prompted a White Sands press release*
> *in March that Tombaugh would be looking for "moonlets" that have gone into*
> *orbit around Earth recently, but are assumed to be natural. [an*
> *impossibility!]* *Allegedly they were being investigated as possible space*
> *station sites.*

The White Sands press release was not prompted by La Paz's paper. It was prompted by the reaction of the media to La Paz's footnote in the paper.

Also, Dr. La Paz certainly didn't think it was an impossibility for natural objects to be captured in earth orbit. Maybe you know something he didn't back in 1954. Care to elaborate?

> *Donald Keyhoe claimed that what had really happened was*
> *that new long range radar had picked up two objects going into orbit*
> *around Earth back in 1953.*

Keyhoe covers this whole subject from his own personal perspective and speculation in the "The Flying Saucer Conspiracy", Chapter 8 "Satellite Search". Must reading. Lots of good stuff on Keyhoe's mindset including the possibility of us "harming" moon men and indiscriminantly starting an interplanetary war based on Zwicky's project.

> *Keyhoe's allegations are backed up somewhat by a story first reported by*
> *"Aviation Week" magazine on August 23. They claimed that there were two*
> *objects orbiting Earth 400 and 600 miles out, which caused great*
> *consternation in the Air Force during the summer [Twining/Cutler MJ-12*
> *meeting, July 16??], until the objects were identified by Dr. Lincoln*

> LaPaz as "natural" (captured meteors) and not artificial objects.

This is the Aviation Week "story" which appeared as one paragraph in the "Washington Roundup" column on August 23, 1954:

"SATELLITE SCARE

Pentagon scare over the observance of two previously unobserved satellites orbiting the earth has dissipated with the identification of the objects as natural, not artificial satellites. Dr. Lincoln La Paz, expert on extraterrestrial bodies from the University of New Mexico, headed the identification project. One satellite is orbiting at about 400 mi. out, while the other track is 600 mi. from the earth. Pentagon thought momentarily the Russians had beaten the U.S. to space explorations."

Nice for the Russians to be so anti-American during the Cold War era. It provided the perfect cover to hide alleged MJ-12 meetings. After all, that was the 50s and we all know now that it was just "Happy Days" with nothing for our government to worry about except for aliens and keeping MJ-12 out of the headlines. (GRIN) What evidence do you have that there was ever a "Twining/Cutler MJ-12 meeting, July 16"? Inquiring minds would like to know.

> In follow-up press stories (e.g., S.F. Chronicle on 8/24 and the N.Y. Times on 8/24 and 10/10/54) LaPaz, denied that he was involved, though not specifically denying the truth of the story, stating that the article "was false in every particular, in so far as reference to me is concerned."

It was after all Tombaugh's project. All he did was report that Tombaugh had notified him of the project. But, we all know that the media never gets anything wrong.

I don't have the S.F. Chronicle article of 8/24/54, but the NYT article is actually longer than the original Aviation Week paragraph. Interesting that they quote the Aviation Week article as stating "Threw the Air Force into a flap". Their quote marks. I keep looking at the Aviation Week article posted above and I simply can't find that in there. They also state that the Aviation Week publication said "The Air Force had kept Dr. La Paz going back and forth between the missile test center at White Sands, NM, and Palomar Observatory in California until the objects were identified as meteors..." I keep looking at the Aviation Week paragraph and I don't find that in there either. I guess the NYT times must of had there own reasons for making their version so much longer and interesting than the original piece in Aviation Week.

The NYT October 10, 1954 piece is entitled "Scientist Denies Space Base 'Find'" and is quite lengthy. It goes into a lot of detail of what Dr. La Paz's research interests were and the significance of having a space platform in earth orbit in terms of world power and military advantage.

> Col. Walker Holler, C/O of the Army Office of Ordnance Research, said the story was false. OOR was looking for such objects, with the aid of famed astronomer Clyde Tombaugh, but none had been discovered. An unidentified source close to the OOR, however, told the Times the story was true and LaPaz was indeed involved. [N.Y. Times, 8/29/54] La Paz reiterated that the purpose of the project was to look for natural space platforms.

Irrespective of every identifiable source stating that La Paz was not involved, UP misquoting the original Aviation Week article and adding a couple more interesting notes not found in the original, we have this unidentified source "close" to the OOR that still gets quoted. What does "close" mean? He sold pizza outside the gates?"

What is imminently clear is that the media recognized that this story of satellites, whether natural or artificial, was a story they wanted to pursue. And all of the above resulted from La Paz stating in a simple footnote in an obscure scientific journal (my apologies to Eric Green if he is reading this) that Tombaugh advised him of a project that Tombaugh was going to do with the Army. I wonder how the media would have reacted SHOULD some government official hiding his true identity as MJ-12 told the media that they had ACTUALLY recovered a "downed satellite"? I think you made my point clear than I could have. Thank you.

> And if one wants to go back even further, ...

I don't, but I find this observation interesting.

> I would have to agree, except for the media stories of "natural objects" in orbit around the earth. The "natural satellites" story could have been used as a cover for a saucer crash. An artificial satellite crash, however, would have been a poor cover, since none existed in 1954 (unless Zwicky had secretly succeeded).

What are suggesting? That the MJ-12 think tank would have disclosed an alleged "secret program" [for which there is nothing to substantiate it] as a cover for their own MJ-12 operation? Well, not even the fabricators of the hoaxed MJ-12 SOM thought that would fly. Read the SOM over again.

> Guess you screwed up, huh Ed? (GRIN)

Yup.

> >Love can be blinding.
> So can wanton, unjustified Friedman bashing. (GRIN)
> David Rudiak

Last I looked, this thread was entitled "MJ-12 and Area 51", not Friedman. If you wish to start a thread on "Friedman", be my guest. In the meantime, if you wish to serve as an apologist for Friedman's claims, this would be the place to post any arguments you wish to present that you feel would provide his claims a vestige of supportive real evidence. Friedman has yet to provide any himself. He simply keeps ignoring the requests. Don't you think that the many Friedman supporters on this list deserve some tangible evidence to support Friedman's claims that MJ-12 is real? Inquiring minds would like to know.

Ed Stewart

Ed Stewart - egs@netcom.com - | So Man, who here seems principal alone,
"There is | Perhaps acts second to some sphere
unknown.
Something Going On!" ,>'?'<, | Touches some wheel, or verges to some
goal,
-Salvador Freixedo- (O O) | 'Tis but a part we see, and not a whole.
-----ooOO-()-OOoo----- Alexander Pope, Essay on Man-----

Search for other documents to/from: [egs](#) | [rudiak](#)

[[Next Message](#) | [Previous Message](#) | [This Day's Messages](#)]
[[This Month's Index](#) | [UFO UpDates Main Index](#) | [MUFON Ontario](#)]

UFO UpDates - Toronto - updates@globalserve.net

penetration may be obtained. A crystal which completely bars the penetration of the ultra-short-wave Levetzov rays does not appear to exist. The Russians found a metal alloy that had the required properties when specially prepared by a secret formula. This alloy may be used as a polarizer, or neutralizer of the Levetzov rays, for about two years. After that period, the alloy's metals fatigue."

By the Law of Conservation of Energy, established in 1847 by Mayer and von Helmholtz, perpetual motion is an impossibility. "Nothing for nothing," says Nature. But what the Ural experimenters did, it is said, was not to try to abrogate this law, but to create a machine that would run steadily without energy from the earth. Since the driving force came from outer space, however, a terrestrial view might be that at last an approach had been made towards a perpetual motion machine, limited by fatigue in the component metals. It is said that by Spring, 1944, a motor car was being driven by this ray from outer space.

A veil of mystery now fell over the experiments. In 1948, came reports of the arrest by the Russian Secret Police of Herr Pinkell and certain Russian scientists. Incarcerated in the prison island of Tohnay, Pinkell was forced to carry on work in a secret laboratory. Their crime appeared to be that they had frankly told the notorious Lavrenti Beria, Secret Police chief, that more time was needed to perfect the work. Although in 1944, ray-propelled aircraft had been constructed in Soviet Russia, Beria demanded instant results. He put the research under the control of the Russian Air-Marshal, K. Vershinin who, in 1948, was alleged to have at his command five planes flying at a then "almost unimaginable speed and service radius, in theory equal to that of half the known space." The phrase is cryptic, but one may guess what is meant.

By February, 1952, it is said there was under construction, in Russia, a "space island" of the American Forrestal type, intended to serve as a stopover for space craft from the earth. (Or so said the Zyalkovsky Institute of Kaluga):

"We take great care, in our advance work, with all parts and assemblies for this space-platform. We surround them with the same conditions that will be encountered in space. Basically, the space island will be an enlargement of a type of aircraft already past

the experimental stage, and which is propelled by a newly discovered energy of extra-terrestrial origin. A trip to the moon is a problem that will not have to wait too long for an answer." (*Report by the Zyalkovsky Institute, February 20, 1952*).

It is possible—who really *knows*, outside the innermost ruling circle of Russia?—that there was more than mere propaganda hot air in this statement. In the same month, the official bulletin of the Soviet State Academy for Technology, called "SUK," published an illustrated description of a "space island."

The *Frankfurter Illustrierte* alleges that:

"Since the forces exerted in propelling a Levetzov ray-machine are several thousand times greater than any previously known, there appears in the discs a radiant glow. This arises from an excess of power, or waste of energy that cannot easily be removed, and appears as heat. So great is the energy developed, that things within a fairly large radius begin to melt. A method of transforming this energy-surplus into waves eliminates the waste without damage."

Follows a description of a *terrestrial* flying saucer on this Russian model, or, as it should be, German-Russian model:

"A disc is the ideal form; but we may have a structure that revolves around its centre at immense speed, and therefore appears discoidal. The main part is a bonnet-like cupola of a framework of metal, the spaces between braces being covered with a transparent substance appearing as ports, or 'windows.' On this hub are mounted fan-wise, six wings with a small positive angle. Each blade or wing carries on the first third, top and bottom, a housing shaped like a hump, containing the transformer discarding the surplus-energy. Set into the outer skin of the blades are polarizing sheets that, dependent on their mutual adjustment, propel the craft, let it hover, and steer. But this entire formation is also being rotated by the Levetzov ray, while the cabin for the crew is suspended within the hub, and more or less stationary. The crew do not experience any feeling of acceleration, or deceleration; since they and the entire aerofoil are shielded from the rays."

.com Resources for those who are stranded here		
UFOs Paranormal Area 51 People Places Random Top 100 What's New Catalog New Books	Search... for keyword(s) 12 Area 51 Go in Page Titles v	Our Bookstore is <u>OPEN</u>
Mothership -> UFO -> Updates -> 1996 -> Dec -> Here		

UFO UpDates Mailing List

Re: MJ-12 and Area 51

From: **Greg Sandow** <GSANDOW@prodigy.net>
 Date: Fri, 13 Dec 1996 19:14:24 -0500
 Fwd Date: Sat, 14 Dec 1996 13:54:57 -0500
 Subject: Re: MJ-12 and Area 51

Just a minor point, but in a dispute I'm definitely not getting into
 Dave Rudiak wrote

> > Col. Walker Holler, C/O of the Army Office of Ordnance Research, said the
 > > story was false. OOR was looking for such objects, with the aid of famed
 > > astronomer Clyde Tombaugh, but none had been discovered. An unidentified
 > > source close to the OOR, however, told the Times the story was true and
 > > LaPaz was indeed involved. [N.Y. Times, 8/29/54] La Paz reiterated that
 > > the purpose of the project was to look for natural space platforms.

And Ed Stewart asked:

> Irrespective of every identifiable source stating that La Paz was not
 > involved, UP misquoting the original Aviation Week article and adding a
 > couple more interesting notes not found in the original, we have this
 > unidentified source "close" to the OOR that still gets quoted. What does
 > "close" mean? He sold pizza outside the gates?"
 >

"Close to" is journalist-ese for someone who's part of the organization
 but doesn't want to be identified. When there's a reference to someone
 close to a named individual, then the quote very likely comes from that
 individual. For instance, if the New York Times reports that someone
 "close to the President" said something, the quote very likely comes
 from the President, speaking not for attribution.

Behind this practice is a game that goes on between journalists and
 sources. It's especially prevalent in Washington, but I've played it
 myself in the music business. You interview someone for publication, and
 they may very well place their remarks in three different categories,
 "on the record," "not for attribution," and "off the record." On the
 record means you can quote them by name. Off the record means you can't
 quote them at all. Not for attribution is the most interesting of the
 three -- it means you <can> use the quote, but you can't pin it on the
 person who said it!

Very commonly, I'd be interviewing a record company president who'd say
 some things for publication, and other things -- usually the most

revealing stuff -- not. So then I'd bargain. Could any of it be printed, not for attribution? If so, I'd have the president of Mercury Records saying things with his name attached, and then "a source close to Mercury" saying other, much more interesting stuff. (The <most> interesting things, of course, I couldn't print at all.)

In Washington, as I said, this is a manic sport, due to the common practice of people advancing their careers or political agendas by leaking information. The leaks, of course, are always anonymous. Everybody needs to appear well-behaved in public. But if you see an interview with Clinton with a few juicy quotes attributed to "a source close to the President," the likelihood is that Clinton said them and wanted them printed, but just didn't want his name attached.

Greg Sandow

Search for other documents to/from: [gsandow](#)

[[Next Message](#) | [Previous Message](#) | [This Day's Messages](#)]
[[This Month's Index](#) | [UFO UpDates Main Index](#) | [MUFON Ontario](#)]

UFO UpDates - Toronto - updates@globalserve.net
Operated by Errol Bruce-Knapp - ++ 416-696-0304

A Hand-Operated E-Mail Subscription Service for the Study of UFO Related Phenomena.
To subscribe please send your first and last name to updates@globalserve.net
Message submissions should be sent to the same address.

[[UFO Topics](#) | [People](#) | [Ufomind What's New](#) | [Ufomind Top Level](#)]

To find this message again in the future...
Link it to the appropriate [Ufologist](#) or [UFO Topic](#) page.

Archived as a public service by [Area 51 Research Center](#) which is not responsible for content.
Software by Glenn Campbell. Technical contact: webmaster@ufomind.com

Financial support for this web server is provided by the [Research Center Catalog](#).

NATIONAL ARCHIVES AND RECORDS SERVICE
WITHDRAWAL SHEET (PRESIDENTIAL LIBRARIES)

FORM OF DOCUMENT	CORRESPONDENTS OR TITLE	DATE	RESTRICTION
18. Letter	Joseph Kaplan, National Academy of Sciences, to D. A. T. Waterman, National Science Foundation re scientific earth satellite (2 pp.) 4/17/58. TB	5/14/55	A (OSTPP)
19. Memo	James S. Loy Jr. to Sec. of Def., Dir. DOD, Spec. Asst. for Natl. Sec. Affairs, Spec. Asst. for Science and Technology re satellites (TS 2 pp.) 4/17/58. TB	8/4/58	A (NSC)
20. Memo	Robert W. Coirns to Asst. Sec. of Def. (Research and Development) re scientific satellite program for the DOD (8 pp.)	5/4/55 1/26/99 d	A (DOD)

FILE LOCATION

WHITE HOUSE OFFICE, Office of the Special Assistant for National Security Affairs
Records, 15C-61

NSC SERIES, Briefing Notes Subseries
Box 7, Folder: [Earth Satellites] (3)

RESTRICTION CODES

- (A) Closed by Executive Order 11652 governing access to national security information.
(B) Closed by statute or by the agency which originated the document.
(C) Closed in accordance with restrictions contained in the donor's deed of gift.