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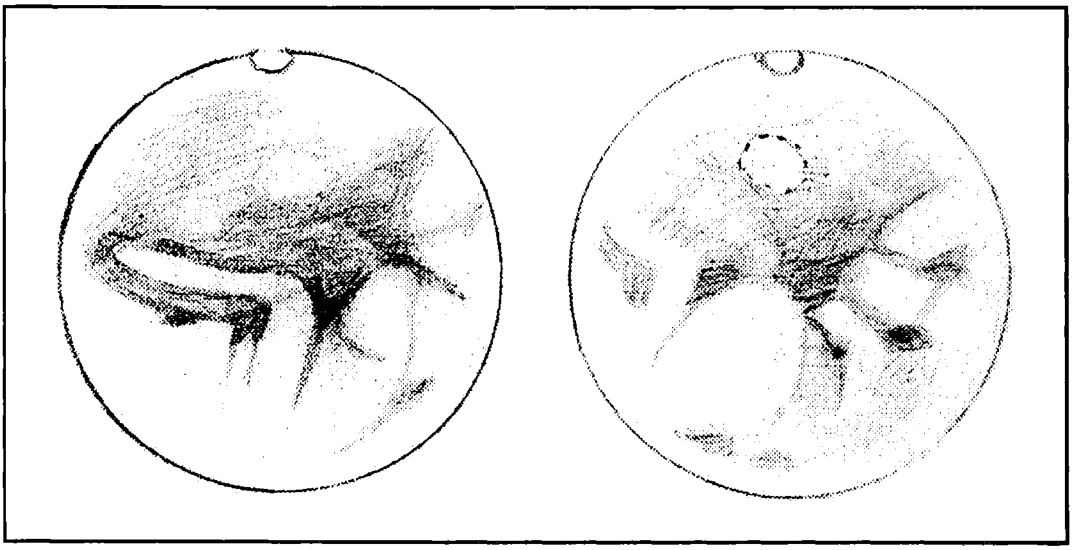

Two drawings of Mars by A.L.P.O. pioneer member Charles M. Cyrus (see p. 172 of this issue), with a 10-in (25cm) Newtonian reflector at 250X on 1941 Oct. 02 UT. The left view was drawn at 05h05m-05h25m UT (CM 012°) with seeing 6-7 on the A.L.P.O. 0 - 10 Scale. The right drawing was done at 06h55m-07h20m (CM 038°), when the seeing had improved to 9; note the very prominent Fons Juventae, slightly below and right of center–Mr. Cyrus described it to be "as well defined as the shadow of a satellite of Jupiter." The Martian South Polar Cap is at the top in both views.

THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

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In This Issue

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The Lost Ring of Saturn

By: Thomas Dobbins, A.L.P.O. Acting Coordinator, Solar System History, and Richard Baum

In a routine summary of the observations of Saturn made at his private observatory at Juvisy-sur-Orges during the planet's 1899 Apparition, the French astronomer Camille Flammarion commented on the unusual diffuse appearance of the outer edge of Ring A. Through his 10.2-inch (26-cm) Bardou refractor it was "in no wise sharply defined, but seemed to shade off rather gently into space." [1] Although Flammarion's popular writings on astronomy had elevated him to the celebrity status enjoyed by Carl Sagan and Patrick Moore today, little if any notice was taken of his remarks at the time. In retrospect, however, his report set the stage for a series of observations that remain the subject of controversy to this very day. [2]

During the edgewise presentation of Saturn's Rings eight years later, a peculiar appearance was reported by the eminent French planetary observer Georges Fournier, who used the 11-inch (28-cm) refractor at the Jarry-Desloges Observatory on the 5100-foot (1550-m) summit of Mount Revard in Savoy. On two nights in early September of 1907, one month before the second passage of the Earth through the ring plane that year, Fournier glimpsed "a sort of nebulous, corpuscular cloud enveloping the ring on both faces" under atmospheric conditions so exceptionally tranquil that he described the image as "at moments absolutely perfect." In the ansae of the very narrowly opened Rings this "very pale luminous zone" was seen to extend for a short distance beyond the extremities of Ring A. [3]

In September of the following year a new telescope went into service at the Geneva Observatory. A 16-inch (41-cm) Cassegrain reflector with the unusually long focal ratio of f/33, the instrument was the product of several months of work by Emile Schaer, a staff astronomer who was also a talented optician. "The optical system is so perfect," Schaer wrote with satisfaction in his journal, "that I cannot detect any error." Emile Schaer and his telescope are shown to the right in *Figure 1.*

On the night of October 5, the Swiss astronomer trained his creation on Saturn. Less than a week past opposition, the planet was well placed for observation in the hours around midnight. Only ten months had elapsed since the Earth had last passed through the plane of the Rings, so they appeared inclined little more than 5° from the vantage point of an earthbound observer.

Fortunately the seeing that night was excellent, rewarding Schaer with the one of the best views of Saturn that he had enjoyed in fourteen years of observing the planet. Despite the oblique presentation of the Rings, it must have been an inspiring sight. Schaer's observing log reads in part: "The Cassini Division can be followed almost to the limb of the planet. It is broad, very well defined and very dark," while the portion of Ring A within the delicate Encke Division appeared mottled or serrated. [4]

After examining the image for about half an hour, Schaer noticed something unusual. Where the Rings passed in front of

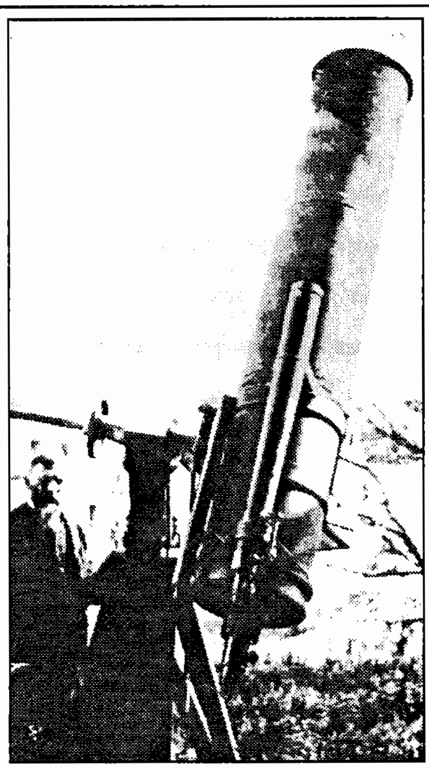


Figure 1. The Swiss astronomer and telescope maker Emile Schaer beside his 16-in (41-cm) Cassegrain, the instrument that revealed an "exterior Crepe Ring" for Saturn in 1908.

the Globe, their outer edge appeared to have a narrow dusky halo. At first he thought this was merely a poorly resolved border between the outer edge of Ring A and the shadow cast by the Rings on the Globe, or perhaps even one of Saturn's atmospheric belts. By 11 P.M., moments of virtually perfect seeing permitted Schaer to increase the magnification from 450X to 660X. Now he could trace the dusky band beyond the confines of the Globe and see it against the dark sky background. In the steadiest moments, it could be glimpsed almost halfway to the extremities of the Rings before becoming lost in their glare.

In equally good seeing on the following night, Schaer was able to distinguish a pencil-thin strip of light reflected by the planet's cloud canopy separating the jet-black shadow of the Rings on the Globe from a dusky band about one second of arc in width bordering the outer edge of Ring A. Only now did he write in his journal of coming to an "almost absolute certainty that the bright rings are bordered by an exterior dark ring." [5]

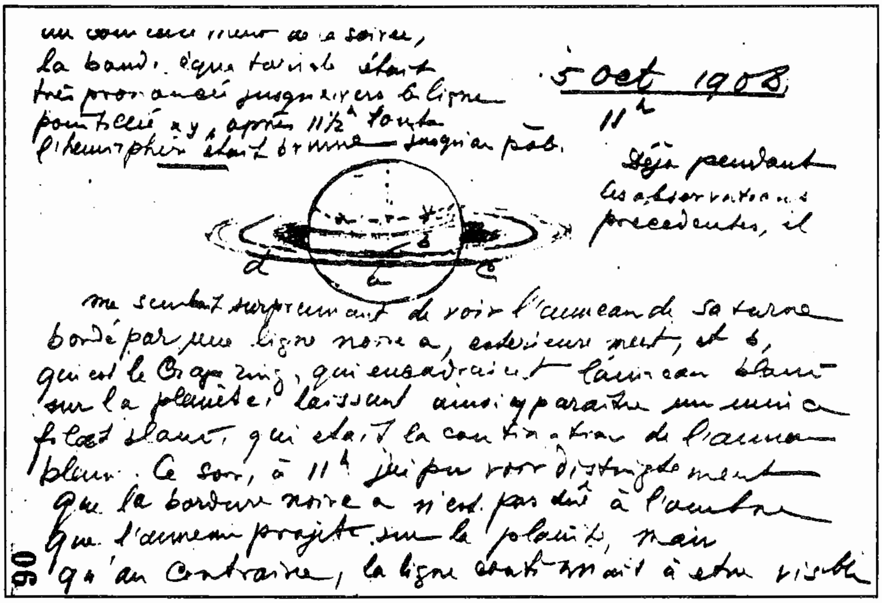
Fournier's observation of the previous year, although prominently reported at the time, had escaped Schaer's notice. Despite his growing conviction that he had made a remarkable discovery, the cautious Schaer would observe Saturn yet again on the night of October 7 before making an announcement. "This evening," he wrote, "I can definitely see the exterior dusky ring in the ansae as far as the location of the Cassini Division, and for an instant perhaps to the eastern and western extremities of the bright rings." On the following morning Schaer telegraphed news of his findings to the Central Bureau at Kiel, Germany, then the principal clearinghouse for announcing astronomical discoveries. The telegram read:

> "A new brown ring surrounding the bright Rings of Saturn. The bright ring that passes in front of the planet is actually bordered by two narrow bands, brownish or dark, depending upon the state of our atmosphere. When the image is very tranquil, the upper band extends beyond the Globe of Saturn and at a greater distance forms the ansae of the Crepe Ring. The lower band likewise does not appear to leave off at the limb of the planet, but follows the bright ring. In this manner one will be in view of a dim exterior ring. This ring is visible with difficulty in my 40cm Cassegrain with magnifications of 270X, 450X, 660X. By contrast the Encke Division is already easily observable with the same instrument." [6]

Schaer's observing notes for October 5 and 7, 1908, are reproduced in *Figure 2* (p. 147).

In response to Schaer's announcement, the 28-inch (71-cm) refractor at the Royal Greenwich Observatory, largest in the British Empire, was swung toward Saturn on the night of October 10. The three-member observing team included a 26 year-old named Arthur Stanley Eddington, later to win fame and knighthood for his contributions to theories of the internal structure of stars and general relativity. Although the British observers were never to experience conditions quite as favorable as those enjoyed by Schaer, on this and six subsequent nights they did catch fragmentary glimpses of Schaer's Ring during the steadiest moments. Their observational notes, published in the *Monthly Notices of the Royal Astronomical Society*, contain the following remarks:

> "October 10—Definition fairly good; bright moonlight. The ring, all round, appeared to be dusky on the outer edge.
>
> October 11—At 11h 15m G.M.T. the north following edge had a different appearance from the south edge; there was a trace of a faint fuzzy ring. At 11h 25m the faint fuzzy ring was suspected on the north preceding edge.
>
> October 12—At 10h 38m the north edge of the outer ring was bordered by a faint, dusky ring, which was seen again at 10h 50m.
>
> October 15—At 11h 10m, with a power of 670, the outer bright ring had a dullish edge on the north side, while on the south side it was bright. At moments of good definition the north edge was bordered by a dusky ring, fairly well outlined.
>
> October 22—With a power of 550 in favourable seeing, there appeared traces of an outer dusky ring on the north preceding and following edge of the white ring. At 11h 10m the difference in the appearance of the north and south edges was most marked.



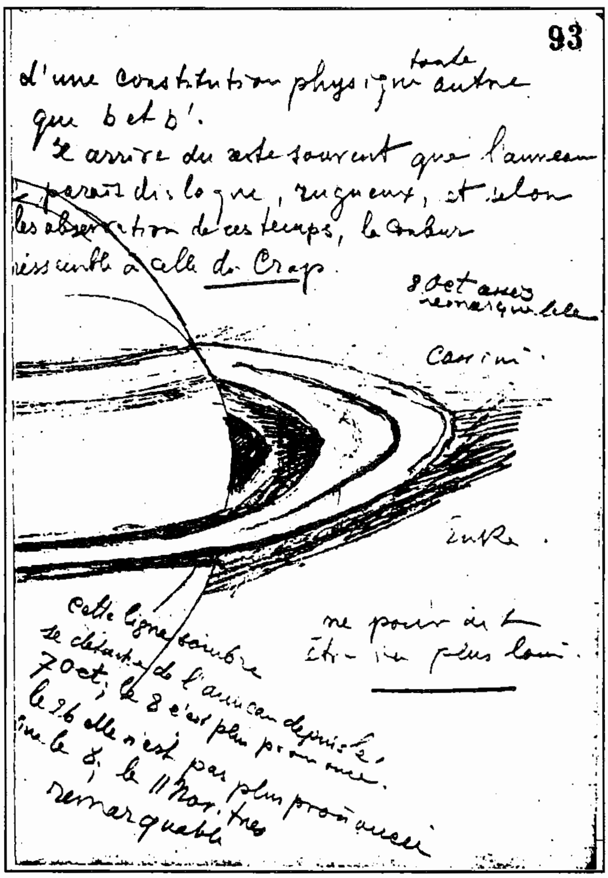


Figure 2. The entries from Emile Schaer's observing log recording his discovery of Saturn's "exterior crepe ring". Page 90 (upper left) is for 1908 Oct 05, while page 93 (left) describes 1908 Oct 07. South is at the top in both drawings.

October 27—While making micrometer measures of the system, the definition was occasionally very fair, and the outline of an outer dusky ring could be seen on the north preceding and following edge of the white ring.

October 30—From 9h 30m to 10h 45m... an outer dusky ring was seen bordering the north preceding and following edge of the outer bright ring." [7]

Across the Atlantic, Schaer's Ring was confirmed by Professor David Todd with the 18-inch (46-cm) Clark refractor at Amherst College. [8] Such was not to be the case, however, when the news reached Edward Emerson Barnard, arguably the foremost observational astronomer in the United States. On two evenings in January of 1909, Barnard carefully examined Saturn with the 40-inch (102-cm) Yerkes refractor at Williams Bay, Wisconsin, then and now the largest instrument of its kind in the world.

By now three and a half months past opposition, Saturn rode low in the southwestern sky at nightfall. Not surprisingly, seeing was so poor that Barnard was prompted to diaphragm down the aperture slightly to improve definition, a practice he seldom employed. Despite recourse to an occulting bar to block the glare from the planet's Globe, he reported that he saw "nothing abnormal anywhere." [9]

Visual discoveries of a dozen comets, several nebulae, and the fifth satellite of Jupiter had earned Barnard a reputation as a remarkably keen-eyed detector of faint objects, which Schaer's Ring was alleged to be. So great was the esteem for Barnard's skill as an observer (combined with the fact that he had employed the largest refractor in the world) that his pronouncement was widely accepted as the final word on the subject of Schaer's Ring, which was soon relegated to obscurity. The tentative confirmation of the presence of an exterior Ring by the Greenwich observers could be dismissed as merely the product of the power of suggestion, while Todd's close alliance with Percival Lowell in the debate then raging over the reality of an intricate network of canals on Mars had severely damaged his credibility among his peers.

Ironically, despite the Yerkes refractor's tremendous light-grasp—six times that of Schaer's Cassegrain and twice that of its counterpart at Greenwich—it was an instrument particularly ill-suited to reveal the presence of any faint object adjacent to the bright outer Ring of Saturn. The residual chromatic aberration of very large doublet refractors is so pronounced that it almost invariably comes as a rude shock to observers accustomed to the views provided by reflectors. Even users of achromatic refractors of moderate size are often disappointed, since, ignoring the minor variations in the optical properties of the crown and flint glasses of that period, the conspicuousness of the secondary spectrum of a doublet objective is proportional to the square of its aperture. [10]

The only solutions to this intractable problem are to employ dense monochromatic color filters when making observations of bright objects, to make one element of the objective lens from one of the "abnormal dispersion" glasses (materials unavailable to 19th-century opticians), or to dramatically decrease the focal ratio of the telescope. Thus, while a century-old 5-inch (13-cm) f/15 doublet may have very unobtrusive residual chromatic aberration, its 40-inch (102-cm) counterpart would require an utterly impractical focal ratio of f/120 to achieve comparable color correction! [11]

The focal ratio of the Yerkes refractor is only f/19, so a bright object like Saturn is awash in an objectionable purple haze of defocussed red and violet light. Nor is this haze merely an offense aesthetically—the "signal" of any dim exterior Ring would be cloaked by the "noise" of this secondary spectrum. When Barnard, who had exclusively used a variety of refractors during his career, finally had the opportunity to observe the planets with the 60-inch (152-cm) Mount Wilson reflector in August of 1910, the experience moved him to tell his host George Ellery Hale that for visual work on the planets he would now prefer a large reflector to either the 36-inch (91-cm) Lick or 40-inch (102-cm) Yerkes refractors. "Compared with the images of Saturn and Mars in the 60-inch, those in a refracting telescope have muddy or dirty look", he explained, while in the reflector a planet "looks as if cut out of paper and pasted on the background sky... perfectly hard and sharp with no softening of the edges. The outline and definition are much superior to that of a refracting telescope." [12]

By temperament Barnard was averse to controversy and there is little reason to believe that he intended that his remarks be taken as a definitive verdict on Schaer's Ring. In fact, his observing notes for one of the two nights that he searched for it refer to difficulty in making out even the Crepe Ring in the turbulent air. [13]

Meanwhile, Schaer claimed his best view of the exterior Ring on the evening of

January 24, 1909. But his energies were increasingly directed toward making instruments rather than observations. Already he was hard at work on a Cassegrain of one-meter aperture, the first of several large reflectors that he would construct. In coming years he would introduce the practice of folding the light path of long-focus refractors into the form of the letter "N" using two planar mirrors, reducing the length of an otherwise cumbersome tube by two-thirds. These compact instruments are still known as "Schaer refractors" in German literature. He would also to play a pivotal role in establishing an observing station atop the 13,668-foot (4166-m) summit of the Jungfrau in the Bernese Alps. By the time of his death in 1931 at the age of 69, he left a rich legacy of telescopes, several of which remain in service to this day. [14]

A trickle of additional confirming reports were all but ignored, typified by the following tale of woe: On November 24, 1910, a tersely-worded telegram from the Observatoire d'Hem in Lille, France was received at the Kiel Central Bureau: "Saturn border exterior Ring A seen many sessions with nebulous degradation. Jonckheere." [15]

The author was the young Belgian astronomer Robert Jonckheere, then just embarking on what would prove to be a distinguished career during which he would discover and catalog 3,350 pairs of double stars. Jonckheere later elaborated: "During the lunar eclipse of the 16th of November, 1910 the 35cm [14-in] equatorial was turned on Saturn. I noted at the eastern extremity of the exterior ring a nebulous projection against the sky. It was chiefly at the lowest magnifications of 100 and 200 times that this nebulosity was seen fading away from the outer edge of Ring A. The phenomenon was again observed, but with greater difficulty, on the 20th and 24th of November."[16]

Years later Jonckheere recalled that he had been unaware of Schaer's report when he made his sightings, adding: "This telegram caused such unanimous reprobation at the time that I let the matter drop, although the 14-inch Lille refractor and my eyesight have not otherwise been found defective." [17]

In 1919 indirect evidence for the presence of an exterior Ring was provided by an eclipse of Saturn's satellite Iapetus by the shadow of the planet's Rings. On February 28 of that year, W.F.A. Ellison observed Iapetus emerge from the shadow of Ring A with the 10-inch (25-cm) Grubb refractor of Armagh Observatory in Ireland. The unexpectedly gradual brightening of Iapetus was not completed until some thirteen minutes after the predicted time of the end of the eclipse, strongly suggesting that the ring system extends farther than was generally supposed. [18]

By the early 1950s, still several years before the dawn of the Space Age, the attentions of the professional astronomical community were directed far beyond the confines of the Solar System. Except for a veritable handful of specialists, monitoring the planets was an activity left to amateurs. The Rings of Saturn were once again obliquely inclined in an almost identical fashion to their presentation at the time of Schaer's 1908 observations. Perhaps coincidentally, a spate of sightings of an exterior Ring followed.

In Chester, England in April of 1952, co-author Richard Baum reported a feature near the limit of visibility much like that described by Schaer. With a variety of instruments ranging from a 4.5-inch (11.4-cm) Cooke refractor to a 9-inch (23-cm) Newtonian, it was detected on several occasions during the next two years. [19]

From halfway around the world came reports from two prominent members of the Association of Lunar and Planetary Observers, Thomas R. Cave, Jr. and Thomas A. Cragg. Cave was the proprietor of the Cave Optical Company, a fledgling telescope-making firm in Long Beach, California that in the coming decades would supply over 15,000 fine Newtonian and Cassegrain reflectors to amateurs, colleges, and universities. [20] He was also an accomplished planetary observer. Using a 12.5-inch (32-cm) f/10.7 Newtonian of his own construction, on several occasions during the 1952 Apparition Cave suspected a 2-3 arc-second wide exterior Ring, fainter than Ring C and seldom equally prominent in both ansae. Significantly, he had no prior knowledge that such a feature had ever been previously reported, so the power of suggestion was definitely not at work in this instance. Like Schaer, Cave's first clue to the presence of the feature was an unusual dusky appearance exhibited by the edge of Ring A where it crossed the Ball of the planet.

Cave confided his suspicions to his friend Cragg, a solar observer at Mount Wilson Observatory. With the aid of a 12-inch (30-cm) reflector, Cragg was able to corroborate Cave's observations on three nights that year. He saw the feature as "duskier than the Crepe Ring, about 2/3 as bright and 1/3 to 1/2 as wide, brightest portion about 2/3 the way out, apparently joined to Ring A without a division. Unless the Crepe Ring is reasonably easy at the ansae," he cautioned prospective observers, "the dusky ring outside of Ring A will probably be invisible." [21] Cave and Cragg independently but simultaneously detected the feature on several occasions during the following two years. Walter Haas, the founder of the Association of Lunar and Planetary Observers, suggested for it the provisional designation "Ring D".

Currently living in retirement, Cave harbors no doubt that what he saw more than four decades ago was real. "It was a difficult object that required excellent conditions to be seen at all. The fact that I was subsequently unable to detect it under equally good conditions suggests to me that it is variable, not that it was illusion of some sort." [22] Two of Cave's drawings, each annotated "Ring D outside Ring A," are shown below in *Figure 3*.

Confirmation was scanty. Charles F. Capen, a renowned Mars specialist and prolific photographer of the planets, glimpsed the elusive exterior Ring on the night of May 4, 1954 with the 24-inch (61-cm) Clark refractor of Lowell Observatory, as shown on p. 151 in *Figure 4*. Claude du Matheray, a Swiss observer, had previously sighted the exterior ring; in 1943 and 1952, as shown in *Figure 5* (p. 152). The Brazilian astronomer Ronaldo R. de Freitas Mourao reported sighting it in 1958 with the 18-inch (46-cm) Cooke refractor of the National Observatory in Rio de Janeiro. [23]

In his definitive 1962 work, *The Planet Saturn*, A. F. O'D. Alexander, Director of the Saturn Section of the British Astronomical Association from 1946-51, characterized the recurring reports of an exterior Ring as "a sort of 'Loch Ness monster' of Saturn in which some believe, but of whose existence most astronomers are very sceptical." [24] However, his German counterpart Werner Sandner found the reports credible, writing in 1965 that "there is a strong possibility that Ring D exists—from time to time at any rate." [25]

Walter Feibelman used the opportunity afforded by the 1966 edge-on presentation of the Rings to conduct a photographic search for the exterior Ring, reasoning: "It is known that when seen nearly edge-on, the A ring, normally fainter than the B ring, can sometimes appear brighter than B. Similarly, an outer "D" ring might appear relatively bright at the time, while when in

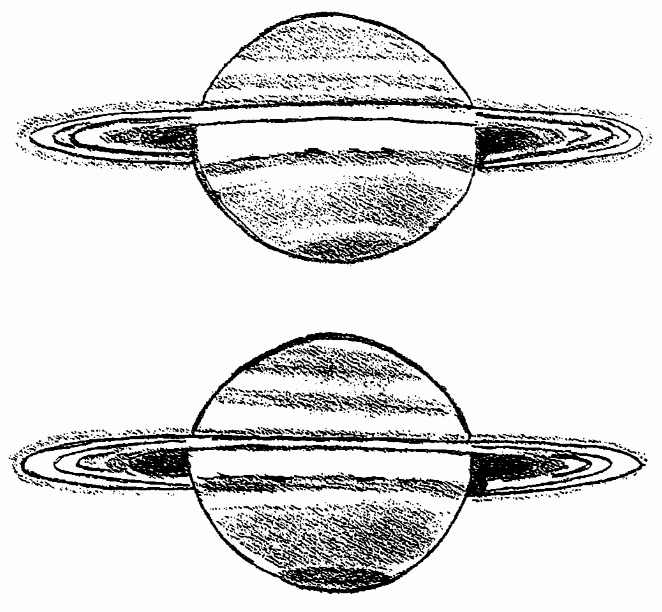


Figure 3. Two drawings of Saturn by Thomas R. Cave showing "Ring D outside Ring A." South is at the top in both views.

Upper: 1952 Apr 07, 05h10m UT, 12.5-in (31.75-cm) Newtonian, F/10.7, 390× & 555×, Seeing = 8-9 (A.L.P.O. Scale, ranging from 0 = worst to 10 = perfect), Transparency = 5 (A.L.P.O. Scale, ranging from 0 = worst to 5 = perfect).

Lower: 1952 Apr 18, 04h30m UT, 12.5-in (31.75-cm) Newtonian, F/10.7, 450× & 900×, Seeing = 9+, Transparency = 5.

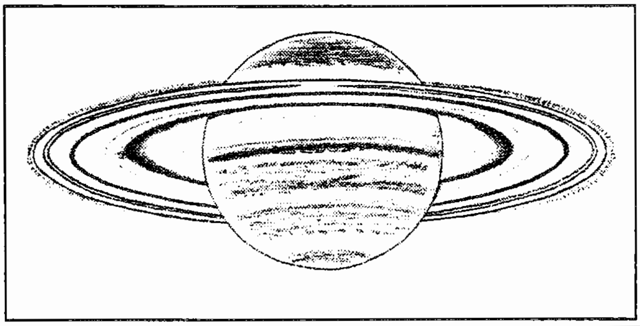


Figure 4. Long-time A.L.P.O. Mars Recorder Charles F. ("Chick") Capen made this drawing on 1954 May 04, 07h45m-08h35m UT. Lowell Observatory 24-in (61-cm) Clark refractor, diaphragmed to 18-20 in (46-51 cm), 310X and 480X, Wratten 12 (yellow), 15 (deep yellow), 23A (red) and 38A (green) Filters. Seeing = 7 (A.L.P.O. Scale), Transparency = 6+ (limiting magnitude). Saturnicentric latitude of Earth = 17°N; north at top. Capen noted "Structure in Ring B. Encke's Div. double. Dusky outer Ring D'/ B5 Div weak."

the open position it may be completely unobservable." [26]

Feibelman used the Allegheny Observatory's 30-inch (76-cm) Thaw refractor on six nights in the fall of 1966 and early winter of 1967 to take dozens of photographs of Saturn with exposure times ranging from 5 to 30 minutes. Two of the plates recorded extremely faint hairlines emerging from the glow of the grossly over-exposed image of the planet and its known Rings. Extending to more than twice the previously accepted diameter of the ring system, Feibelman's exterior Ring candidate was very tenuous, with only about one-millionth the brightness of Ring A. [27] However, it did lend a new air of plausibility to the earlier reports by Schaer and other visual observers.

The Moon is a virtually airless world and its orbital motion makes it act like a knife-edge slicing through space, cutting off the light of the far more distant planets and stars without any appreciable distortion. If a bright star is accompanied by a very close, much fainter companion, a lunar occultation may block the glare of the primary, affording a momentary glimpse of the otherwise invisible companion if its position angle is favorable. Many previously unknown or suspected binary systems with apparent angular separations of as little as 0.02 arc-seconds have been discovered or confirmed in this fashion. [28]

It was under these very circumstances that a unique observation of Saturn was made in the autumn of 1973, when the Rings were presented at their maximum apparent opening of 27°. On the night of October 17th, a group of Canadian amateurs observed an occultation of Saturn by the Moon. As the occultation neared an end and the outer edge of Ring A was just seconds from reappearing from behind the Earthlit portion of the Moon, one of the observers, Glen Reed, noticed a "faint glow which delineated the dark limb... like seeing a campfire on the other side of a treeless hill on a dark night." With a 6-inch (15-cm) Newtonian at a magnification of 230X, averted vision was at first required.

The extent of the glow was estimated afterwards to have been a little greater than the east-west extent of the Rings. The pinpoint of light from the Rings which appeared in the center of the faint glow rapidly brightened and became bigger as the Rings became visible following the third contact. The glow increased slightly in width and showed easily detectable lunar limb curvature on its sharp edge but at about four seconds beyond third contact the glow was indistinguishable against the increasing Ring brilliance. [29]

The apparent motion of the Moon relative to Saturn was half an arc-second per second of time, so the timing of Reed's detection of the glow corresponds to the estimates of the width of the exterior Ring by Schaer, Cave, Cragg and others. Here again was tantalizing evidence of the presence of a very delicate halo beyond the generally accepted limits of the ring system. Only a much closer inspection by spacecraft promised to shed further light on the mystery.

In September of 1979, the Pioneer 11 spaceprobe flew past Saturn's Rings at a distance of less than 21,000 miles (34,000 km), returning tantalizing images of a Ring centered just 2400 miles (3900 km) beyond the outer edge of Ring A. Named "Ring F" by the Pioneer imaging team (in their nomenclature "Ring D" was the designation given a very tenuous Ring that extends from the inner edge of the Crepe Ring down to Saturn's cloud tops), it was so narrow that the probe's primitive video camera could not resolve it. It was also extremely faint, with less than one-tenth the mean optical density of the tenuous Crepe Ring. Despite a location that coincides perfectly

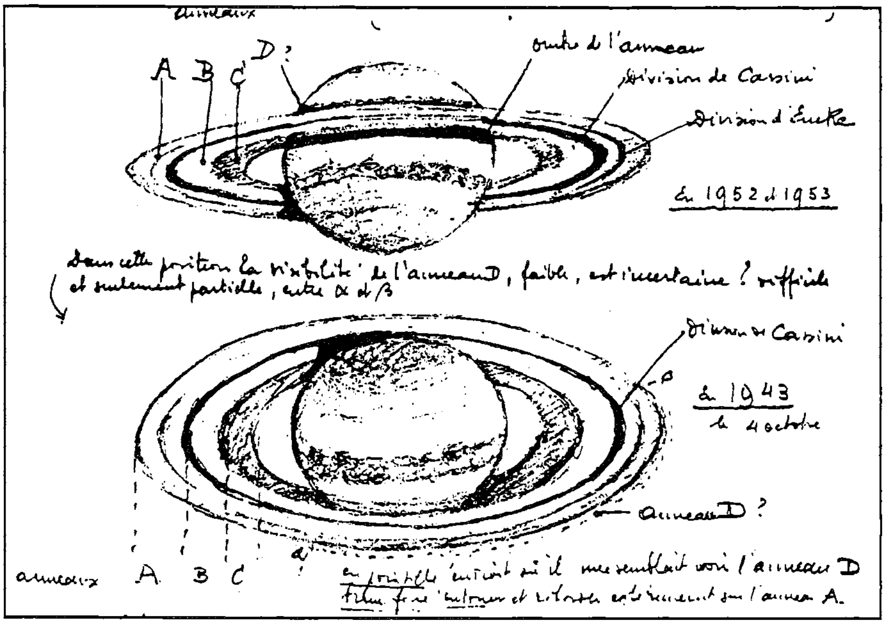


Figure 5. The eminent Swiss planetary observer Claude du Matheray not only sighted the exterior ring when the Rings were obliquely presented in 1952, but also when they were "wide open" nine years earlier. The halo described by du Matheray did not completely circle the outer edge of Ring A, consistent with descriptions of fragmentary arcs by other observers.

with the location of Schaer's Ring, such a meager wisp of light could not possibly have been detected by a telescopic observer.

Pioneer 11 was followed in November of 1980 by the Voyager 1 spaceprobe, which in turn was followed by a duplicate craft, Voyager 2, in August of 1981. Equipped with far more sophisticated television cameras than Pioneer, Voyager 1 resolved Ring F into three strands, each measuring less than 20 miles in width. The outer two strands exhibited a bewildering array of warps, kinks, and knots. In places they even appeared to be helically intertwined like braids.

Voyager 1 discovered a pair of "shepherd" moons orbiting just to either side of Ring F. Christened Pandora and Prometheus, these satellites are irregularly shaped chunks of ice about 120 miles (190 km) across whose gravitational influence confines the particles in Ring F to a narrow swath.

During the nine months that elapsed between the visits of the two sister spaceprobes, the structure of Ring F somehow changed markedly. Voyager 2 found a single strand predominating, smoothed of kinks and accompanied by five fainter, rigidly parallel companions. Streaks on long-exposure images suggested the presence of several moonlets, perhaps ten miles (16 km) across, embedded within the Ring itself.

When the Voyagers passed beyond Saturn and looked back toward the Sun, the forward scattering of sunlight made Ring F appear to brighten dramatically, revealing that most of its constituent particles are on the order of only a micron in diameter, like the motes of dust in a sunbeam. Particles this small are subject to drag from the pressure of impinging photons of sunlight (the so-called Poynting-Robertson forces) and, from collisions with charged particles in Saturn's magnetosphere, rapidly losing energy and spiralling downward toward the Globe of the planet. The smallest particles in Ring F must be of recent origin—as little as 20 years old by some estimates.

Astronomers Jeffrey Cuzzi of NASA's Ames Research Center and Joseph Burns of Cornell University have suggested that Ring F is an unstable structure that is evolving on a time scale measured in decades. Re-examining the Voyager data, they found evidence of a halo of kilometer-sized moonlets surrounding Ring F, accompanied by localized clouds of ice spray created when these objects collide with one another. Ring F is merely the largest of these collections of debris, they believe, and is destined to soon disappear as its constituent particles are swept up by and adhere to other moonlets.

Images acquired with the Hubble Space Telescope during the 1995 passage of the Earth and Sun through the plane of the Rings revealed the presence of several elongated clumps or arcs of material in or near Ring F. At first mistaken for moons, these objects were not present during the Voyager flybys fifteen years earlier and appear to be short-lived "sandbank satellites." They appear as obvious features in some Hubble images but are curiously absent in others taken just a few months earlier or later. "The F Ring must be an exciting place to live," quipped Cornell University's Philip Nicholson, a member of the Hubble imaging team. [30]

Backtracking 1995 Hubble and 1981 Voyager positions of the shepherd moon Prometheus, investigators located the satellite on pre-discovery photographs taken during the ring-plane crossings of 1980 and 1966. A surprising fact emerged from the refined parameters of its seemingly erratic orbit. According to Carl Murray of London's Queen Mary and Westfield College and his Brazilian colleague Silvia Giuliatti Winter, Prometheus actually makes contact with Ring F at intervals of nineteen years. The most recent collision occurred in 1990. [31]

Two cycles may be at work—the 15-year cycle of oblique ring inclinations, which greatly influences the visibility of any intrinsically faint exterior Ring to telescopic observers, and the 19-year cycle of collisions of Prometheus with Ring F, which determines the amount of material present in the Ring. Both cycles coincided very favorably during the early 1950s, so it may be no coincidence that a spate of sightings occurred during those years.

An emerging consensus supports the view of Eugene Shoemaker that the Rings of Saturn and the other Gas Giants are not primordial leftovers from the days of the formation of the planets, but are instead the short-lived products of an ongoing process of creation and destruction. The untold thousands of moonlets embedded in the Rings of Saturn are the likely source of material for the youthful Rings we see today, requiring only collisions with one another or with a passing meteoroid or comet to give birth to new rings.

Do such collisions periodically replenish an exterior Ring which evolves before our very eyes? It is estimated that the prominent A Ring consists of the remnants of a satellite only about 30 miles (48 km) in diameter, so the far more delicate feature described by Schaer would have signified a rather minor catastrophe.

The Saturn revealed by the Voyager spacecraft vindicated many telescopic observers who had studied the planet under superb conditions with good instruments but whose reports had been greeted with scepticism and even ridicule. The principal Rings really were "minutely subdivided into a great number of narrow rings" as George Bond of Harvard College Observatory had claimed in 1851. The Cassini Division really was "not devoid of material" as Camille Flammarion had alleged in 1899. Most improbably, even the ephemeral radial spokes first reported in 1896 by Eugene Antoniadi proved to be only too real. Perhaps Schaer and his successors witnessed transient phenomena in a ring system far more complex and dynamic than anyone dared to imagine until very recently.

FOOTNOTES

[1] A.F.O'D. Alexander, *The Planet Saturn —A History of Observation, Theory, and Discovery*, Faber & Faber, London, 1962. p. 259.

[2] William Francis Denning's classic book, *Telescopic Work for Starlight Evenings* (London, Taylor and Francis, 1891. p. 209), contains a cryptic reference to earlier observations: "Exterior to the outer ring a faint luminosity has been suspected, as though the phenomenon of the inner ring [Ring C] has its counterpart there."

[3] R. Jarry-Desloges, *Observations des Surfaces Planetaires*, Fascicule I, 1907, Paillart, Abbeville. p.106.

[4] Emile Schaer, "Observations de Saturne et de ses Anneaux." *Astronomische Nachrichten*, No. 4331, 177-181 (1909).

[5] *Ibid.*

[6] *Ibid.*

[7] "Notes on the Appearance of Saturn's Rings, 1908 October." *Monthly Notices R.A.S.*, LXIX.1 (Nov. 13, 1908).

[8] R. Jarry-Desloges, *Observations des Surfaces Planetaires*, Fascicule X, Annees 1926-1941, Paillart, Abbeville.

[9] E.E. Barnard, "Recent Observations of the Rings of Saturn." *Monthly Notices , R.A.S.* LXIX.8 (June 11, 1909).

[10] Henry E. Paul, *Telescopes for Skygazing*, Amphoto, Garden City, New York, 1976. pp. 119-120.

[11] Harrie Rutten & Martin van Venrooij, *Telescope Optics—Evaluation and Design,* Willmann-Bell, Richmond, VA, 1988. pp. 53-55.

[12] William Sheehan, *The Immortal Fire Within—The Life and Work of Edward Emerson Barnard,* Cambridge University Press, 1995. p. 398.

[13] Barnard, *Op. Cit.*

[14] Henry C. King, *The History of the Telescope*, Dover Pub., New York, 1979. pp. 419-421.

[15] *Astronomische Nachrichten*, No. 4457, 186 (1910).

[16] *Astronomische Nachrichten*, No. 4461, 261 (1910).

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[19] Richard M. Baum, "On the Observations of the Reported Dusky Ring Outside the Bright Rings of Saturn." *Journal , B.A.A.*, 64:192 (1954).

[20] O. Richard Norton, "Cave Optical Company." *Sky & Telescope*, August, 1994. pp. 88-93.

[21] Thomas A. Cragg, "A New Ring Around Saturn?" *Journal, A.L.P.O.,* 8:22 (1954).

[22] Letter from Thomas Cave to Thomas Dobbins, Feb. 7, 1996.

[23] Werner Sandner, *Satellites of the Solar System*, Scientific Book Club, London, 1965. p.76.

[24] Alexander, *Op. Cit.*, p. 319.

[25] Sandner, *Op. Cit.*, p. 77.

[26] Walter A. Feibelman, "Concerning the 'D' Ring of Saturn." *Nature*, 214:793 (1967).

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[28] Dennis di Cicco, "Occultations and the Amateur", *Sky & Telescope*, Nov., 1988. p. 480.

[29] Glen Reed *et al.*, "Extended Glow Preceding Reappearance of Saturn During a Lunar Occultation." *Nature*, 247:447 (1974).

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An Independent Confirmation of an Outer Dusky Ring of Saturn

By: Walter H. Haas, A.L.P.O. Director Emeritus

On February 23, 1952 (or perhaps one or two days either earlier or later) near 10h 30m UT, Mr. Cecil Post observed Saturn with a 6-inch, f/10 Newtonian reflector at 180X. The sky was very clear and the seeing must have been fairly good. The planet was 54° above the horizon and near an azimuth of 195°. The observation site was in Las Cruces, New Mexico.

Mr. Post was surprised to see a faint dusky ring *exterior* to Ring A. He found this feature perhaps one-half as bright as the familiar Crepe Ring (Ring C) and two or three arcseconds wide. The demands of his job allowed the observer only a brief look. The telescope had been directed to Jupiter the previous evening and had been left outside and "ready for action"; it was hence fully adjusted to the outside temperature. The observer recorded no notes and made no drawing.

Mr. Post soon reported this observation orally to Walter Haas, who said, correctly, that an outer dusky ring of Saturn has been a controversial feature for many years, and also said, very unfortunately, that an observation without a drawing is no observation. Thus this observation has been known over the years only to the observer and to those friends whom he told about it.

At the time of the observation Mr. Post had no knowledge whatsoever of the existing past reports relating to an outer dusky ring. The troublesome power of suggestion is here completely ruled out.

It may be relevant to state the values of several physical quantities on 1952 Feb 23: Polar diameter of Saturn 16".9; major axis (bright) Rings, 42".6; minor axis (bright) Rings, 6".8; tilt, B, of Saturn's axis to Earth, +9°.3; tilt, B', of axis to Sun, +7°.8; phase angle, i (Earth-Saturn-Sun angle), 3°.84 (computed by Walter Haas from 1952 *Astronomical Almanac* data).

[*Note by Editor:* Likewise in the 1952-53 observing season, the Swiss planetary observer Claude du Matheray recorded an exterior dusky ring, as is shown in *Figure 5* of the preceding article (p. 152).]

Results and Analysis of the A.L.P.O. Survey: Perceptions and Opinions about Association Operations, with Proposals for Positive Growth

By: Matthew L. Will (Survey Analyst), A.L.P.O. Board Member, A.L.P.O. Training Program Co-Coordinator

Abstract

On October 15, 1998, all current A.L.P.O. members, a smaller number of lapsed members and a still smaller number of non-members who participate in A.L.P.O. observing programs, received the A.L.P.O. Survey Questionnaire. The purpose of the survey was to solicit opinions and gauge perceptions of those that belong to or otherwise participate in our organization. Also, in understanding their perspective of the A.L.P.O., we can better assess deficiencies in services the A.L.P.O. Board regulates and can modify approaches to assisting members in their enjoyment of what the A.L.P.O. sections have to offer. Questions covered personal background, interest in Solar System astronomy, A.L.P.O. literature, and section management. A database was constructed focusing on comments and answers to survey questions. An analysis was performed and the results are discussed in the text, tables, and figures of this report. The A.L.P.O. is a very mature organization; not just in age but in its approach to lunar and planetary astronomy. The A.L.P.O. attracts both casual and serious amateur astronomers but tends retain serious amateurs with matured skills. This report proposes that, to survive, the A.L.P.O. must adapt itself to the broader amateur community through a higher profile and implementing programs and services that appeal to a broader base of amateurs without detracting from its current mission, the scientific study of the Solar System. A longer report was released to the A.L.P.O. Board of Directors on June 1, 1999. This article is a condensed version of that report. It is hoped that enough information has been reported to understand the conclusions.

Introduction

At the A.L.P.O. Board of Directors Meeting in July, 1998 Matthew Will proposed polling our members. Over the past 5 to 10 years, members, staff, and the Board have been concerned about the decreasing membership in the A.L.P.O. (see *Figure 1*, p. 156). At previous conventions considerable debate and opinions have focused on the decline of the A.L.P.O. membership. However, given our limited attendance at conventions and the inherent difficulties of trying to "go on record" with such opinions with the Board and staff, Mr. Will proposed a membership survey. The purpose of this survey was to provide a focus for consolidating opinions and understanding the perspective of the A.L.P.O. membership and its various constituencies and groupings within the Association. The data within these pages should provide an objective basis for decision making but not necessarily the answers to all problems the A.L.P.O. may face.

Compilation of Survey Data

On the week of October 11, 1998, the A.L.P.O. Survey Questionnaires were distributed to A.L.P.O. members, lapsed members, and non-members who participate in A.L.P.O. programs also received questionnaires. [Because of its considerable length, and because most of our readers have already seen it, the survey questionnaire itself is not reproduced here. Ed.] Our Membership Secretary Harry Jamieson mailed questionnaires via the U.S. Postal Service for those without e-mail addresses. Matthew Will, coordinator and analyst for the A.L.P.O. Survey, e-mailed questionnaires to those of the membership who were "online". The questionnaires sent through the post office included a self-addressed stamped envelope (SASE) to encourage a response. A total of 615 were sent out both through the postal mail and e-mail. A categorized breakdown of the distribution can be reviewed in *Tables 1* and *2* (p. 156). In this report, I will refer to

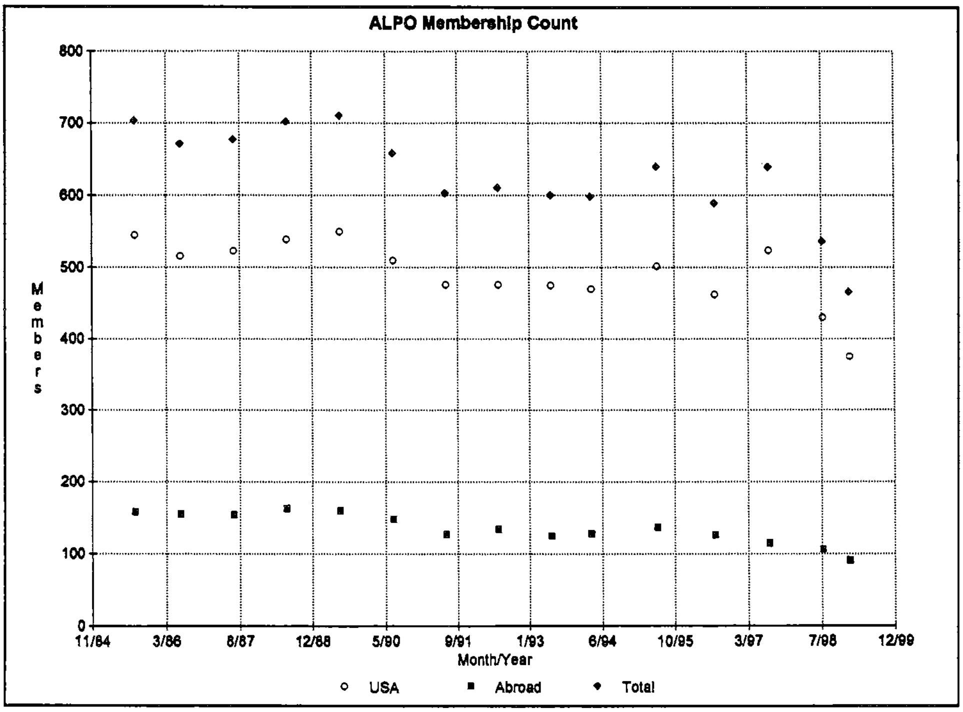


Figure 1. A.L.P.O. domestic, foreign, and total membership size, 1984-1999.

Table 1. Distribution of the Survey.

Participant Category	Postal	E-Mail	Total
Domestic Members	261	158	419
Domestic Lapsed Members	121	0	121
Domestic Non-Members	3	44	47
International Members *	0	14	14
International Non-Members	0	14	14
Totals	385	230	615

Table 2. Responses to the Survey.

Participant Category	Postal	E-Mail	Total	Response Rate
Domestic Members	116	34	150	35.8%
Domestic Lapsed Members	15	0	15	12.4%
Domestic Non-Members	0	3	3	6.4%
International Members *	0	11	11	78.6%
International Non-Members	0	4	4	28.6%
Totals	131	52	183	29.8%

* Postal surveys were mailed to domestic members while e-mail coverage extended to international members as well as domestic members. There were a total of 106 international members in the A.L.P.O., only 14 with e-mail addresses at the time of the survey.

the total group of respondents of the survey (members, lapsed members, and non-members) as simply the "respondents". Some of the analysis will involve only A.L.P.O. member responses and this group will be identified using terms such as "members" or "the membership".

To manage the survey data properly, a spreadsheet was developed and was used to store many of the results from the survey. All the numerical and multiple-choice answers to survey questions were entered into the spreadsheet. Responses to some "short answer" questions were also entered into the spreadsheet database whenever responses could be tabulated easily. However, most of the questionnaire's 32 questions were "short answer," and not easily translatable to a spreadsheet format. For these, detailed log books were kept, recording concisely responses to short-answer questions from each member by question. The answers to most short-answer questions are presented in tables within this report.

The spreadsheet data were sorted and cross-indexed with groupings of respondents. These groups are categories of respondents that answered certain questions that distinguished themselves from other respondents. It was useful to track different interest groups and how they fitted in with the respondents overall. These groups defined themselves by different experience levels or observing skills, participation in A.L.P.O. programs, age, length of membership, web use, and so on. There were 18 different groups analyzed for this survey. The groups are always subsets of the total number of respondents and are not necessarily mutually exclusive of one another; a respondent can be associated with several groups depending on the nature of a question being studied.

Throughout the text of this report, the reader will be referred to its figures and tables. The rest of this report will focus on specific question categories as they relate to these figures and tables.

The A.L.P.O. Membership Profile

Perhaps, before we dive into the issue of what is right or wrong with the organization., we should get to know our membership better. The A.L.P.O. Survey asked respondents to answer questions about themselves.

The average A.L.P.O. member is 50 years old. All sub-groups seem to have an mean age close to the mean for the entire group of respondents within ±2 years. Later in this report, there will be more comments about the reasons why we have so many older members. The age range of the respondents from the survey runs from 14 to 85 years (see *Figure 2*, below). Males outnumbered females 17:1. A typical member has been with us for 12 years. This average member joined the A.L.P.O. at age 38. Advanced and active observers appear to join at a younger age than the total group whereas beginners tend to join at an older than average joining age. A typical member is likely to have found out about the A.L.P.O. through popular astronomy publications such as *Sky & Telescope* and *Astronomy*.

A member or participant in the A.L.P.O. tends to be a member of a local astronomy club and may be a member of many other international astronomy organizations, although no members gravitate around any one particular organization. *It has been suggested by other members in this survey that we consider an outreach methodology for the local clubs, soliciting membership directly from them.* Understanding the exposure that our members already have to local clubs, it might be worthwhile to set up such a program.

There appears to be no strong relationship between age groups and responses to questions about general interest levels in lunar and planetary astronomy. The age groups have similar proportional numbers related to interest, activities and opinions

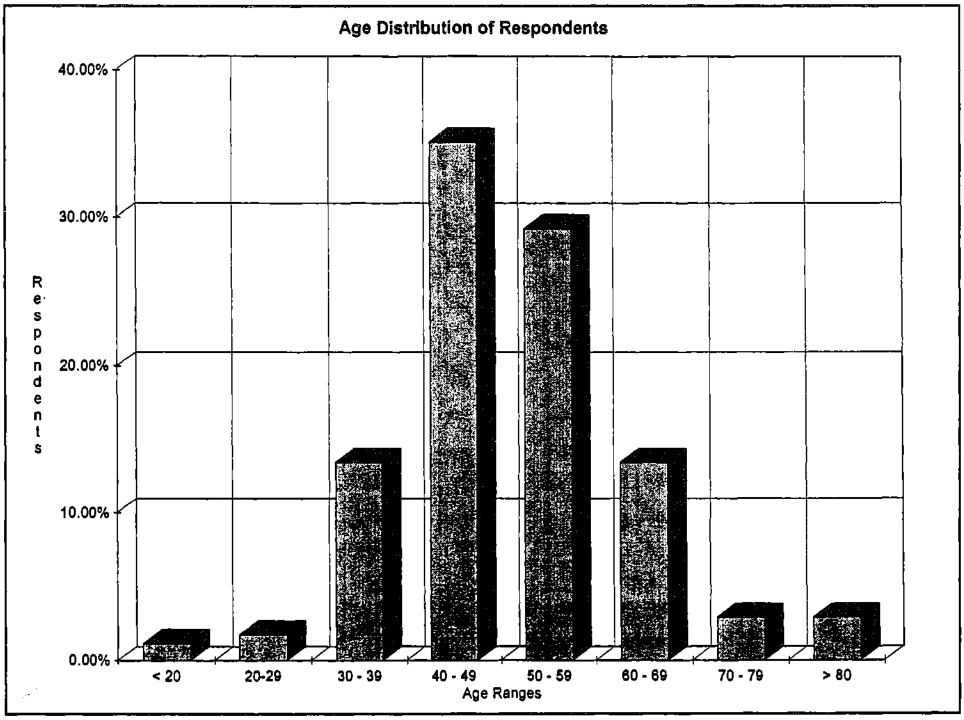


Figure 2. Distribution of survey respondents by age range.

concerning amateur astronomy, which is probably remarkable in itself.

Most members appear to be employed in a wide variety of professional careers. However, many are retired (17 percent). Another 13 percent are employed in semi-skilled or vocational labor. Over 8 percent did not reply. One out of ten members derives at least a part-time living from astronomy. Interestingly, most in the astronomy-related occupations (professionals, educators, instrument manufacturers) rate themselves as having photographic observing skills.

The Survey asked about avocational interests the respondent might have had other than astronomy. For the most part, interest varied enough that there did not appear to be a strong tendency toward, say, the arts or the sciences or toward sporting and outdoor activities. *However, it was surprising that there were special interest areas such as photography, bird watching, ham radio, and amateur geology that had a high representation among members in our organization.* Also, there were some that simply answered "yes" to this question without divulging their interest. Over one quarter of the respondents either indicated no interests or did not respond.

Interest and Participation in Sections

The A.L.P.O. Survey asked respondents to rate their experience level in observing the Solar System; identifying oneself as a beginner, with not much previous observing experience; an intermediate observer, with some experience recording planetary observations; or an advanced observer, having some years of observing and participating in A.L.P.O. observing programs. The respondents as a whole were split between intermediate and advanced observers, with a smattering of persons identifying themselves as beginners. Slightly more judged themselves to be intermediate observers rather than advanced (see *Figure 3,* to upper right). Most of our younger respondents (under 40) rated themselves as intermediate. Older (over 40) and active observers tended to fall in the advanced category.

When respondents were asked about their observing skills, the vast majority indicated visual observation. Many also responded that they have additional observ-

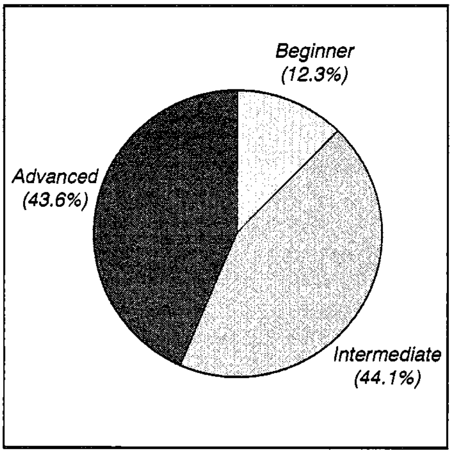


Figure 3. Experience level of observers represented in the survey.

ing skills (see *Figure 4*, p. 159). Photography was the runner up to visual observation, with video/CCD finishing third and photometry a distance fourth. These interest levels were consistent among all sub-groups in the survey.

A serious effort was made to identify members who were active observers. Active observers were identified from the answers given from two questions in the survey: (1) Question 4 simply asked, what A.L.P.O. programs do you participate in? (2) Question 6 asked about member inactivity. If a member did not respond to Question 6 he or she could be considered active (see *Figure 5*, p. 159). There were more active observers answering Question 4 than there were not answering Question 6. *If we used Question 6 as a more stringent qualifier for activity, then roughly one third of the respondents actively observe.*

Interest and participation levels change appreciatively among some subgroups. *Figure 6* (p. 160) shows interest versus participation for each section. As with the main group of all respondents, Jupiter is the most popular and active section in the A.L.P.O., followed by Mars and then Saturn. Please note that this survey was conducted before the 1998-1999 Martian Apparition was in full swing. So it is possible that if the survey had been conducted in Spring, 1999, the Mars Section would have been more popular than when the survey actually took place.

There is a distinct difference in responses between Question 1 of the survey, inquiring about A.L.P.O. section interest, and Question 4, asking about A.L.P.O.

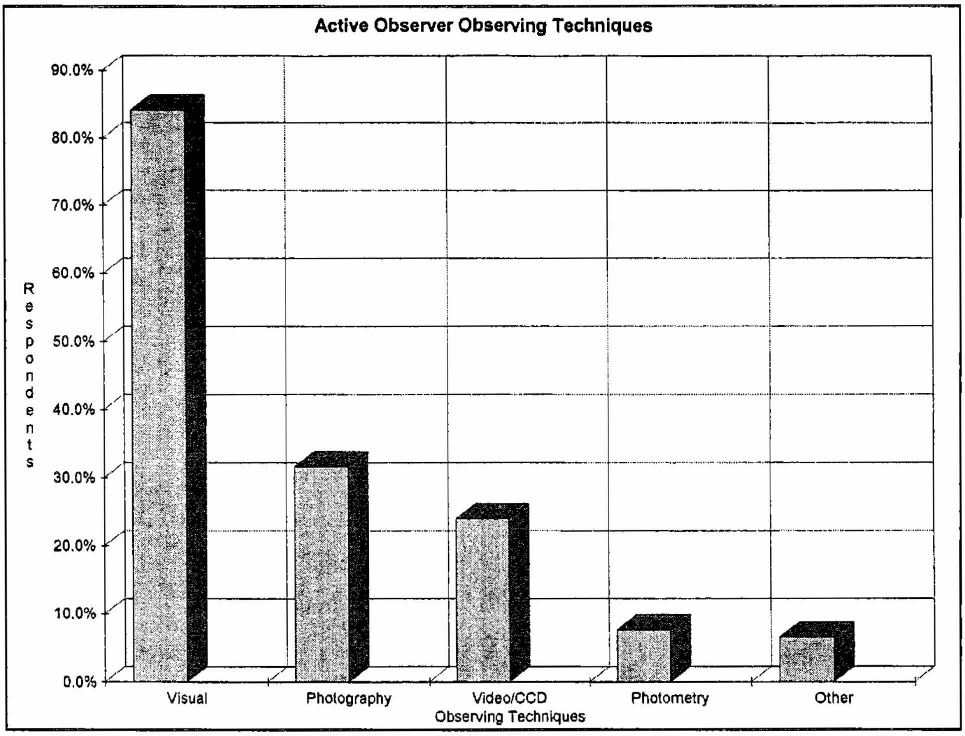


Figure 4. Observing technique used by active observers among the survey respondents.

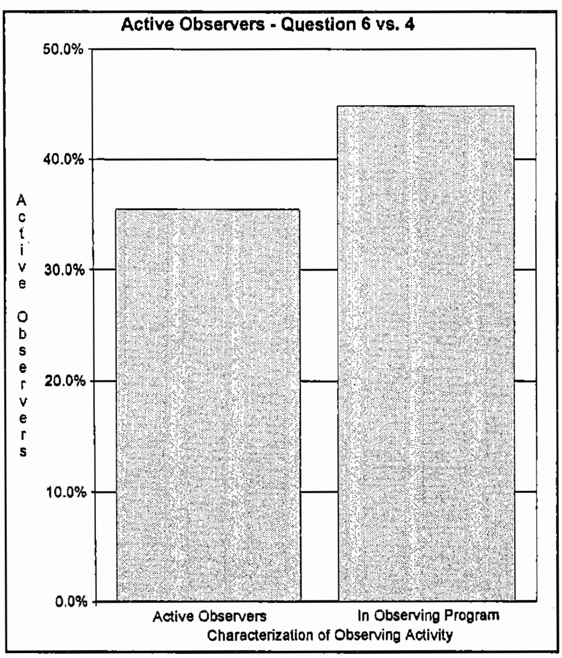


Figure 5. Form of observing activity among the observers represented in the survey.

observing program participation. Interest and actual participation can be two different things. One can read the sections newsletters and *Journal, A.L.P.O.* and become interested in a variety of topics but never submit observations. This aspect of interest versus participation was especially striking with the General Lunar Programs Section (now renamed the Lunar Topographical Studies Program). A total of 67 respondents indicated a definite interest in this section on Question 1. However, only 6 responded that they were active in this program!

Question 5 of the survey asked the respondent to list A.L.P.O. literature acquired over the last 5 years, where "A.L.P.O. literature" was considered to be anything other than the *Journal, A.L.P.O.* since every member receives that publication (see *Figure 7*, p. 160). It was determined how many requests for material there were and what kinds were obtained. Approximately half of those responding said that they had ordered some form of A.L.P.O. literature. This is about the same fraction of those considered to be active observers, as determined from Question 4. The *Training Program Handbook* was the most frequently purchased piece of

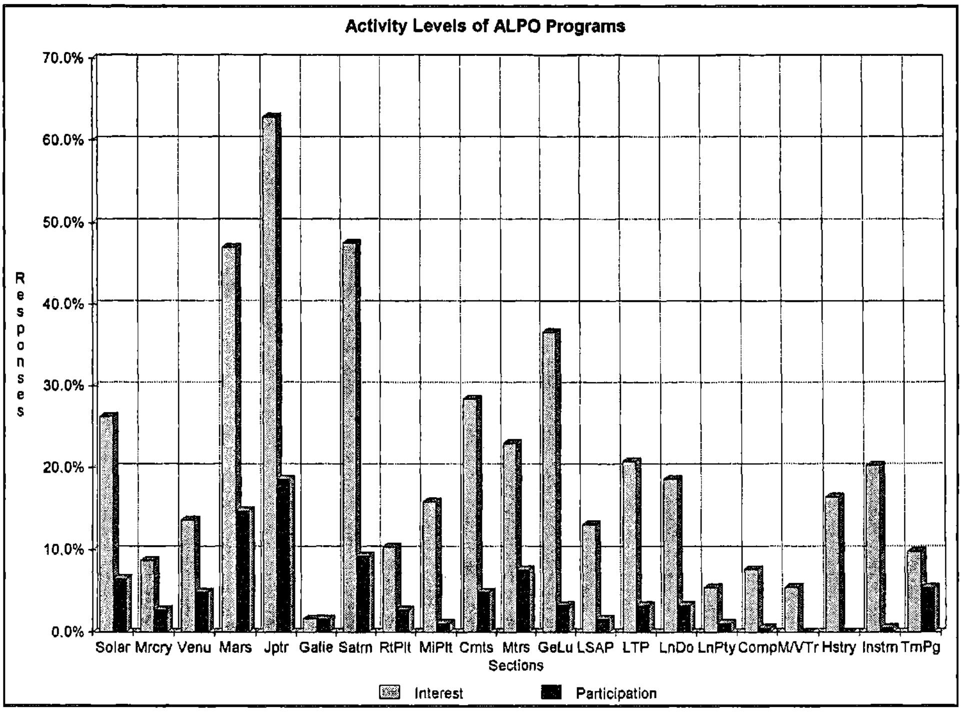


Figure 6. Activity levels of survey respondents among the A.L.P.O. programs.

Abbreviations are as follows: Cmts = Comets, Comp = Computing; Galie = Galilean Satellites; GeLu = General Lunar Studies; Hstry = History; Instm = Instruments; Jptr = Jupiter; LnDo = Lunar Domes; LnPty = Lunar Photometry; LSAP = Lunar Selected Areas Program; LTP = Lunar Transient Phenomena; M/VTr = Mercury/Venus Transits; MiPlt = Minor Planets; Mrcry = Mercury; Mtrs = Meteors; RtPlt = Remote Planets; Satrn = Saturn; TrnPg = Training Program; Venu = Venus

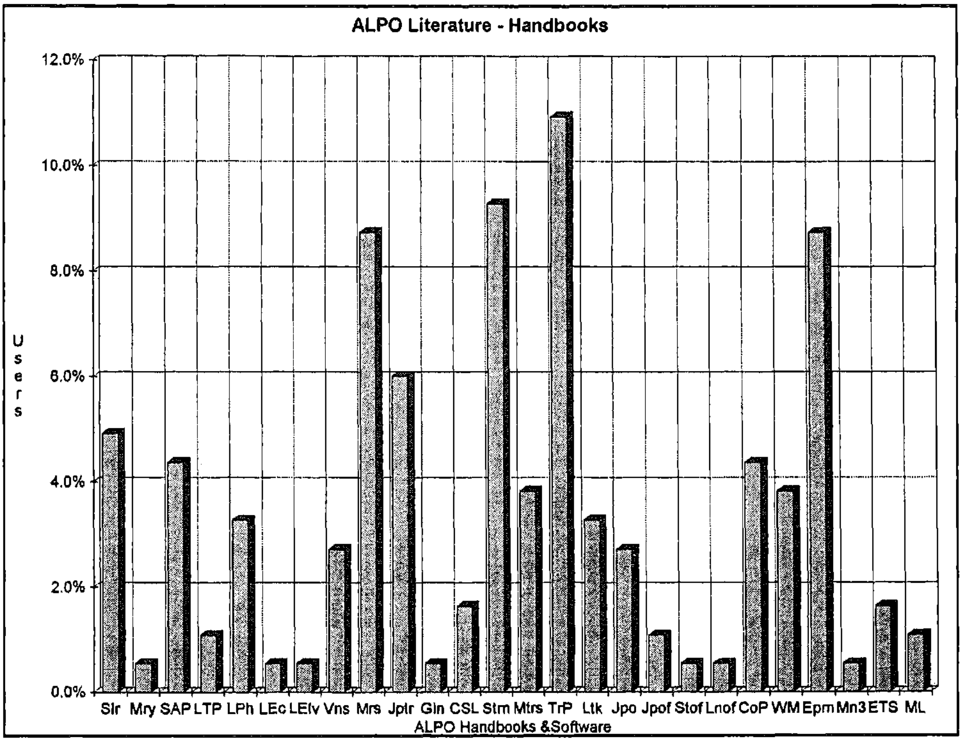


Figure 7. Section handbooks acquired by survey respondents. Abbreviations are defined on p. 161.

Abbreviations Used in Figure 7:

CoP	Convention Proceedings
CSL	Comet Shoemaker/Levy
Epm	ALPO Solar System Ephemeris
ETS	Exploring the Solar System with the ALPO
Gln	Galilean Satellites
Jpo	Jupiter Observing Kit
Jpof	Jupiter Observing Forms
Jptr	Jupiter
LEc	Lunar Eclipses
LElv	Lunar Elevations
Lnof	Lunar Observing Forms
LPh	Lunar Photometry
Ltk	Lunar Tool Kit
LTP	Lunar Transient Phenomena
ML	Membership List
Mn3	Monograph No. 3
Mry	Mercury
Mrs	Mars
Mtrs	Meteors
SAP	Lunar Selected Areas Program
Slr	Solar
Stof	Saturn Observing Forms
Strn	Saturn
TrP	Training Program
Vns	Venus
WM	Wilkins Moon Map

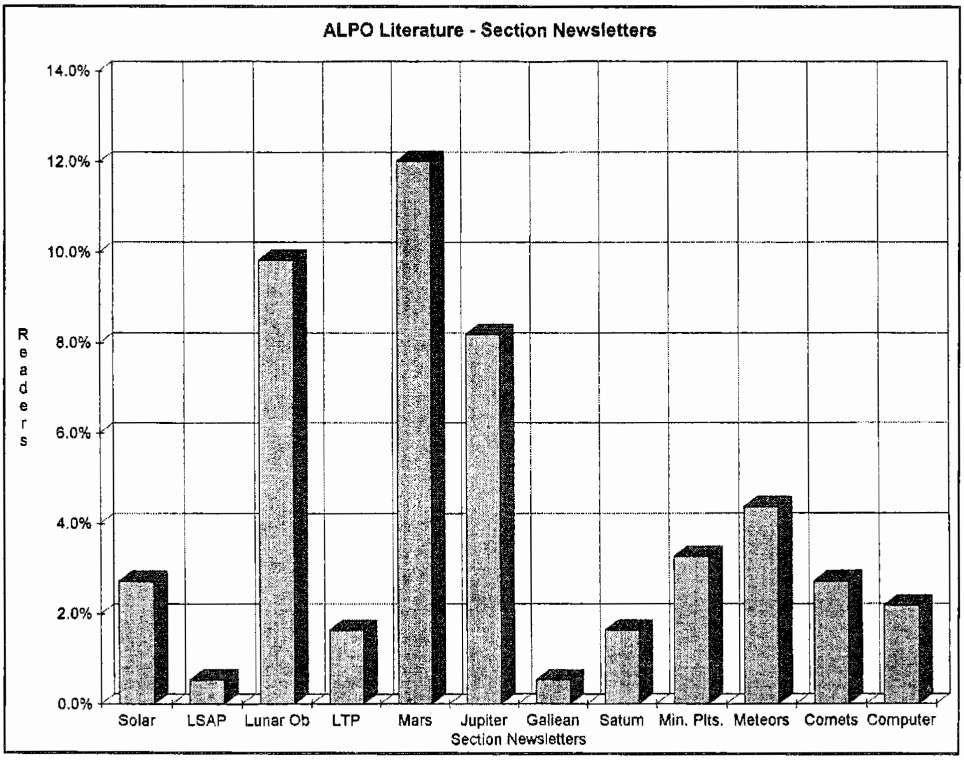


Figure 8. Section newsletters acquired by survey respondents.
Abbreviations are as follows: LTP = Lunar Transient Phenomena; LSAP = Lunar Selected Areas Program; Lunar Ob = Lunar Observer; Min. Plnts. = Minor Planets

A.L.P.O. literature. The *Saturn Observing Handbook* and the *A.L.P.O. Solar System Ephemeris* were second and third, respectively, followed by what I believe are past editions of the *Jupiter Observing Handbook.*

Section newsletters were similarly popular, with the Mars newsletters being most favored (see *Figure 8*, above). The *Lunar Observer* and the Jupiter newsletter were also very popular. Others were mentioned but did not have the interest levels of these three. When asked how survey respondents rated the section newsletters for relevance, understanding, and reading enjoyment, most that responded rated them excellent or good, more saying that the newsletters were excellent. For more detail on this topic, see *Figure 9* (p. 162), a three-dimensional graph that depicts interest levels going across the page and each interest category going into the page. The percentage of responses is proportional to the height of each block. It appears that most people rated the newsletters best at covering relevant topics, rated understanding the material second and judged reading enjoyment the least of these three broad classifications of writing quality.

Turning to the inactive observers, Question 6a of the survey addressed their inactivity and why they have problems in participating in A.L.P.O. programs (see *Figure 10*, p. 162). The nature of this question was not intended to blame members

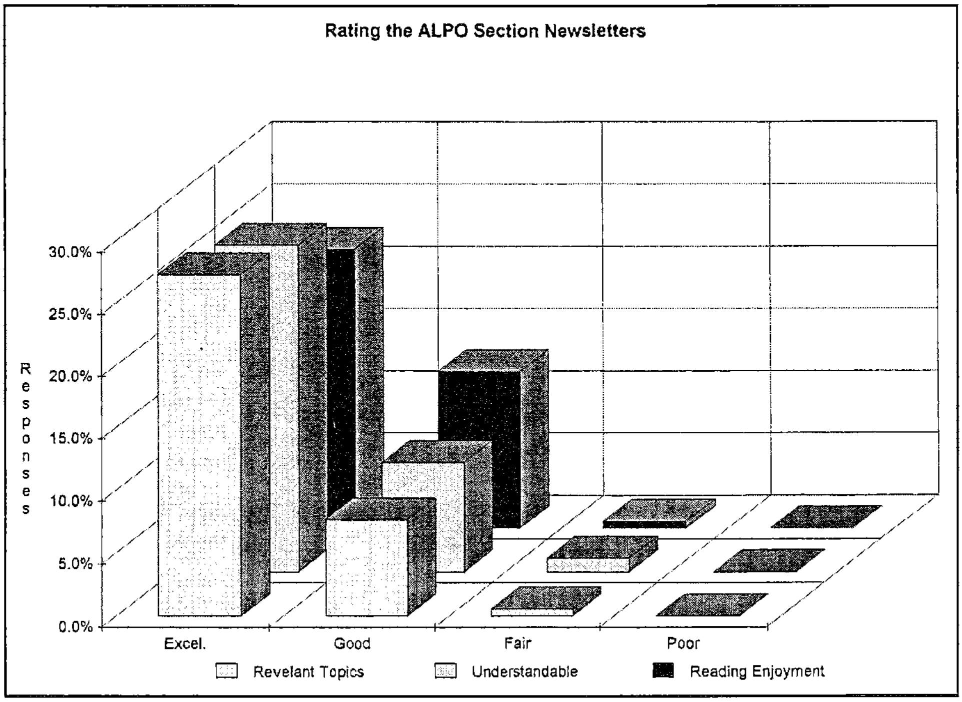


Figure 9. Rating of section newsletters by survey respondents.

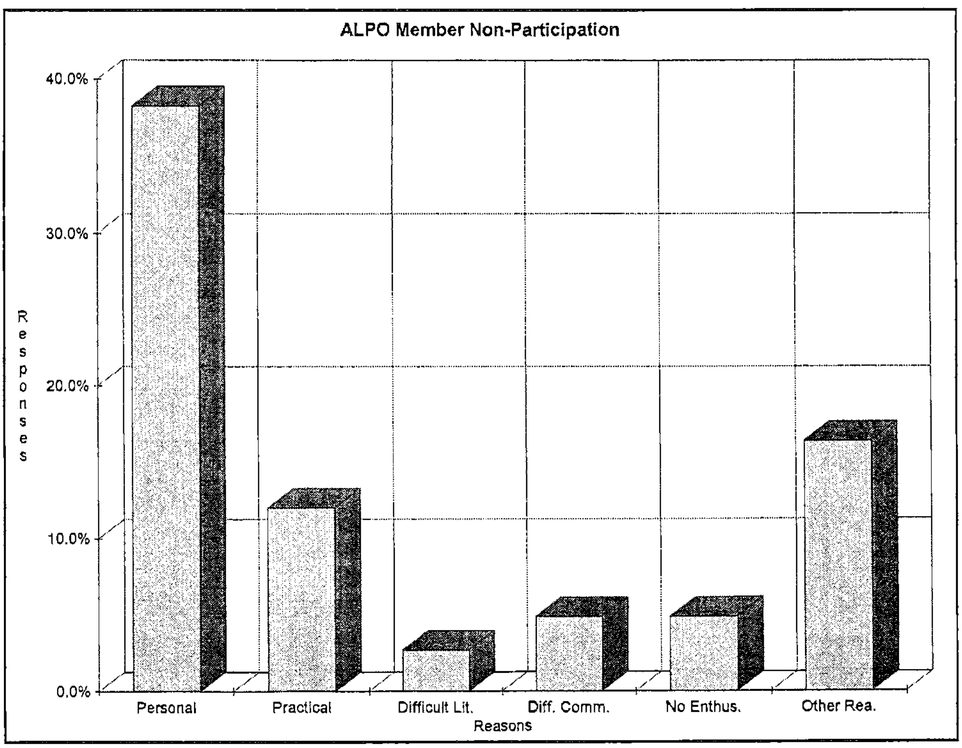


Figure 10. Reasons for not participating by non-participating member survey respondents. Abbreviations are as follows: Difficult Comm. = Difficult Communications; Difficult Lit. = Difficult Literature; No Enthus. = No Enthusiasm; Other Rea. = Other Reasons

for not participating in A.L.P.O. observing program. As explained in the survey:

> "The A.L.P.O. considers its non-activity members who do not participate in A.L.P.O. programs/activities to be just as vital and important to the A.L.P.O. as our active members. The membership of non-participants is still an endorsement of the A.L.P.O.'s mission which is wholeheartily appreciated by the organization."

Nearly half the respondents stated that their inactivity was due to either personal or work-related commitments or that the practicality of their living circumstances did not permit them to observe outdoors. These are people who are in demanding careers or need to devote considerable time to their families. Some can not observe because the local urban environment discourages it or they suffer from a disability or some impairment that keep them indoors. *About 20 respondents or one-ninth of those polled said that they had problems with the A.L.P.O. literature, A.L.P.O. staff, or the A.L.P.O.'s style of managing sections.* Generally, most of these complaints centered around lack of acknowledgment of observations or a lack of feedback on observations performed. Some had other reasons for not observing, such as not having a telescope or the proper equipment to observe. Other miscellaneous reasons people gave for not being active included other astronomical commitments, and observing only for personal enjoyment. Others said they thought that they could not produce results acceptable for study. One specifically said that he could not produce CCD images like Don Parker's and thought this held him back from participating in the A.L.P.O. observing programs.

THE JOURNAL

One of the most important elements of membership in the A.L.P.O. is the accompanying subscription to the *Journal of the Association of Lunar and Planetary Observers*, otherwise known as "The Strolling Astronomer." Every member receives it and therefore, can fairly evaluate it, giving an opinion about whether or not it meets his or her interest. A series of questions were asked about how members and former members perceived the Journal.

Respondents were asked, "What do you like best about the Journal?" The list of responses to this question is in tabular form (see *Table 3*, lower right). The format of tables used in the analysis of the short-answer questions lists all responses, by popularity of responses in descending order, with the *actual number* of responses to the right on the table. So, the frequency of the responses is expressed as an actual count, and *not* a percentage. About five-sixths of the respondents answered this question. Almost all the responses appear to have dwelled upon content. The vast majority of answers centered around the reader's interest in reviewing observations of others, and the scientific treatment of topics in the *Journal, A.L.P.O.*

Fewer persons responded in the question "What do you least like about the Journal?," which is encouraging. About half of respondents replied. So by this we can assume that more people think favorably of the *Journal, A.L.P.O.* than those that don't. But many that liked the Journal still had constructive criticisms (see *Table 4*, p. 164).

Table 3. Responses to the Question: "What do you like best about the Journal?"

Answer	Total Responses	Lapsed and Non-Members Responses
No response.	*31*	*11*
1. Observations submitted by observers.	26	3
2. Detail and completeness, scientific treatment.	23	4
3. Apparition and Section Reports.	21	1
4. Variety.	13	
5. Fine, just the way it is.	11	
6. Good data and informative articles.	11	2
7. Letters to the editor.	10	
8. Observation reports.	8	1
9. Observing techniques and how-to articles.	7	
10. Technical articles/research reports.	5	
11. Announcements.	5	
12. Learning from the written analysis.	4	
13. Outlet for amateur research.	4	
14. My participation in observing programs.	4	
15. Book Reviews.	3	
16. Lunar articles.	3	
17. Special interest articles.	3	
18. Historical information on planets.	3	
19. Staff changes.	1	
20. References to literature.	1	
21. Reports on annual conventions.	1	
22. Articles outlining needed future observations.	1	

No further analysis of the answers was performed.

Table 4. Responses to the Question: "What do you least like about the Journal? "

Answer	Total Responses	Lapsed and Non-Members Responses
No response.	*57*	*13*
Nothing.	*20*	*2*
1. Long lag time between events and reports.	18	1
2. Dry style, uninteresting.	12	3
3. Publishing schedule irregular.	8	1
4. Too few articles about observing techniques.	6	
5. Too technical for inexperience observers.	6	
6. Letters, endless arguments.	4	1
7. No stated purpose for observations or suggestions where to send them.	4	
8. Layout and typeset.	3	
9. Not thick enough.	3	
10. Bad quality of photo reproduction.	3	
11. More general articles for less advanced members	3	
12. Database driven articles.	3	
13. No immediate news about other research, i.e. other organizations.	3	
14. Not enough general background (history, skills topics, etc.) in Section Reports.	2	
15. Not enough articles for less experienced observers.	2	
16. Lack of explanation of technical terminology.	2	
17. Restrictions of writers/submission policies.	2	
18. Some papers lack scientific content.	2	
19. Information doesn't seem usable for my observations.	2	
20. Lack of reports from some sections.	2	
21. Seems a "contrived" attempt at serious work.	2	

22-33. One (total) response each: Not enough variety; Smallish physical size; Too long between issues; Needs to be more user friendly; Too many Jovian satellite reports; No color; Individual meteor reports should be summarized; Apparition reports hard to follow; Skeptical of Mercury, Venus, and LTP reports; Lunar articles, dislike; Inaccessibility of members; Too few historic articles.

Analysis of the Question: "What do you least like about the Journal? "

Categorization of answers	Total Responses
Content of the Journal.	40
Written quality of the Journal.	21
Comments about the distribution of the Journal.	17
Production quality of the Journal	11

Respondents were asked to rate the Journal in terms of reading enjoyment, understanding, and relevant topics. A three-dimensional graph (*Figure 11*, p. 165) was produced that was identical in format to *Figure 9*, which concerned interest levels with the A.L.P.O. section newsletters. In general, the results are similar to the rating of the section newsletters. However, judging from the spread of the numbers, there appears to be more dissatisfaction with the *Journal, A.L.P.O.*, with a greater proportion of people rating it fair to poor in all categories than with the newsletters. Again, as with the section newsletters, there tends be higher satisfaction with relevant topics covered in the Journal. As with the newsletters, smaller numbers are satisfied with understandability of the *Journal, A.L.P.O.*, with the most dissatisfaction expressed with over reading enjoyment. *Over one quarter of those responding found the Journal fair to poor for reading enjoyment.* These results did not vary significantly among subgroups. However, more lapsed members tended to rate the *Journal, A.L.P.O.* "good" for all categories rather than "excellent".

Another question was "What improvements or changes would you like to see in the *J.A.L.P.O.*?" Less people responded to this question than with the first two questions, (see *Table 5*, p. 165). However, half of our respondents did reply. Comments concerning the content of the Journal were numerous. After that, distribution of the *Journal, A.L.P.O.* was of more concern than the production quality or writing style of the articles and papers.

In summary, the people that complained about the Journal generally have difficulty integrating it into their interest in lunar and planetary observation. Sometimes this is due to the writing style of the papers. Other times terminology is not defined well in the papers. Section reports and research papers in the *Journal, A.L.P.O.* are not necessarily items that the membership can easily embrace. Members have expressed desire for articles that can help improve their performance as lunar and planetary amateurs. Despite these difficulties though, the membership as a whole, still has a positive regard for the Journal.

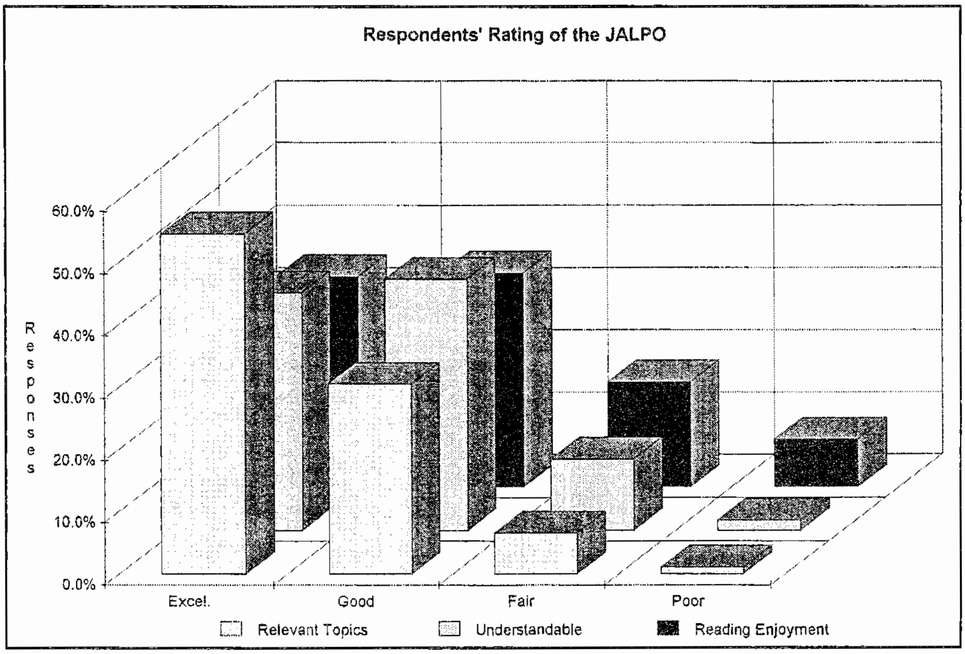


Figure 11. Survey respondents' rating of the *Journal, A.L.P.O.*

Table 5. Responses to the Question: "What improvements or changes would you like to see to the JALPO?"

Answer	Total Responses	Lapsed and Non-Members Responses
No response.	*67*	*13*
None.	*18*	*5*
1. Timely publication.	13	3
2. Telescopic and observing techniques and "how-to" articles.	9	
3. More timely articles or at least interim apparition reports.	9	2
4. Articles for newcomers.	6	
5. Increase page count.	6	
6. Present material, apparition reports, should be better written.	6	
7. Needs more general articles that are "non-technical".	4	
8. Color photos.	4	
9. Articles on history of astronomy/ALPO history.	4	
10. Change layout, less dense typography, glossy paper better quality images.	4	1
11. Have a beginner section or average member with no scientific interest.	3	
12. Articles that are more educational, provoking enthusiasm and popularizing.	3	
13. Personal accounts of observing experiences.	3	
14. More correlations with professional astronomy, justification of observing.	3	
15. Hard, meaningful in depth reviews of books.	2	
16. More non-technical articles.	2	
17. More lunar articles.	2	
18. Enlarge size.	2	
19. "Sampler program" of larger sections.	2	
20. Data could be presented in a narrative form instead of tables.	2	

21-43. One (total) response each: Better print quality; More letters to the editor; Radio astronomy, amateur level; Like it the way it is; Attempts to solicit broader participation; Have a less snobbish demeanor; More terminology definitions in the text; More information on comets; Pare down useless sections, Mercury and Venus; Information about meeting topics; More "original" research articles; News notes about sections and members; Less reliance on internet distribution & access; Like to see more about observatories; Less strict submission requirements; Web journal for younger members; Breaking up articles for shorter reading; More drawings/less CCDs, for the beginner; More on current items and future events; More pictures; Publish monthly; Highlight a section with each issue, explain activities; Publish at 2 to 3 month intervals.

Analysis of the Question: "What improvement or changes would you like to see to the JALPO?"

Categorization of answers	Total Responses
Content of the Journal.	64
Comments about the distribution of the Journal.	26
Production quality of the Journal.	12
Written quality of the Journal.	6

THE A.L.P.O. WEBSITE

One portion of the A.L.P.O. Survey Questionnaire was devoted to the A.L.P.O. Web Site and computer-related issues. Nearly, four-fifths of those responding use computers in some way. Slightly more than half of the respondents said they use IBM compatibles. Only 10 percent use Apple computers (see *Table 6*, below).

Table 6. Responses to the Questions: "Do you use a computer? If so, what kind? "

Answer	Total Responses
No response.	*7*
No.	34
Yes, not specified.	19
IBM compatible.	90
Apple.	17
Sun and IBM.	4
IBM and Apple.	2

Respondents were asked, "Do you use the A.L.P.O. Web Site?" This was posed as a short-answer question and the answers fell into four categories (see *Figure 12*, upper right). Respondents either answered: (1) yes, (2) occasionally, (3) no, but I will check it out, or (4) no. The first three answers imply that the respondent can view the web page with possibly varying degrees of effort, so we can assume access is possible for them and not possible for those that answered simply "no".

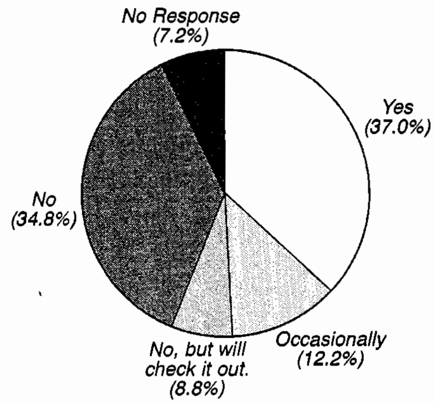


Figure 12. Survey Respondents' Use of the A.L.P.O. Website.

About 58 percent of our respondents said that they have used the A.L.P.O. web site at least once. *About three-eighths of all respondents use the web site actively.* Responses to this question were analyzed by subgroups. Those 60 years of age or older were less likely to use the web site. Most beginners do not use the web site either. More than a half of the active and advanced observers use the A.L.P.O. Web Site and appear to be the web site's primary users. The largest number of e-mail responses came from these two subgroups.

Table 7. Responses to the Question: "What do you like best about the ALPO web site? "

Answer	Total Responses	Lapsed and Non-Members Responses
Not applicable/do not use web site.	*90*	*13*
1. Quick updates on planetary phenomena, alerts.	32	7
No response.	*13*	
2. Informative.	12	
3. Nice lay out, easy to navigate.	11	
4. Recent observations.	11	4
5. Newsletters.	7	2
6. Everything is good.	6	
Nothing.	*5*	
7. Addresses of contacts and staff.	4	
8. Its existence, start of a good idea.	4	1
9. Near real time imagery.	4	
10. Easy to link with other web sites.	3	
11. Observing forms.	3	
12. Solar Section.	3	
13. Jupiter Section.	3	1
14. Section pages.	3	1
15. Matt's Section.	2	1
16. Communications between staff and members is easy.	2	

17-25. One (total) response each: Ephemeris data; Announcements; Observing program information; Good access to the ALPO in general; Lunar Section; Clock; Events; Saturn Section (lapsed/non-member); Great variety of material shown.

Analysis of the Question: "What do you like best about the ALPO web site? "

Categorization of answers	Total Responses
Content-related comments.	64
Comments about style of presentation.	25

The observing skills subgroups (other than visual observing) aligned themselves very closely in web use along with the advanced and active subgroups. Non-active observers fall in between, in that only a third of them use the web site, while one-half appear to have access to it but only one-fifth responded to the survey via e-mail. *One conclusion that could be drawn is that lack of use of the web site is due to an absent of resources, namely a PC at home, as opposed to not being interested in the web site due to the actual content on the site.*

Respondents were asked, "What do you like best about the A.L.P.O. Web Site?" Most answers were centered on the content of the web site (see *Table 7*, p. 166).

Fewer people answered the question, "What do you least like about the A.L.P.O. Web Site?," than the last one (see *Table 8*, below). The most frequent responses concerned out-dated observations and material on the web site. Some had difficulty reading the text on the site because some color combinations with the text blend into the background. Still, others thought information for some sections was too sparse. Downloading times appear to run too long for other respondents. More comments were given about content than style of presentation.

A related question was, "What changes would you like to see to the A.L.P.O. web pages?" Most comments concerned content development and management (see *Table 9*, p. 168). Many of the same complaints from the previous question were reworded by respondents as suggestions for improvement.

It should be noted that our A.L.P.O. Web Master, Rik Hill, has already reviewed these comments from the survey about the web site and is working very closely with the A.L.P.O. Section Staff to improve the many functions of the site. Many items addressed by the respondents have already received Mr. Hill's attention.

MAKING A BETTER A.L.P.O.

The next few questions solicited opinions about how the A.L.P.O. might improve itself and become a more useful organization for its members. The answers to these questions were for the most part wide-ranging, thought-provoking, provocative, and carefully crafted.

One survey question asked, "What would you like to see changed in the A.L.P.O. to make it a more 'user-friendly' organization?" About half those polled responded to this question (see *Table 10*, p. 168). There were many good suggestions. The largest plurality, one-third of the comments, focused on the need for beginner support. Second most in the minds of the respondents were improvements tied to the productivity of the A.L.P.O. There were a sizable number wanting more casual astronomy in the A.L.P.O. and better communications with staff.

Table 8. responses to the Question: "What do you like least about the ALPO web site?"

Answer	Total Responses	Lapsed and Non-Members Responses
Not applicable/do not use web site.	*90*	*12*
No response.	*28*	*2*
1. Out-dated observations/material.	16	2
Nothing.	*15*	
2. Some color combinations for text and background impossible to read.	7	
3. Background image overwhelming/too much attention to graphics.	6	
4. Some section information sparse.	4	
5. Download time too long for oversized graphic.	4	4
6. Infrequent updates.	3	
7. Lack of observing kit and aids.	2	
8. Poor quality reproductions of observing forms - Jupiter.	2	

9-22. One (total) response each: Out-of date e-mail addresses; I am satisfied; Poor use of submitted photos; Poor communications section to section; Clock quits working after a few minutes; Not very informative (lapsed/non-member response); Nothing to make me come back - outdated; More hype; Update "What's New" more often; Lack of a JALPO online; More articles for beginners; No archiving of old articles; Better layout; No info on CMs, on drift rate for planets (lapsed/non-member response).

Analysis of the Question: "What do you like least about the ALPO web site?"

Categorization of answers	Total Responses
Content-related comments.	32
Comments about style of presentation.	24

Table 9. Responses to the Question: "What changes would you like to see to the web pages?"

Answer	Total Responses	Lapsed and Non-Members Responses
Not applicable/do not use web site.	*90*	*12*
No response.	*36*	*4*
1. More updates.	15	5
None.	*10*	
2. Change background and colors to make text easier to read.	4	
3. Show only the latest images to reduce downloads.	3	1
4. Input from all; not just the advanced members*.	3	
5. Purge out-of-date information?	2	
6. Okay as is.	2	
7. Online observing kits.	2	
8. Post educational material about the Solar System for the public.	2	

9.-29. One (total) response each: Correct information about addresses?; Get rid of typewritten forms, go digital; Radio astronomy coverage; Inclusion of how-to articles; Good observations; Links to members' home pages; Add minor planets finder charts for one or two per month; Have section databases online; Reduce size of background graphics; Coordinators should publish reports on web; Simplify first page; Font size too large.; More informative (lapsed/non-member response); Section news; Add upcoming events.; Up-date "What's New" for observing alerts; JALPO online; Access old articles mentioned in ALPO manuals.; Calculator for Jovian features, clock showing transit time; More items of immediate interest, transient solar system phenomena; Online Solar System Ephemeris.

*let amateurs post their own observations; eg., shallow - sky mailing list.

Analysis of the Question: "What changes would you like to see to the web pages?"

Categorization of answers	Total Responses
Content-related comments.	40
Comments about style of presentation.	12

Table 10. Responses to the Question: "What would you like to see changed in the ALPO to make it a more "user-friendly" organization?"

Answer	Total Responses	Lapsed and Non-Members Responses
No response.	*46*	*3*
Nothing.	*38*	*6*
1. JALPO easier to read for casual membership/less technical.	7	
2. Staff should be friendly/good communication/quick response.	7	
3. Okay as is.	6	
4. More motivation for observing, appeal for observations.	5	
5. Better "updated" information on web page/better coordinator input on web site.	5	1
6. Observation section, for members to submit for interest sake, not usefulness.	4	
7. More frequent JALPO.	3	2
8. Articles from young members/better outreach.	3	
9. Lower entry level programs for beginners.	3	
10. Solicit clubs "point-of-contact" like the AL/contact with local observers.	3	
11. Prompt publication of section reports.	3	
12. Articles for beginners.	2	
13. Master observing manual/general starter package.	2	
14. Bring back the newsletter (TTT).	2	
15. JALPO needs to broaden audience to teachers and students.	2	
16. Bring back the ALPO Ephemeris.	2	
17. Section materials need to be online for foreign members. (Can't send SASEs)	2	1
18. Less demanding observational procedures.	2	
19. Central ordering of publications.	2	
20. Advertise in *Sky & Telescope.*	2	

21-51. One (total) response each: Joint AL and ALPO meetings; Acknowledgment of drawings; Notification of events; More feedback from coordinators; Don't like firing of past recorders; All sections need regular newsletters; Promotional items; Newsletters should be driven by observations, not articles; Closer conferences; Better organization of sections; Discrete projects for observers; Immediate use of observations; Tangible benefits at conventions for work done; Remove restrictions on letters to the editor; Split up ALPO into two groups beginners and advanced; JALPO articles on historical events; More; Membership drive, emphasis on enjoying Solar System observations; More advertising; Chat areas on internet; More active Solar Section; More active Jupiter Section; More how-to articles.; Work with AL in certificate program; Critiques of observations by more proficient observers; Weekly hotline for member input (lapsed/non-member response); Divide JALPO into a newsletter and journal; More planetary news from professionals; Team up with Planetary Society; JALPO more widely published; More updated articles in the JALPO.

Analysis of the Question: "What would you like to see changed in the ALPO to make it a more 'user-friendly' organization?"

Categorization of answers	Total Responses
Need for beginner support.	20
Improvements tied to productivity of ALPO.	15
Members wanting more casual astronomy.	13
Better communications.	13
Members wanting local club interaction.	4

Another question asked, "What services would you like to see offered by the A.L.P.O., that aren't available today." Less than half responded to this question (see *Table 11*, below). About one-third of the comments stressed a need for better products. On the top of the list was a request to bring back the *A.L.P.O. Solar System Ephemeris*. Some wanted better services. There was equal interest in seeing that "timely" bulletins appear on our web pages. This was perhaps in reference to the clutter that sometimes causes slow downloads, rather than just getting items up on the web promptly. Concerns for section management were also expressed in terms of the way that services are being rendered.

Finally the respondent was asked, for any other comments or criticisms that he or she would like to make or are there any aspects of the A.L.P.O. that they would like to address that had not been touched upon in the survey? This was the last question in the survey (see *Table 12*, p. 170).

CONCLUSIONS

It is apparent from the feedback and data complied from this survey that the A.L.P.O. is a very mature organization, with a high mean age for its members and participants. Maturity is also pervasive in the A.L.P.O., in terms of the level of sophistication of the literature we produce, the activities we sanction, and the caliber of observers who are active in the organization.

Yes, active and advanced observers can take full advantage of what the A.L.P.O. has to offer in the way of products and as an outlet for directing observer output. It is true that the mean joining age and mean age of new members in the active and advanced observer camps are younger than the total group mean. However, this signifies the A.L.P.O.'s appeal to skilled observers, to those with a taste for sophistication and to those that have the will and energy to take on the A.L.P.O.'s challenge.

The A.L.P.O.'s mission and institutional attitude can be contrasted with the personal circumstances of the would-be newcomer. One interpretation of this survey is that most amateur astronomers are inclined toward casual, non-intensive astronomical activities. Between school and, later on, raising families in the midst of managing careers, the intensity level for serious amateur astronomy might not have a chance to develop. Only in later years, when the family is well along and the career is assured, do most people have time for personal growth projects. This could be a plausible explanation for the maturing of

Table 11. Responses to the Question: "What services would you like to see offered by the ALPO, that aren't available today?"

Answer	Total Responses	Lapsed and Non-Members Responses
No response.	*69*	*15*
None.	29	
1. Bring back the ALPO Ephemeris.	8	
2. Timely bulletins concerning transient phenomena through e-mail and web.	3	
3. Don't like the renewal notices are sent with JALPO, send separately.	2	
4. Involvement in radio astronomy.	2	
5. More notification of upcoming observing events.	2	
6. Put run programs on the web.	2	

7-36. One (total) response each: Better quality printing of handbooks; Borrowing of the ALPO's rare planetary books and journals; Hard copy of the ALPO Ephemeris; Hard copy membership list; Hat, logos, membership cards, T-shirts, etc.; A page for amateur observers not associated with observing programs; Observing forms made larger in size; Information package for astronomy clubs; All sections need regular newsletters; Don't like renewing newsletter separately; Program of discounts of astronomy literature and material from companies; Training sessions at a local conference; Permanently staffed office; Outreach service - answering questions of members not active in programs; Put Training Program on the web; A booklet on observing the sun in the H-alpha filter for amateurs; Publicize its own manuals for general availability; Online message board where people can post question to coordinators; Video tape and photos to a wider audience; Observing program for interest sake as opposed to gathering useful data; ALPO news releases for club newsletters; Encourage e-mail chat group; JALPO on the web site; An easier way for Europeans to pay dues with Credit Card; More active solar division; End articles with info about program and how to get involved; Information package for all sections; A complete observing manual for all observing sections (lapsed/non-member response); Could we obtain and lend instruments, such as the BAA does? (lapsed/non-member response).

Analysis of the Question: "What services would you like to see offered by the ALPO, that aren't available today?"

Categorization of answers	Responses
The need for better products.	17
The need for better services.	17
Concerns for section management.	13

Table 12. Responses to the Question: "Do you have any other comments or criticisms that you would like to make or are there any aspects to the ALPO that you would like to address that have not been touched upon in this survey?"

Answer	Total Responses	Lapsed and Non-Members Responses
No response.	*59*	*11*
None	33	4
1. Great organization to be with/satisfied.	15	1
2. Thanks for this survey.	6	
3. We may be scaring away newcomers with our sophistication & commitment level.	5	
4. I value the ALPO and my membership.	3	
5. Higher profile at star parties and in the magazines.	2	
6. Bring back ALPO Ephemeris	2	
7. Could use a recruitment campaign, around an event.	2	
8. Needs to be attractive to young members/better outreach.	2	1
9. Timely publishing.	2	1
10. Section for less advanced observers/Special projects section.	2	
11. Would be interested in observing programs.	2	
12. Material could be written in a more inviting manner for newcomers.	2	

13-48. One (total) response each: You have a great new director; Too much politics; Wrong papers of little interest; Didn't like Jeff Beish's writing style; Friends quit because of time limitations; Break with tradition, change ALPO logo; More newsletters; Bring back upcoming events; Have ALPO materials available to clubs for people to review and decide on joining; Have other amateurs seen UFOs like me?; Friendlier staff (lapsed/non-member response); Local training sessions; Should have asked members if they maintain a web page; Section news; I know the survey has been a lot of work; Have learned a great deal, motivation has been stimulated by participation; Past problems with past Jupiter recorders, Budine, Westfall & McAnally were okay; Journal needs better writing; Encourage people to send in basic drawings; ALPO serves a community of amat. astrnmrs. who don't meet critical standards; ALPO portrayed as a bit of an elite group—Scary to non-members; We need proactive coordinators not afraid of more members and data; Tell Walter Haas not to get discouraged—We all believe in the mission of the ALPO; More Jupiter observation reports; Live in remote area now; Stronger Solar program; Too much of a reliance on computers for staff members; Quitting the ALPO; Don't find justification for a paid staff; Think professionals are disinterested in ALPO; Dismayed over deep-sky interest; Mail a copy of JALPO to each astronomy club in the USA; Reduced personal income, will not renew (lapsed/non-member response); Important segment of amateur astronomy (lapsed/non-member response); Might become a member (lapsed/non-member response); Promote strong collaboration with other world-wide organizations (lapsed/non-member response).

Analysis of the Question: Do you have any other comments or criticisms that you would like to make or are there any aspects to the ALPO that you would like to address that have not been touched upon in this survey?

Categorization of answers	Responses
Complimentary words.	30
Suggestions to better the ALPO, organizational & sectional changes.	12
Attitudes toward policy.	10
Product dissatisfaction.	7
Miscellaneous comments.	7
JALPO changes.	6
Product development.	5

the A.L.P.O. based on the responses from the survey. *Figure 10* and the answers to *Question 6a* help support this conclusion.

There is more evidence from the survey to support this conclusion. For example, more members with ages in the 40s joined the A.L.P.O. between ages 40 to 49 than any other age group. As *Figure 13* (p. 171) shows, a clear majority of current members joined the A.L.P.O. between the ages of 30 and 49. This is apparently a trend that has been going on for some time. This is not simply a result of the population of members getting older in the absence of younger ones joining. *We actually attract older people or people with a matured interest in lunar and planetary astronomy. In other words, what we do, serious observations and research, attracts people with both the time and patience for academic detail.* Thus our problems may be associated with the product we sell as much as it is with exposure to potential members.

The A.L.P.O. has three options that it can pursue for its future. First, it can accept the current course, remaining a scientific organization producing mainly highly sophisticated observational reports, and live with an older and perhaps increasingly smaller membership. Second, it could drop its current mission and appeal to a younger population that does just casual lunar and planetary astronomy. Or, third, it could become a hybrid of the previous two models in such a way that would please both segments, casual and serious amateur astronomers. This last option would probably be preferable; however, such modifications to the institutional personality of the A.L.P.O. are not without pitfalls and will take considerable planning.

There is no shortage of ideas on how to open the A.L.P.O. to newcomers and casual amateurs; just read the comments from the tables in this report. Basically, we must have a plan for attracting people out-

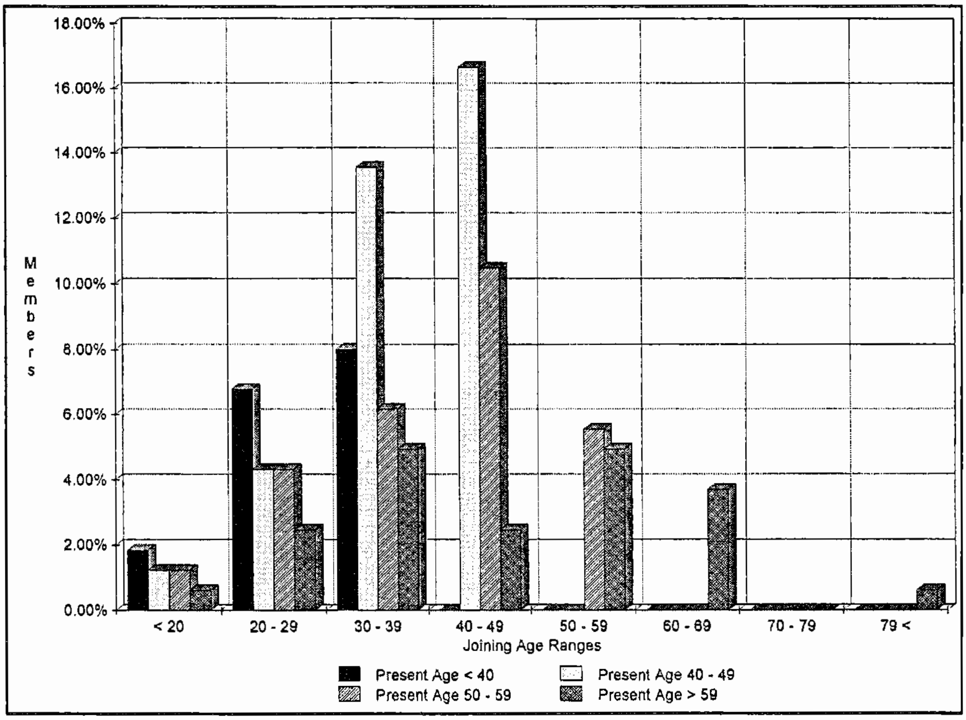


Figure 11. Age of joining the A.L.P.O. versus age at time of survey, for survey respondents.

side the organization and making available services that appeal to those less inclined to participate in the formal observing programs. One way may be to associate the A.L.P.O. more closely with local astronomy clubs. There is a high correlation between members that belong to local clubs and belong to the A.L.P.O. Perhaps a package designed for local clubs to stimulate interest in lunar and planetary astronomy and the A.L.P.O. could help in recruiting new members. Also, many present members state that they first learned about the A.L.P.O. in *Sky & Telescope* and other periodicals. A continued presence in these magazines, in order to continue a steady stream of newcomers coming into the A.L.P.O., is essential. A higher profile at conferences outside the yearly convention and in media outlets related to astronomy will help as well.

Of course, we will need to have programs and services appealing to a broader audience. Perhaps some currently existing programs, along with newer ones, could be placed under one umbrella that would accommodate beginners. The Training Program, Instruments Section, Lunar Topographical Studies Section, a section for general planetary astronomy, Publicity Section and Membership Secretary's Office could all be loosely linked to provide support for people coming into the A.L.P.O., as well as outreach for those considering membership. The general planetary astronomy section could be administered through a quarterly column in the Journal (or a separate newsletter like the old *Through the Telescope*, were it revived) that "baits" people into working on smaller projects, giving them a taste for submitting observations to the A.L.P.O. This is similar to what the late Walter Scott Houston used to do in his "Deep-Sky Wonders" column in *Sky & Telescope*. Results from the observations could be reported in a following issue. Some plan will be needed to keep our more casual members in the A.L.P.O. This recommendation is based on my interpretation of the survey data.

The potential of local clubs and the media for use in attracting newcomers and beginners has previously been mentioned. The internet and the A.L.P.O. Web Page will be part of this process, but they need to be integrated with other plans. Only the active and advanced observers make significant use of the web site; this is not because of the content of the web page but that they have the resources (i.e., a PC) to access it. Many beginners and non-active members do not have PCs, as the survey bears out.

Certainly, PC and web access will grow in the future. However, the profile of the website user is one that is more technically involved with the A.L.P.O. Perhaps this profile could change. However, for the present we should be mindful that, while the web site should be part of a integrated campaign to solicit new members, the range of people we attract with it may be limited.

Epilogue

It is possible that the A.L.P.O. can adapt itself to the current trends in amateur astronomy without sacrificing its mission or soul. Considerations for making such changes need to be thought out carefully. What is offered here is an approach based on the data from our survey. Manpower and implementation issues need to be resolved.

In the final analysis, the A.L.P.O.'s diminishing membership is due in large part to our presence or lack of it in the field of amateur astronomy and how we are perceived. Cultural and social trends away from the sciences are certainly contributing to this, but this process is something over which we have little or no control. The concluding proposal stated that we adapt the organization to the broader amateur astronomy community. What has been offered is an interpretation of the data from the survey and a direction for preventing further erosion of our membership, while still providing stability to the organization.

Acknowledgements

I here thank the A.L.P.O. Board of Directors for their support by authorizing this survey, particularly Harry Jamieson for providing diligent and dependable service in mailing out the printed copies of the A.L.P.O. Survey, which was no easy task. Also, special thanks go to Don Parker and Rik Hill. They, along with Harry, resolved issues concerning specific membership problems that were brought to my attention through the survey. Last, but certainly not least, I express my gratitude to the A.L.P.O. members and non-members that participated in this survey. Without them, this study could not have been performed.

In Memoriam: Charles M. Cyrus

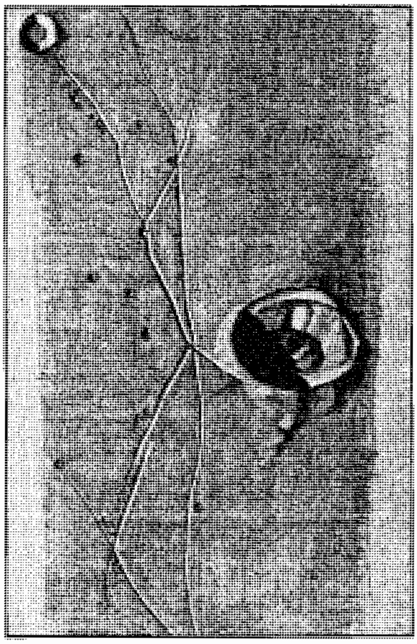
Notes by Walter H. Haas, A.L.P.O. Director Emeritus

Charles M. Cyrus, of Baltimore, Maryland, died in October, 1999 of head trauma complications after a traffic accident.

He was a very early member of the A.L.P.O., and indeed belonged to that small group of cooperating amateur astronomers of the Moon and bright planets whose efforts in the late 1930s and 1940s led to the founding of the A.L.P.O. in 1947. Other early members included Hugh Johnson, Tom Cave, Latimer Wilson, Frank Vaughn, Ed Martz, David Barcroft, J. Russell Smith, and Walter Haas. Mr. Cyrus was then an active observer with a 10-inch reflector in Lynchburg, Virginia. Two drawings by him of Mars during its 1941 Apparition are shown on the front cover of this issue. A drawing by Charles Cyrus of the lunar crater Triesnecker and its associated clefts appeared on the cover of our June, 1962 issue, and is reproduced to the right.

A most loyal supporter of the A.L.P.O. over the years, he even recently declined the offer of a free membership. Mr. Cyrus observed from Baltimore with his 10-inch reflector, replaced eventually with a 12-1/2 inch instrument. In the 1950s and 1960s, he regularly contributed observations to our Venus, Mars, Jupiter, Saturn and Lunar Sections. He participated in our 1986 Convention in Baltimore, at which time he was corresponding with our Mars Recorders about the best applications of color filters in studies of that planet.

He will be remembered as a friendly and helpful colleague who always shared with others his keen interest in our skies.



Triesnecker (right of center) and its cleft system as drawn by Charles M. Cyrus under low morning lighting (Colongitude 008°.4)on 1961 Jul 21, 00h55m-01h45m UT. 10-in (25-cm) Newtonian, 316X. South at top.

Observing the Moon: Mountains

By: Bill Dembowski, Coordinator, A.L.P.O. Lunar Section, Lunar Topographical Studies

The mountains of the Moon are quite different from those of Earth. In fact, by earthly standards, they are not really mountains at all. On Earth, mountains are formed by tectonic forces; the folding and lateral movement of the crust. On the Moon, however, nearly all of the mountains are the result of impact events. The classic examples of this are the Montes Carpatus, Apenninus, Caucasus, Alpes, and Jura, which encircle the Imbrian Basin. [Note: *Montes* is the Latin for mountains, or mountain range; the singular, *Mons*, is used for individual mountains or peaks.] They are nothing more than segments of the broken rim of an enormous impact crater. For our purposes, however, the fact that they do not form a continuous circle makes them mountains, rather than a crater rim.

It was once believed that lunar mountains were extremely high, jagged formations. That belief was the result of reasoning that, since there were no erosive forces on the Moon, the mountains would remain unweathered. This view appeared to be enforced by the long, sharp shadows cast by the mountains, but that was an illusion brought about by observers tending to view them under low sun angles. The true forms of lunar mountains became clear from orbital and surface views of the Moon in the 1960s.

Beginning with the mountains outlining the Imbrian Basin, we see the Montes Carpatus range, which marks the southern border of the basin. They extend for 400 km (250 mi) from the crater Tobias Mayer in the west to Gay-Lussac, just north of Copernicus, in the east.

Proceeding in counter-clockwise order, we next encounter the spectacular Montes Apenninus, which many believe to be the most beautiful mountain range on the Moon. An indication of their origin is the fact that they present a much steeper angle on the side facing the Imbrian Basin than they do on the side which faces away; a characteristic of impact crater walls. The Montes Apenninus extend from near Eratosthenes in the southwest, through a sweeping arc to the juncture of Mare Imbrian and Mare Serenitatis in the north; a distance of about 650 km (400 mi; *Figure 1*, below). Points of interest along the way are several major peaks. Mons Wolff, near the southern end of the Apennines, rises about 3600 m [meters] (12,000 ft). Mons Huygens, about halfway up the range, is the highest peak at 5400 m (18,000 ft). Farther north we encounter Mons Bradley at 4200 m (14,000 ft) and end with Mons Hadley near the northern extreme at 4500 m (15,000 ft). At this point the Apennines are joined by the Montes Haemus which run for 400 km (250 m) to the southeast, forming the southwest border of Mare Serenitatis.

The Montes Caucasus can almost be considered an extension of the Montes Apenninus. The former extend from the border of Mare Imbrian and Mare Serenitatis to the crater Eudoxus, a distance of about 520 km (323 mi). The highest points in the Caucasus range rise 6000 m (20,000 ft) above the adjoining maria. When exploring this area, be sure to spend some time looking at the crater Calippus, which lies about midway in the range. The somewhat deformed shape of Calippus makes for some very interesting viewing.

Continuing our sweep around the Imbrian Basin, we come to the Montes

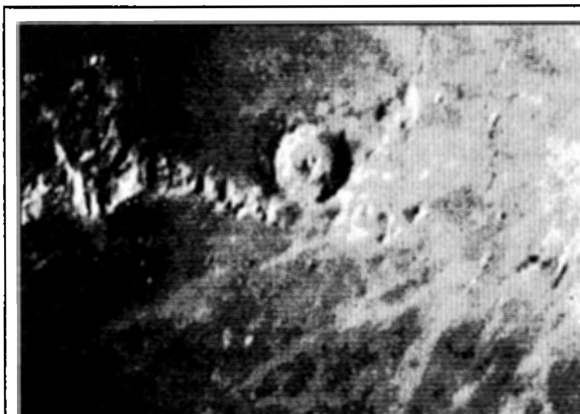


Figure 1. Eratosthenes (above center) and southwest Montes Apenninus (upper left). CCD image by William O'Connell, Whitman, MA. 1998 Nov 14, 10h10m UT. 20-cm (8-in) Sch.-Cass. Colongitude (lunar longitude of sunrise terminator) 213°.5. South at top.

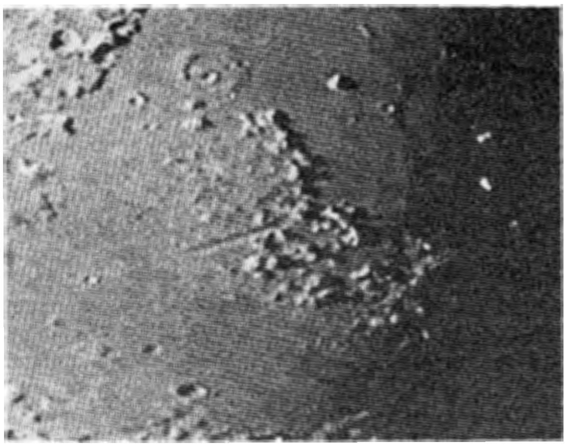


Figure 2. Montes Alpes (center), with Vallis Alpes; Montes Caucasus in upper left. Video frame by Patrick Anway, Munising, MI. 1999 Jun 22, 02h30m UT. 28-cm (11-in) Sch.-Cass. Colongitude 009°.9. South at top.

Alpes (*Figure 2,* above). The Alps begin just northwest of the crater Cassini and proceed for 250 km (155 mi) with heights that average between 1800 and 2400 m (6000-8000 ft). The gem of the lunar Alps is, of course, the Vallis Alpes. This 8-km (5-mi) wide gash runs for 180 km (110 mi) through the mountain range. With steep, parallel walls and a flat floor, it is interpreted to be a graben, similar to the basin of the Red Sea on the Earth. Grabens are areas that have subsided between two nearly parallel faults. It is virtually impossible to view this area of the Moon without pausing at the Vallis Alpes.

The final stop in our tour of mountain ranges is at the Sinus Iridum, the Bay of Rainbows. When lunar observers talk about the beauty of Sinus Iridum they are actually referring to the Montes Jura, the mountain range that frames the bay. Sinus Iridum is the flooded remains of a major impact that occurred after the formation of the Imbrian Basin. The Montes Jura are bounded by Promontorium Laplace on the northeast and Promontorium Heraclides on the southwest. These mountains reach their highest elevation, 6000 m (20,000 ft) near their center. The most prominent crater in the range itself is Bianchini, also near the mid-point. Sunrise on the many peaks of this crescent shaped range is one of the most beautiful sights on the Moon.

There are, of course, other mountain ranges on the Moon. Some are as extensive as those just discussed. Others, like the Montes Spitzbergen, north of the crater Archimedes, are more accurately described as mountain clusters rather than ranges. Any good lunar map or atlas will cite their locations. Our attention, however, now turns to a second class of lunar mountains, the isolated peaks.

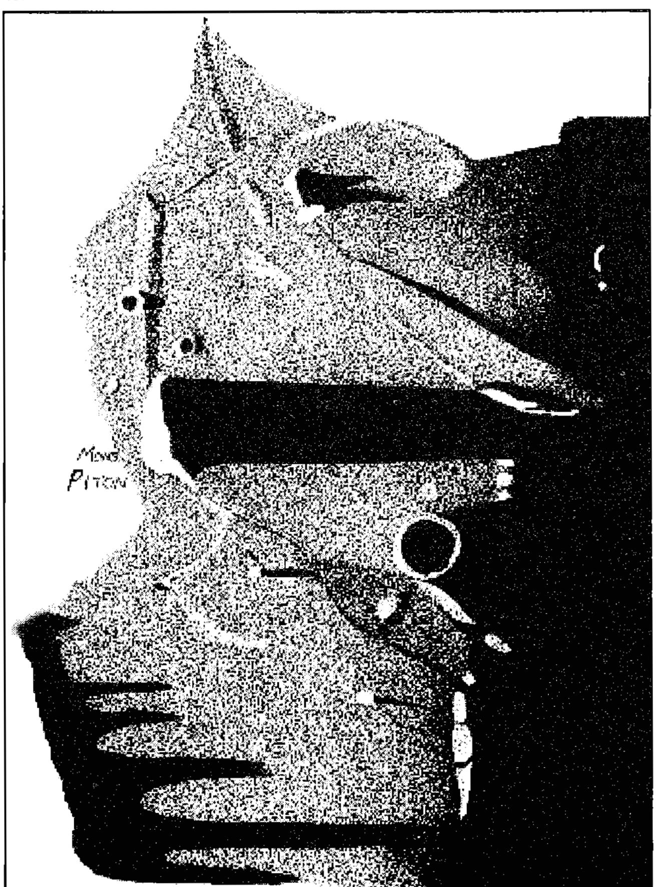


Figure 3. Drawing of Mons Piton and vicinity by Colin Ebdon, London, England. 1998 Jun 02, 02h50m-21h50m UT. 25-cm (10-in) Newtonian, 183X. Colongitude 005°.2-005°.7. South at top.

Two of the most famous individual mountains are Mons Pico and Mons Piton in northeast Mare Imbrian (*Figure 3*, p. 174). When originally formed, the Imbrian basin was a multi-ringed feature, much like Mare Orientale. After the interior was flooded with lava, Mons Pico and Piton were among the few remaining peaks of the inner ring. Both peaks are also of particular interest to LTP (lunar transient phenomena) enthusiasts as they are the sites of relatively frequent reports of events.

Another pair of interesting mountains as Mons Gruithuisen Delta and Mons Gruithuisen Gamma, also located on Mare Imbrian. These two mountains lie on the northwest edge of Mare Imbrian, where it joins Oceanus Procellarum. Both mountains are about 20 km (12 mi) wide at the base, but Mons Gruithuisen Gamma, in particular, is curiously dome-like in appearance despite its composition of light-toned highlands material.

Mons Hansteen, in the southeast of Oceanus Procellarum, also presents an interesting appearance under different lighting conditions. About 30 km (19 mi) across at its base, it has a rather triangular shape. In addition, if you can find it under a high sun, it appears quite bright. It is certainly worth a look.

Finally we turn to the most frequently observed type of mountains on the Moon, the central peaks of craters. Most of these mountains are also impact-related. The majority were formed as a result of a rebound effect immediately following the impact or deep-seated lateral mass transfer, a form of slumping. A significant number, however, may have been formed by volcanic processes. These suspected volcanic peaks tend to be conical in shape and have summit pits. The frequency of summit craters on central peaks is debatable, and even the frequency of central peaks themselves in craters appears to be somewhat in doubt. In 1931 Goodacre estimated that 20 percent of lunar craters had central peaks. Baldwin, however, in 1963 stated that 68 percent of the craters over 8 km (5 mi) in diameter had central peaks. To confuse the matter more, Wood in 1968 used Kuiper's *Photographic Lunar Atlas* to determine that fewer than 7 percent of craters over 10 km (6 mi) contain central peaks. The wide disparity in these estimates is usually attributed to differences in sampling and to disagreement as to what constitutes a central mountain.

Perhaps the most famous central mountain is that within the crater Alphonsus. It was here in 1958 that Nikolai Kozyrev used the Crimean Astrophysical Observatory's 50-in telescope to make a spectrographic recording of what may have been the outgassing of molecular carbon.

Immediately to the southwest of Alphonsus is the crater Alpetragius. Although only about one third the diameter of Alphonsus, Alpetragius has a central peak that is nearly double Alphonsus's in size. The Alpetragius central elevation is one of those conical peaks with a summit pit, mentioned earlier. Under the right lighting conditions some think it looks like an egg in a nest (see *Figure 4*, below).

Tycho has a central mountain which rises 1500 m (5000 ft) above the crater floor. It, too, has been the subject of many LTP reports and is of particular interest to David Darling's A.L.P.O. LTP project.

Copernicus and Eratosthenes have multiple central peaks, which are among the favorite such for lunar observers. Be sure to take a look at the mountains in Eratosthenes when the crater is away from the terminator as the peaks tend to be bright under a high sun. Some observers find it difficult to find Eratosthenes under these

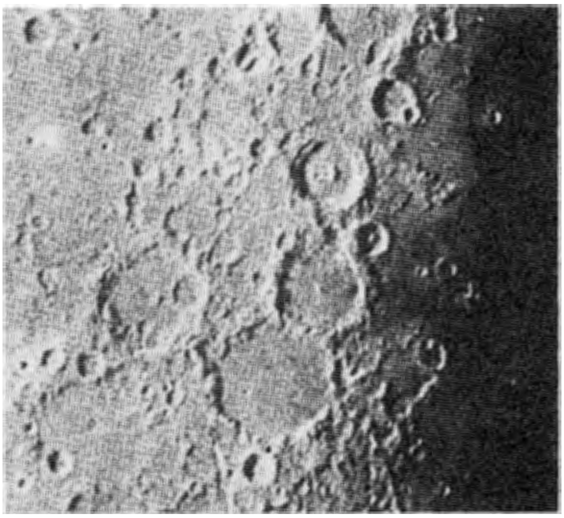


Figure 4. Alphonsus (near center), with Alpetragius adjoining it on the upper right. Photograph by Bill Dembowski, Elton, PA. 1996 Aug 24, 02h06m UT. 12.7-cm (5-in) refractor, f/66, 1/2-sec exposure on Kodak T-Max 400 Film. South at top.

conditions but all you really need to do is follow the sweep of the Montes Apenninus to their western limit. The mountains on the floor of Gassendi are more widely spaced and provide interesting viewing under different lighting conditions. The highest peak in the Gassendi group rises about 1200 m (4000 ft.). Like all central peaks, it does not rise above the height of the crater walls.

And, finally, be sure not to miss the central peak in the crater Pythagoras, near the northern limb. It is 1500 m (5000 ft) high and, since it is so near the limb, can be seen virtually in profile when the libration is favorable. It is certainly one of the most interesting views on the Moon.

Your observations, sketches, and images of lunar mountains are encouraged and welcomed by the Coordinator of Lunar Topographical Studies, and may be published in future articles (the locations of some of the features are shown in *Figure 5*, below). So, too, are those of the lunar highlands which will be the topic of the next installment of "Observing the Moon..

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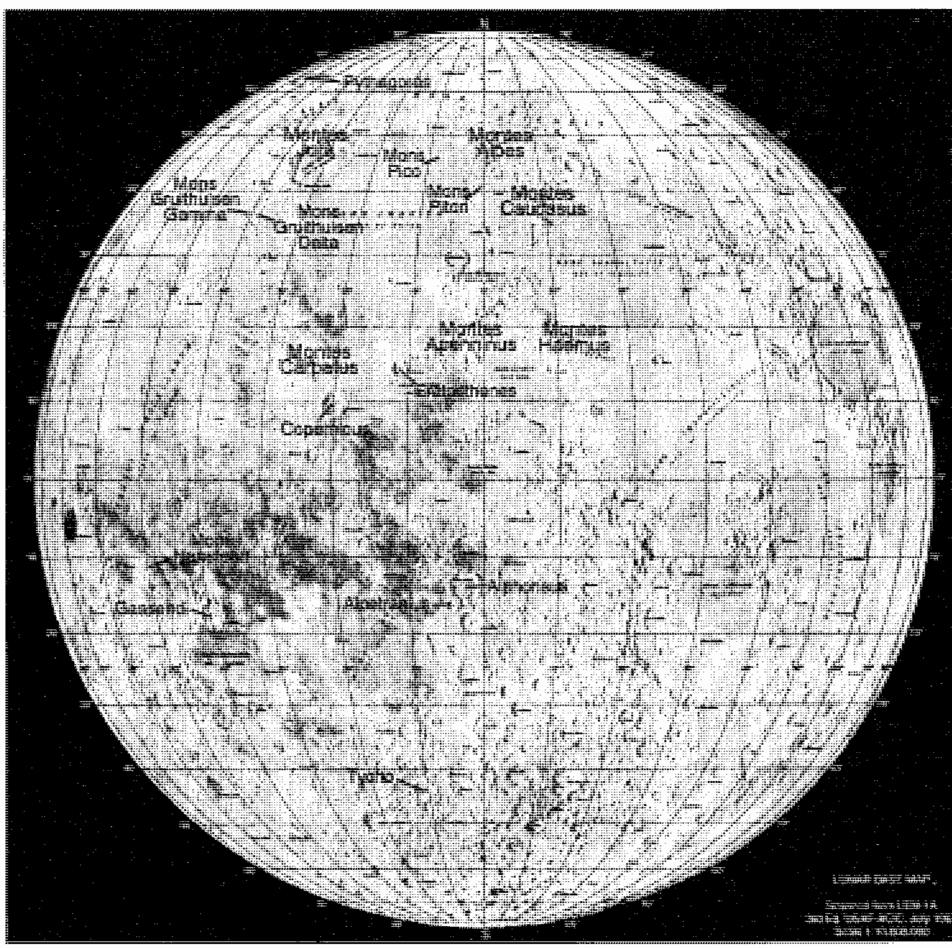


Figure 5. Lunar base map showing the locations of some of the mountains (Mons), mountain ranges (Montes) and craters mentioned in the text. North at top.

THE 1991-92 WESTERN (MORNING) APPARITION OF VENUS: VISUAL, PHOTOGRAPHIC AND CCD OBSERVATIONS

By: Julius L. Benton, Jr., A.L.P.O. Venus Coordinator

ABSTRACT

This report summarizes 288 visual, photographic and CCD observations of Venus for the 1991-92 Western (Morning) Apparition, based on data submitted by twenty A.L.P.O. Venus Section observers in the United States, Canada, the United Kingdom, Belgium, Germany, Sweden, and Italy, including the instrumentation and data sources used in compiling those observations. Comparative studies deal with observers, instruments, and visual and photographic data. The report includes illustrations and a statistical analysis of the categories of features in the atmosphere of Venus, including cusps, cusp-caps, and cusp-bands, seen or suspected at visual wavelengths, both in integrated light and with color filters. Terminator irregularities and the apparent phase are discussed, as well as coverage based on results from the continuing monitoring of the dark hemisphere of Venus for the Ashen Light.

INTRODUCTION

Observers contributed a substantial number of visual and photographic observations of Venus during the 1991-92 Western (Morning) Apparition. The geocentric parameters for the apparition are given in *Table 1* (below).

Table 1. Geocentric Phenomena in Universal Time (UT) for the 1991-92 Western (Morning) Apparition of Venus.

Inferior Conjunction	1991 AUG 22^{d}20^h
Greatest Brilliancy (m_V= -4.6)	SEP 28 23
Dichotomy (predicted)	NOV 01 09.84
Greatest Elongation West (46°.5)	NOV 02 09
Superior Conjunction	1992 JUN 13 16

Observed Range (1991 AUG 24-1992 APR 24) of:

Apparent Diameter: 57".4 - 10".0
Phase Coefficient: 0.011 - 0.973

A total of 288 observations consisting of visual drawings, photographs and CCD images were received for the 1991-92 Apparition, and *Figure 1* (p. 178) shows the distribution of observations for each month.

On the basis of the number of reports received, observational coverage was fairly good, with individuals starting their programs early in the apparition and following through until Venus neared the time of Superior Conjunction. The "observing season," or observation period, was from 1991 AUG 24 to 1992 APR 24, with an emphasis during the months of 1991 September through November (72.6 percent of the total observations). As in a great number of previous apparitions, the observational activity in 1991-92 increased during the period when Venus was at greatest brilliancy and maximum elongation from the Sun.

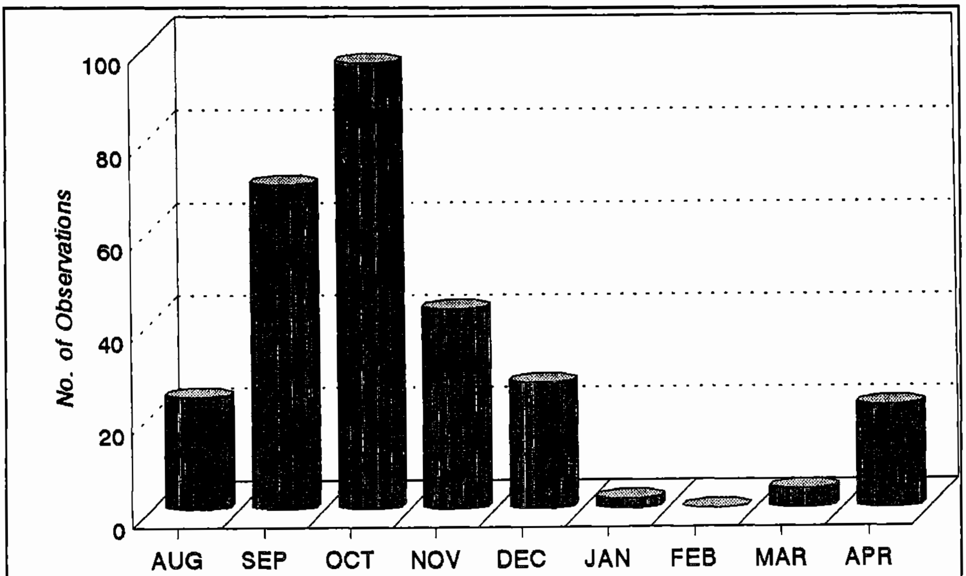
Twenty individuals submitted observations of Venus during the 1991-92 Apparition. These observers are listed in *Table 2* (p. 178) with their observing sites, number of observations, and instruments used.

Figure 2 (p. 179) shows the distribution of observers and contributed observations by nation of origin for this apparition. One-quarter of the participating observers were located in the United States, and those individuals only accounted for 5.9 percent of the total observations received. There is no doubt that our programs continue to be international in scope.

The types of telescopes used to make observations are depicted in *Figure 3* (p. 179). In addition, it should be noted that over three-fourths (79.2 percent) of the observations were made with telescopes of 15.2-cm (6.0-in) aperture or greater. The number of observations were almost evenly distributed between instruments of Catadioptric and Classical design.

In terms of atmospheric conditions, the mean Seeing was 4.1, or "fair," on the standard A.L.P.O. Seeing Scale that ranges from 0.0 (worst seeing conditions) to 10.0

[text continued on p. 180]



Number of Observations	24	70	96	43	27	2	0	4	22

Month of Observation (1991-92)

Figure 1. Observations contributed by month, 1991-92 Western (Morning) Apparition of Venus.

Table 2. Participants in the A.L.P.O. Venus Observing Program, 1991-92 Western (Morning) Apparition.

Observer and Observing Site	No. Obs.	Telescope(s) Used*
Benton, Julius L.; Wilmington Island, GA	10	15.2-cm (6.0-in) REF
Bosselaers, Mark; Berchem, Belgium	17	22.5-cm (8.9-in) NEW
Boyar, Daniel; Boynton Beach, FL	2	6.0-cm (2.4-in) REF
Buggenthien, Rudiger; Göttingen, West Germany	1	15.2-cm (6.0-in) REF
Gelinas, Marc A.; Ile-Perrot, Quebec, Canada	1	15.2-cm (6.0-in) REF
Genovese, Marco; Torino, Italy	9	20.3-cm (8.0-in) NEW
Giuntoli, Massimo; Montecatini, Italy	3	8.0-cm (3.1-in) REF
Graham, David L.; Brompton-on-Swale, UK	2	15.2-cm (6.0-in) REF
Graham, Francis; East Pittsburgh, PA	1	17.8-cm (7.0-in) REF
Gubbels, Guido; Tessenderlo, Italy	1	11.4-cm (4.5-in) NEW
Haas, Walter H.; Las Cruces, NM	2	20.3-cm (8.0-in) NEW
Heath, Alan W.; Nottingham, UK	12	30.0-cm (12.0-in) NEW
Johnson, Andrew; North Yorkshire, UK	7	21.0-cm (8.3-in) NEW
Louderback, Daniel; South Bend, WA	2	8.0-cm (3.1-in) REF
Niechoy, Detlev; Göttingen, West Germany	34	6.0-cm (2.4-in) REF
	132	20.3-cm (8.0-in) SC
	18	30.0-cm (12.0-in) NEW
Sarocchi, Damiano; Florence, Italy	2	30.0-cm (12.0-in) NEW
Testa, Luigi; Parma, Italy	8	20.3-cm (8.0-in) NEW
Viens, Jean-Francois; Charlesbourg, Quebec, Canada	2	11.4-cm (4.5-in) NEW
Vitale, Francesco ; Torino, Italy	16	10.2-cm (4.0-in) REF
Wardell, Johann ; Uppsala, Sweden	4	16.0-cm (6.3-in) REF
	2	15.2-cm (6.0-in) NEW
Total Number of Observers	20	
Total Number of Observations	288	

* NEW = Newtonian, REF = Refractor, SC = Schmidt-Cassegrain.

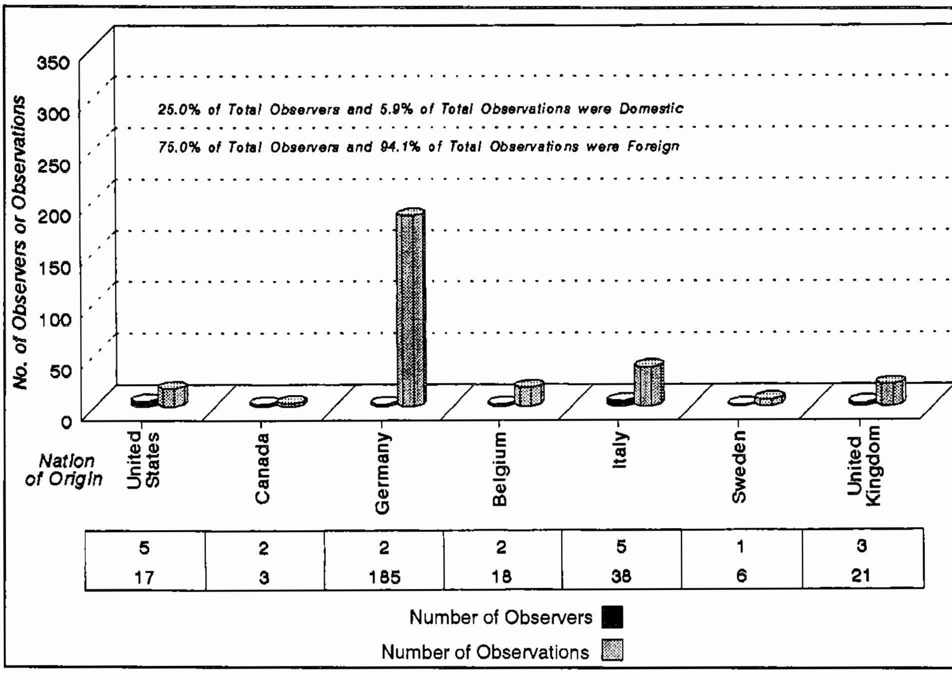


Figure 2. Distribution of observers and observations by nationality, 1991-92 Western (Morning) Apparition of Venus.

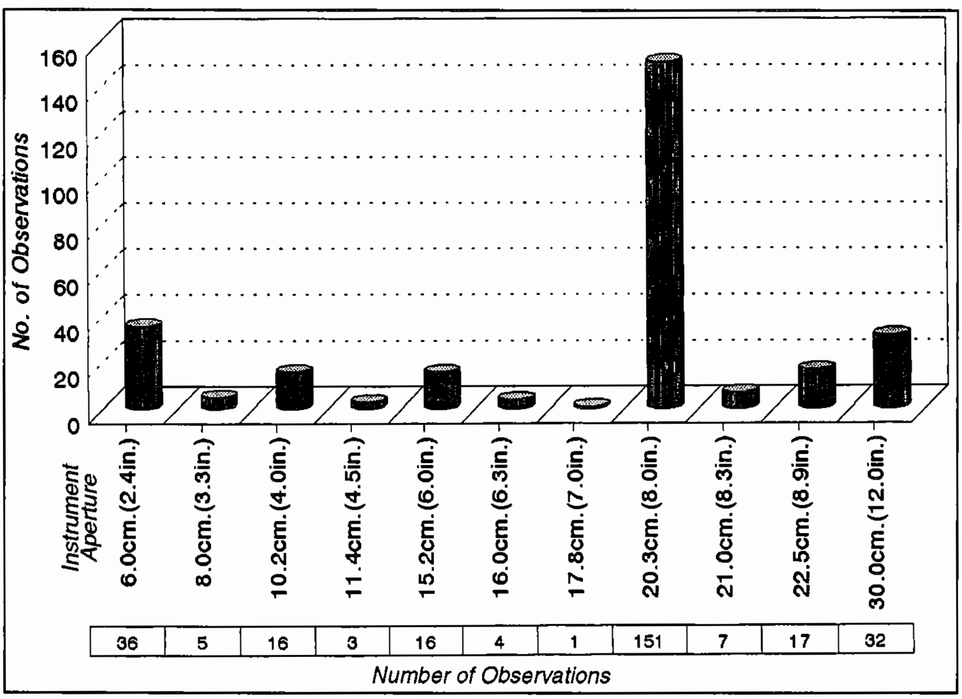


Figure 3. Distribution of observations by aperture of telescope used, 1991-92 Western (Morning) Apparition of Venus.

(perfect); the mean Transparency, expressed as the limiting stellar magnitude, was about +4.5. During 1990-91, virtually all observations were made against a light (or twilight) sky.

This Coordinator extends his warmest gratitude to the twenty enthusiastic observers mentioned in this report who carried out investigations of Venus for the A.L.P.O. Venus Section. All observers are encouraged to join, or continue, with us in coming observing seasons. There is already a very welcome and continuing cooperation from such groups as the British Astronomical Association, the Vereinigung der Sternfreunde in Germany, the Unione Astrofili Italiani in Italy, the Swedish Amateur Astronomical Society in Sweden, and other groups throughout the World.

Observations of Venusian Atmospheric Details

As noted in previous Venus reports that have appeared in this Journal, the methods and techniques for conducting visual studies of the somewhat vague, characteristically elusive "markings" in the atmosphere of Venus have been outlined in the appropriate Venus Section publications. We recommend that new observers study these sources as well as previous apparition reports.

All of the observations used for this report were made at visual wavelengths, and several samples of these observations in the form of drawings and photographs appear in this report in order to aid the reader in interpreting the phenomena reported or suspected on Venus in 1991-92. (See *Figures 6-23*, pp. 184-187.)

The visual and photographic data for the 1991-92 observing period represented essentially all of the categories of dusky and bright markings/features on Venus, as covered in the literature cited above. *Figure 4* (below) summarizes the frequency that the specific forms of markings were reported. Many observations showed more than one type of marking or feature, so that totals of over 100 percent are possible. Undoubtedly, there is a subjective element in the reporting of the elusive, vague markings of Venus which must affect the values in Figure 4. Nevertheless, our tentative conclusions derived from these data are considered reasonable.

The dusky markings of Venus' atmosphere are usually extremely hard to detect, both for the novice as well as the experienced visual observer. It is widely thought that ultraviolet (UV) photographs of Venus are preferred in order to reveal these subtle shadings. The A.L.P.O. Venus Section actively seeks UV photographs because many features look different in these short wavelengths of light than in the visual region of the electromagnetic spectrum, particularly radial dusky patterns. Figure 4

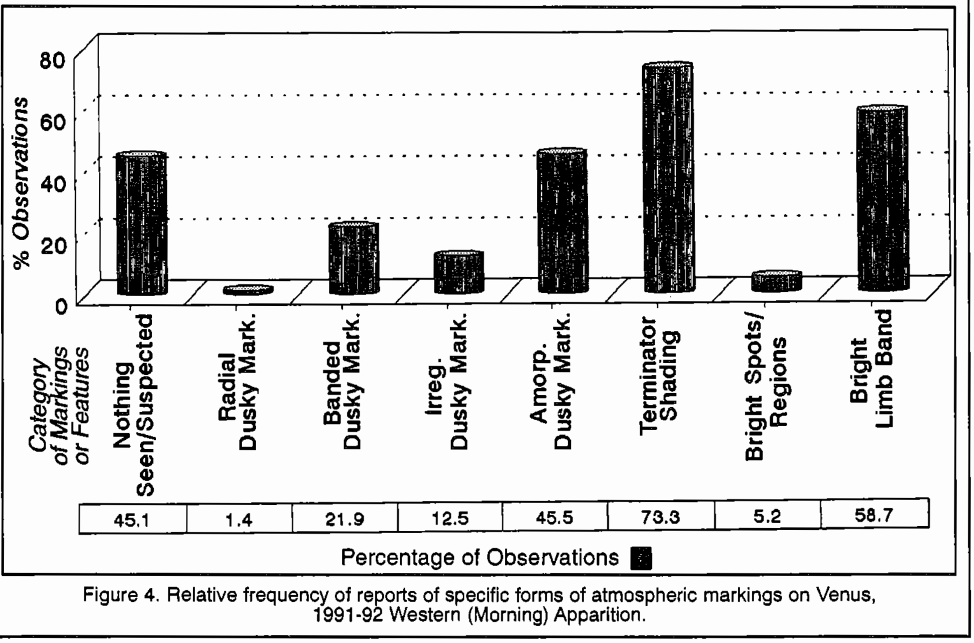


Figure 4. Relative frequency of reports of specific forms of atmospheric markings on Venus, 1991-92 Western (Morning) Apparition.

shows that 45.1 percent of the drawings and other visual observations of Venus during the 1991-92 observing season showed the planet as devoid of shadings or markings of any kind, which compares well with many of the observing seasons prior to 1988-89. This finding contrasts somewhat with what appeared to be a lower frequency of the totally blank aspect of Venus during the 1990-91 Eastern (Evening) and 1990 Western (Morning) Apparitions. In the photographs taken at visual wavelengths there were no indications of markings. Venus, therefore, displayed a completely blank disc photographically, even though visual observers recorded banded, radial, irregular, and amorphous dusky markings. One important factor here is that observers have been utilizing more standard, systematic techniques with polarizing and color filters in recent apparitions.

Figure 4 graphically shows that slightly less than half of the dusky features that were reported fell in the category of "Amorphous Dusky Markings," indicated in 45.5 percent of the total observations. Other dusky shadings were distributed among the categories of "Banded Dusky Markings" (21.9 percent) and "Irregular Dusky Markings" (12.5 percent), and only 1.4 percent of the observations reported "Radial Dusky Markings" in 1991-92.

Terminator shading was prominent during the 1991-92 Apparition, visible in 73.3 percent of the observations, as shown in Figure 4. There was the usual tendency for the terminator shading to lighten (i.e., assume a higher intensity value on the A.L.P.O. Scale, which ranges from 0.0 for total black to 10.0 for the brightest possible features) as one proceeded from the terminator region toward the illuminated limb of the planet. Sometimes this gradation in brightness ended in the Bright Limb Band, and frequently this terminator shading extended from one cusp region to the other. Unlike the many drawings received during 1991-92, photographs seldom clearly showed any hint of terminator shading.

The mean relative intensity for all of the dusky features on Venus in 1991-92 ranged from 8.0 to 8.8.

Ranging from 0.0 for "definitely not seen" up to 10.0 for "certainly seen," the A.L.P.O. Scale of Conspicuousness was also used rather effectively during the 1991-92 observing season. The dusky markings in Figure 4 were assigned a mean conspicuousness of 5.5 during the apparition, meaning that all of these features lay somewhere between vague suspicions and strong indications of actual presence on Venus.

Figure 4 also shows that "Bright Spots or Regions," exclusive of the cusp areas, were infrequently detected (averaging about 9.2 in mean relative intensity). At visual wavelengths, only a small number of drawings showed these bright spots or mottlings. No photographs revealed any indication of these features.

Color-filter techniques were extensively and systematically employed during the 1991-92 Western Apparition. These methods generated useful results when compared with studies in Integrated Light, and the usage of Wratten and Schott color filters, and variable-density polarizers, improved the overall visibility of atmospheric phenomena on Venus.

The Bright Limb Band

In the 1991-92 Western (Morning) Apparition, 58.7 percent of the observations submitted described an obvious "Bright Limb Band" on the sunlit hemisphere of Venus, as shown in Figure 4. When this brilliant band was recorded, the feature extended uninterrupted from cusp to cusp 73.4 percent of the time, and was broken or partially visible in 26.6 percent of the positive reports. The mean numerical intensity of the Bright Cusp Band was 9.8, and its visibility was substantially improved when color filters and variable-density polarizers were utilized.

Terminator Irregularities

The terminator of Venus is the geometric curve that separates the sunlit and dark hemispheres of the planet's globe. Slightly more than one quarter (26.0 percent) of the observations in 1991-92 referred to an asymmetric or irregular terminator. During these times when the terminator was not seen as a regular geometric feature, amorphous and irregular dusky markings, and to a lesser extent banded and radial dusky shadings, merged with the terminator shading and with possible reported deformities. As with other filter observations during this apparition, successful filter techniques probably enhanced the visibility of any terminator irregularities and associated dusky atmospheric features.

Also, the phenomenon of irradiation may cause brilliant features adjacent to the terminator to become apparent bulges, and dark features may appear as dusky hollows.

Cusps, Cusp-Caps and Cusp-Bands

The most contrasting and conspicuous features sometimes seen in the atmosphere of Venus are located at or near the planet's cusps, generally when the phase coefficient, k, lies between 0.1 and 0.8 (the phase coefficient is the fraction of the disc that is illuminated). These cusp-caps are occasionally bounded by dark, often diffuse, peripheral cusp-bands. Figure 5 (below) graphically depicts the visibility statistics for Venus' cusp features throughout 1991-92.

Figure 5 shows that, when the northern and southern cusp-caps were recorded, more than half of the time they were of equal size and brightness. There were instances, however, when either the northern or southern cusp-cap was the larger, the brighter, or both. In almost two-thirds (64.2 percent) of the observations, neither cusp-cap could be detected. The mean relative intensity of the cusp-caps was about 9.8 during the 1991-92 Apparition.

The cusp-caps were devoid of bordering dusky cusp-bands in almost three-fourths (72.9 percent) of the submitted observations. When seen, the reported cusp-bands had a mean relative intensity of about 7.2 (see Figure 5).

Cusp Extensions

As illustrated in Figure 5, 83.0 percent of the observations reported no cusp extensions beyond the 180° expected from simple geometry, in integrated light and with color and polarizing filters.

However, as Venus passed through crescentic phases during the apparition, several reports of cusp extensions were received, averaging in extent from 2° to 45°. There were, though, several instances when the reported extensions of both cusps joined, forming a beautiful halo encircling the entire dark hemisphere of Venus. These cusp extensions were depicted on drawings, enhanced by color filters and polarizers, but were wholly invisible on any photographs that were submitted. As expected, cusp extensions are exceedingly troublesome to capture on film, since they are significantly fainter than the sunlit regions of disc of Venus.

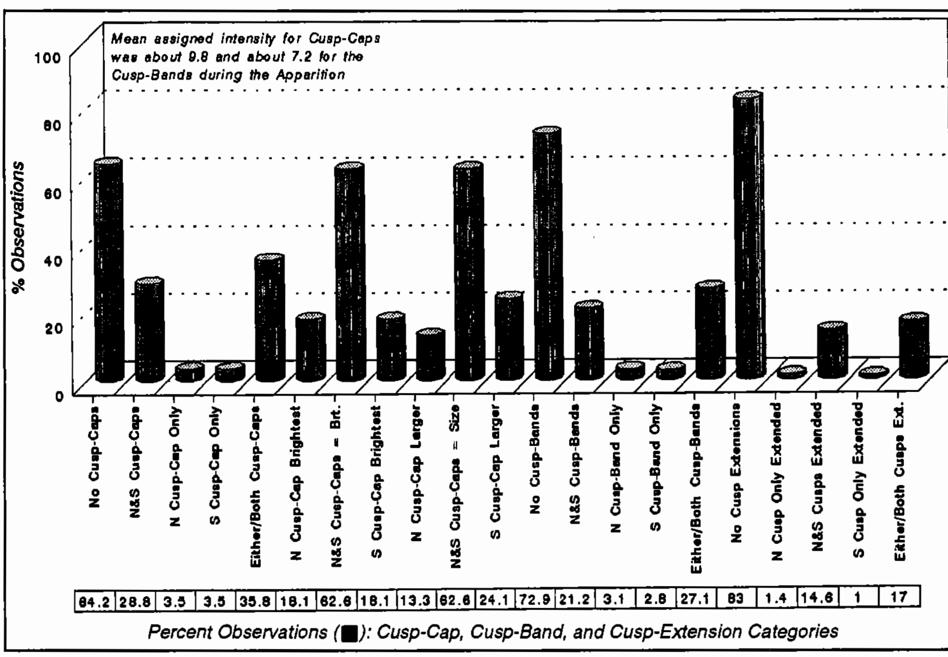


Figure 5. Relative frequency of reports of cusp-caps, cusp-bands and cusp-extensions on Venus,1991-92 Western (Morning) Apparition.

Estimates of Dichotomy

The "Schroeter Effect" on Venus, a discrepancy between the predicted and the observed dates of dichotomy (half-phase), was reported in 1991-92. The predicted half-phase occurs when k = 0.500, and the phase angle, i, between the Sun and the Earth as seen from Venus equals 90°. The observed-minus-predicted discrepancies for 1991-92 are given in *Table 3* (below).

Table 3. Observed versus Predicted Dichotomy of Venus, 1991/92 Western (Morning) Apparition.
(UT Dates, 1991)

	Observer	
Dichotomy (k = 0.500)	J. Benton	J.F. Viens
Observed (O)	Nov 05.05	Nov 04.50
Predicted (P)	Nov 01.41	Nov 01.41
Difference (O-P, days)	+03.64	+03.09

The Ashen Light and Other Dark-Hemisphere Phenomena

The Ashen Light, first reported by G. Riccioli in 1643, is an extremely elusive, faint illumination of the dark hemisphere of Venus. It resembles, but cannot have the same origin, as Earthshine on the dark portion of the Moon. It is often argued that Venus must be viewed against a dark sky in order to perceive the Ashen Light, but the planet is very low in the sky at those times and suffers significantly from poor seeing and glare in contrast with the dark sky background.

Table 4 (upper right) summarizes the dates during 1991-92 when there were positive observations of this phenomenon. There were cases, however, on the same date that the same observer may not have been able to detect the Ashen Light in integrated light or using other filters. Detlev Niechoy of West Germany reported most of the positive sightings of the Ashen Light, but three other observers also reported the phenomenon during the apparition. However, there were no simultaneous observations of the Ashen Light during the 1991-92 Apparition.

There were a few instances when observers thought that the dark hemisphere of Venus looked actually darker than the background sky, but this phenomenon is most probably a contrast effect.

Table 4. Ashen-Light Observations, 1991-92 Western (Morning) Apparition of Venus.

1991 UT Date and Time		Observer	Instrument	Filter	Ashen Light
August					
24	10:00	Sarocchi	15.2 REF 200	0G550	DS
28	11:13	Niechoy	20.3 SC 225	IL	S-v
	11:20			W25	S-v
	11:28			W15	S-v
29	10:49	Niechoy	20.3 SC 225	IL	S-v
	10:54			W15	S-v
	11:00			W47	S-v
31	10:18	Niechoy	20.3 SC 225	W15	S-v
September					
01	09:00	Niechoy	20.3 SC 225	W47	S-v
06	04:15	Niechoy	20.3 SC 225	IL	DS
07	04:20	Johnson	21.0 NEW 195	W47	S
09	04:10	Niechoy	20.3 SC 225	W15	DS
12	04:30	Johnson	21.0 NEW 195	W47	S
13	03:58	Niechoy	20.3 SC 225	IL	S-v
	04:14			W25	DS
14	04:27	Niechoy	20.3 SC 225	IL	DS
	04:35			W25	DS
22	05:47	Niechoy	20.3 SC 225	W15	S-v
23	01:52	Haas	20.3 NEW 231	W47	S

Notes:

Instrument data are: Aperture in cm, type (NEW = Newtonian, REF = refractor, SC = Schmidt-Cassegrain), and magnification. Filters are as follows: IL = Integrated Light (no filter), 0G550 = orange, W15 = yellow, W25 = red, W47 = deep blue. Under "Ashen Light," the visibility codes are as follows: S = suspected (-v = "vague"), and DS = definitely seen by the observer.

Conclusions

Atmospheric activity on Venus during the 1991-92 Western (Morning) Apparition was moderate. It is of value to compare these results with those of previous morning observing seasons, as well as with evening apparitions of the planet. Our studies of the Ashen Light, which peaked during the Pioneer Venus Orbiter Project, are continuing on a fairly regular basis; it is clear that better coverage by all observers is needed to improve the chance for simultaneous observations of dark hemisphere events. The international cooperation of individuals and organizations in making continuous, systematic, and simultaneous observations of Venus remains our primary objective. We invite all interested readers to join us.

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Hunten, D.M., *et al.*, eds. (1983). *Venus.* Tucson: University of Arizona Press.

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The drawings, photographs and CCD images that follow (Figures 6-23) have had their contrast enhanced and are oriented with the South Pole of Venus at top. Unless otherwise stated, Seeing is expressed in the Standard A.L.P.O. Scale (0 = worst, 10 = perfect) and Transparency is given as the limiting visual stellar magnitude in the vicinity of Venus. Computed phases (k) and angular diameters (d) are given unless otherwise stated. Ephemeris data are from *The Astronomical Almanac 1991*.

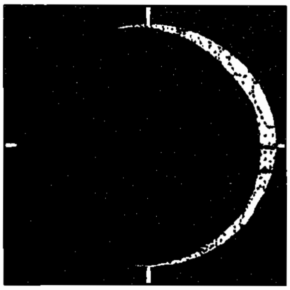


Figure 6. Drawing of Venus by Mark Bosselaers. 1991 SEP 05, 07h40m UT (daytime observation). 22.5-cm (8.9-in) Newtonian, 222X, deep violet filter. Mediocre conditions. k = 0.069 (observed k = 0.067), d = 53".5.

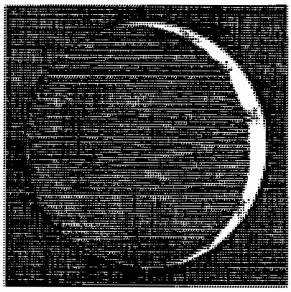


Figure 7. Drawing of Venus by Andrew Johnson. 1991 SEP 07, 04h40m UT. 21.0-cm (8.3-in) Newtonian, 195X, no filter. Seeing = II (Antoniadi Scale, ranging from I = best to V = worst), transparency = 1 (on a scale from 1 = best to 5 = worst). k = 0.084, d = 52".3. Mr. Johnson noted "First possible sighting of the 'Ashen Light."

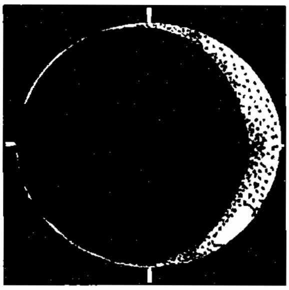


Figure 8. Drawing of Venus by Mark Bosselaers. 1991 SEP 10, 04h25m UT. 22.5-cm (8.9-in) Newtonian, 150X, no filter. Mediocre-bad conditions. k = 0.109 (observed k = 0.13), d = 50".4.

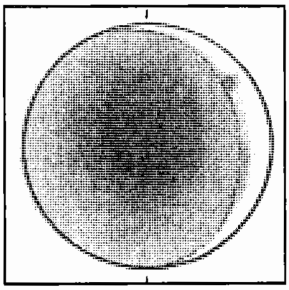


Figure 9. Drawing of Venus by Andrew Johnson. 1991 SEP 12, 04h30m-05h35m UT. 21.0-cm (8.3-in) Newtonian, 195X; W15 (yellow), W58 (green) and W47 (deep blue) filters. Seeing = 4, transparency = +4.0. k = 0.127 (observed k = 0.13), d = 49".0. Notes: "Ashen-Light' again seen. Brightest near Limb and Cresent *[sic.]*, i.e. dark in the centre. Again 'mottled' appearance suspected. No detection of colour. However, the Ashen-light was well seen with a #15 yellow filter, indicating a strength in the light at the 'Red End' of the spectrum. Some shading seen on cresent. Nothing particularly striking."

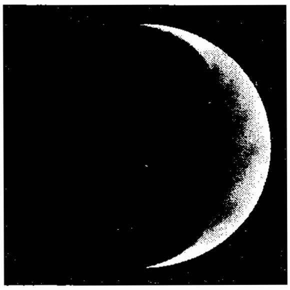
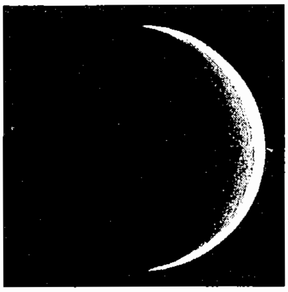


Figure 10. Drawing of Venus by David Graham. 1991 SEP 15, 07h25m UT. 15.0-cm (5.9-in) refractor, 22X. k = 0.155, d = 46".8.

Figure 11. Drawing of Venus by Massimo Giuntoli. 1991 SEP 15, 08h40m UT (daylight observation). 8.0-cm (3.1-in) refractor, 96X, no filter. Seeing = II (Antoniadi Scale). k = 0.155 (observed k = 0.14), d = 46".8. (Compare with Figure 10, drawn just 75 minutes earlier.)



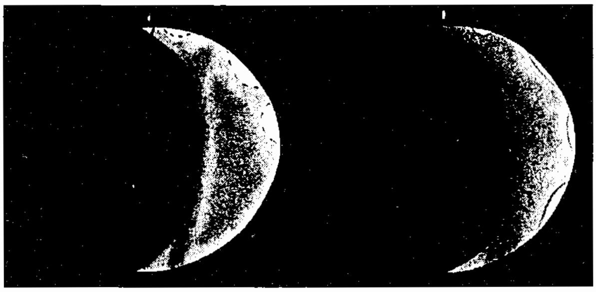
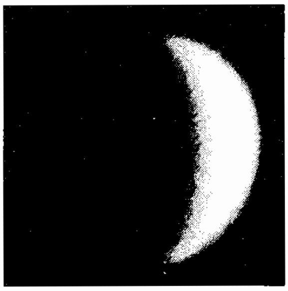


Figure 12. Two drawings of Venus by Giovanni Marabini. 1991 SEP 25 UT. 20.3-cm (8.0-in) Schmidt-Cassegrain, 203X. (Note that Mr. Marabini's observations were received too late to be included in the tables and graphs in the body of this report.)

(left) 03h50m UT, no filter. Seeing = 3.5, k = 0.243 (observed k = 0.27), d = 40".3.

(right) 04h20m UT, W-80A (light blue) Filter. Seeing = 3.5, k = 0.244 (observed k = 0.25; also observed as 0.25 with W25 [red] Filter), d = 40".2.

Figure 13. Photograph of Venus by Alan Heath. 1991 SEP 30, 06h00m UT. 30-cm (11.8-in) Newtonian, 190X. 1/25 sec, Tri-X Film. k = 0.286, d = 37".3.



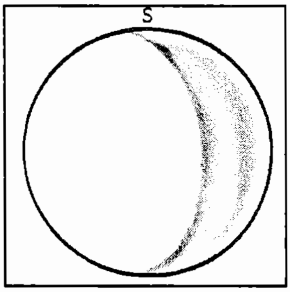


Figure 14. Drawing of Venus by Dan Boyar. 1991 OCT 03, 10h50m-11h05m UT (twilight observation). 6.0-cm (2.4-in) refractor, 100X & 129X, no filter. Seeing = 6-7, transparency = 4 (on a scale from 0 = worst to 5 = best). k = 0.312, d = 35".5.

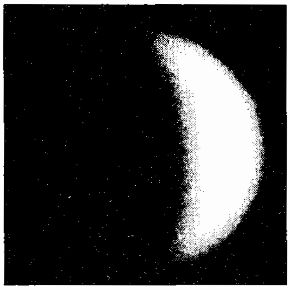


Figure 15. Photograph of Venus by Alan Heath. 1991 OCT 06, 06h00m UT. 30-cm (11.8-in) Newtonian, 190X, no filter. 1/25 sec. k = 0.333, d = 34".1.

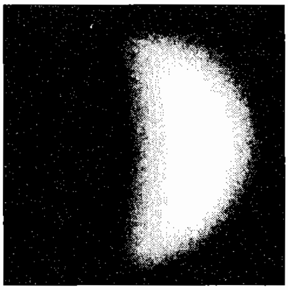


Figure 16. Photograph of Venus by Alan Heath. 1991 OCT 19, 06h30m UT. 30-cm (11.8-in) Newtonian, 190X, no filter. 1/25 sec. k = 0.423, d = 28".6.

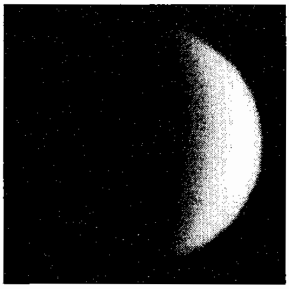


Figure 17. CCD image of Venus by the San Gersolé Planetary Group (L. Aerts, G. Quarra & D. Sarocchi). 1991 OCT 25 06h09m UT. 30-cm (11.8-in) Cassegrain, f/24, W47 (deep blue) Filter. Lynxx PC+ CCD camera. k = 0.460, d = 26".5.

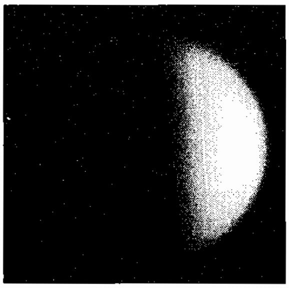


Figure 18. CCD image of Venus by the San Gersolé Planetary Group (L. Aerts, G. Quarra & D. Sarocchi). 1991 Nov 02, 06h06m UT. 50-cm (19.7-in) Cassegrain, f/18, W47 (deep blue) Filter. Lynxx PC+ CCD camera. k = 0.504 (approximately 20 hours after predicted dichotomy), d = 24".2.

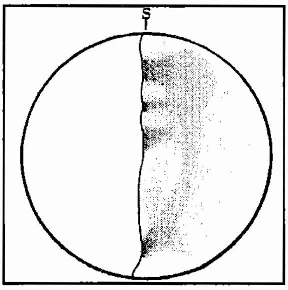


Figure 19. Drawing of Venus by Andrew Johnson. 1991 Nov 04, 06h25m-06h50m UT. 21.0-cm (8.3-in) Newtonian, 195X, W15 (yellow) & W58 (green) Filters. Seeing = 4, transparency = +5.5. k = 0.515 (observed k = 0.50±0.01), d = 23".7. Note terminator deformations.

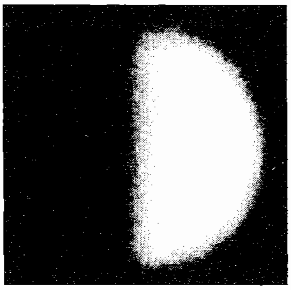
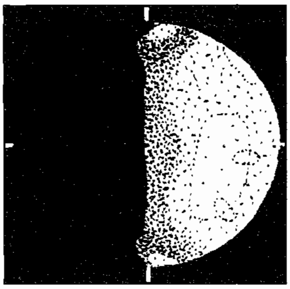


Figure 20 (left). Photograph of Venus by Alan Heath. 1991 Nov 04, 06h50m UT. 30-cm (11.8-in) Newtonian, 190X, no filter. 1/25 sec. k = 0.515, d = 23".7. Compare with the almost-simultaneous drawing in Figure 19.

Figure 21 (right). Drawing of Venus by Mark Bosselaers. 1991 Nov 06, 11h10m UT (daytime observation). 22.5-cm (8.9-in) Newtonian, 150X & 222X, deep violet filter. Bad conditions. k = 0.526 (observed k = 0.50), d = 23".1.



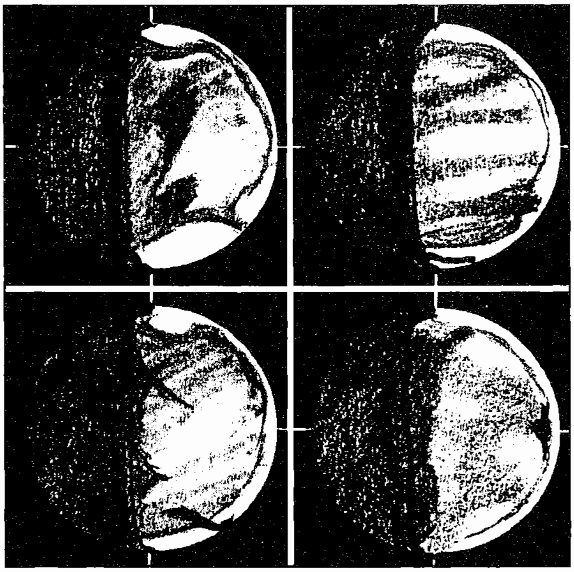


Figure 22. Four drawings of Venus by Detlev Niechoy. 1991 Nov 22 UT. 20.3-cm (8.0-in) Schmidt-Cassegrain, 225X. k = 0.602, d = 19".9. Note depictions of Ashen Light.

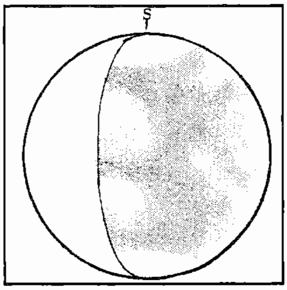
(upper left) 06h20m UT, no filter.

(upper right) 06h26m UT, W15 (yellow) Filter.

(lower left) 06h35m UT (beginning of twilight), W47 (deep blue) Filter.

(lower right) 06h41m UT (twilight), W25 (red) Filter.

Figure 23. Drawing of Venus by Andrew Johnson. 1991 Dec 27, 07h50m-08h15m UT (light sky). 21.0-cm (8.3-in) Newtonian, 195X, no filter/W58 (green) Filter. Seeing = 4-6, transparency = +5. k = 0.734 (observed k = 0.67±0.01), d = 15".4.



AN ELECTRONIC STROLLING ASTRONOMER?

It has recently been suggested that the A.L.P.O. should make its Journal available in electronic form to those members who would prefer that format. If so, they would most likely receive their issues in the form of e-mailed pdf files and, if they wished paper copy, would need to print it themselves. On the other hand, they would receive their Journal somewhat more promptly than by the present postal mail and also enjoy a significant reduction in the amount of their dues. The *contents* of the paper and electronic versions would be identical, and individual members could continue with the present paper version if they so wish.

Before plans for this step become serious, we need to know how many members would choose this option (assuming, for the sake of argument, a 30-percent reduction in North American dues and a 50-percent reduction for overseas dues). We also would like to know how much mailing time this would save for overseas members; in order to know this, we need to know the date when those members receive this issue. Thus, please contact our Membership Secretary, Harry Jamieson, letting him know if you might take advantage of the "electronic option" (this is *not* a commitment), and, if you are a foreign member, the date that you received this issue of our Journal.

The Association of Lunar and Planetary Observers

Founded by Walter Haas in 1947, the A.L.P.O. now has about 500 members. Our dues include a subscription to our quarterly Journal *(J.A.L.P.O.), The Strolling Astronomer*, and are $23.00 for one year ($40.00 for two years) for the United States, Canada, and Mexico; and $30.00 for one year ($54.00 for two years) for other countries. One-year Sustaining Memberships are $50.00; Sponsorships are $100.00. There is a 20-percent surcharge on all memberships obtained through subscription agencies or which require an invoice.

Our advertising rates are $85.00 for a full-page display advertisement, $50.00 per half-page, and $35.00 per quarter-page. Classified advertisements are $10.00 per column-inch. There is a 10-percent discount for a three-time insertion on all advertising.

All payments should be in U.S. funds, drawn on a U.S. bank with a bank routing number, and payable to "A.L.P.O." All cash or check dues payments should be sent directly to: A.L.P.O. Membership Secretary, P.O. Box 171302, Memphis, TN 38187-1302. When you write to our staff, please provide a stamped, self-addressed envelope. Note that the A.L.P.O. maintains a World-Wide Web homepage at: http://www. lpl.arizona.edu/alpo/

Keeping Your Membership Current.—The top line of your *J.A.L.P.O.* mailing label gives the volume and issue number when your membership will expire (e.g., "41.4" means Vol. 41, No. 4). We also include a First Renewal Notice in that issue, and a Final Notice in the next one. Please let the Membership Secretary know if your address changes. Dues payments should be made directly to the Membership Secretary.

A.L.P.O. Announcements

Section Changes

New Lunar Impacts Program.—A new provisional program has been added to our Lunar Section, the A.L.P.O. Lunar Section Meteoritic Impacts Search. The Acting Coordinator of this program is **Brian Cudnik** (Address: 7490 Brompton Road, #370, Houston, TX 77025. E-mail: cudnik@cps.pvsci.pvamu.edu). Mr. Cudnik was the first person to report a lunar meteoritic flash during the Leonid Meteor Shower on 1999 Nov 18. Subsequently, at least five such flashes were confirmed by three different observers, while unconfirmed meteoritic impact flashes were also reported during the Geminid Meteor Shower on 1999 Dec 14-15. Mr. Cudnik plans to coordinate simultaneous visual and video meteoritic impact searches, particularly during meteor showers and lunar eclipses.

New Solar Coordinators—**Tony Grigsby** and **Brad Timerson** have been appointed as Acting Assistant Coordinators of the Solar Section. Their addresses are: (1) Tony Grigsby, 209 Hubbard Lane, Mt. Washington, KY 40047 (E-mail: tony@alltel.net); (2) Brad Timerson (E-mail: bwtimer@eznet.net).

New History Coordinators.—The following two persons have been appointed to the History Section as Acting Coordinators: **Thomas A. Dobbins**, Acting Coordinator, Solar System History, 2061 Hillcrest Road, Coshocton, OH 43812 (E-mail: kmdobbins@coshocton.com); **William Sheehan**, Acting Assistant Coordinator, Solar System History (Mr. Sheehan is in transit as we go to press, and should be contacted through Mr. Dobbins).

Staff E-Mail Address Changes.—(1) **Jeff Medkeff**, Assistant Solar Coordinator, has changed his e-mail address to medkeff@mindspring.com . (2) **Matthew L. Will**, A.L.P.O. Board Member and Training Program Coordinator, has changed his e-mail address to will008@attglobal.net. (3) The e-mail address of **Julius L. Benton, Jr**., A.L.P.O. Board Member, and Coordinator for the Lunar, Venus and Saturn Sections, has changed to: jlbentonaina@msn.com .

A.L.P.O. Convention.—Our 2000 Convention will be held at Ventura, California, July 19-22, meeting with the Astronomical League and several other organizations. The meeting is hosted by the Ventura Astronomical Society. For further information, check the webpage: http://www.vcas.org/astrocon/ (E-mail: astrocon2000@vcas.org). The A.L.P.O. paper session will be held for the entire day of Thursday, July 20. A.L.P.O. Executive Director Donald Parker is organizing our paper session; those interested in delivering a paper should contact him (address on p. 192), giving their title, delivery time requested, and audio-visual needs.

<u>Other A.L.P.O. News</u>

E-Mailer Service.—A.L.P.O. Membership Secretary Harry D. Jamieson has obtained an e-mailer program that makes it possible for him to send personalized mass email to our members. Two planned applications are to e-mail renewal notices and dues acknowledgements. This will save time for Mr. Jamieson and money for the A.L.P.O. in terms of postage and supplies costs. In order for this to work effectively, Mr. Jamieson needs our members' current e-mail addresses; please make sure that he has yours.

Other Amateur and Professional Announcements

B.A.A. Mars Memoir Available.—Richard McKim, Director of the Mars Section of the British Astronomical Association, has recently completed a B.A.A. Memoir, *Telescopic Martian Dust Storms: A Narrative and Catalogue*. The 168-page book includes a catalogue, maps and charts, and 300 illustrations. It may be purchased by American readers for $32 payable to the British Astronomical Association, Burlington House, Piccadilly, London, W1V 9AG, Great Britain (telephone: 0171 734 4145; Fax: 0171 439 4629; E-mail: office@baahq.demon.co.uk). American A.L.P.O. members who are also members of the B.A.A. need pay $22 only.

<u>Roster of Upcoming Meetings</u>

February 28-March 3, 2000: Space 2000 and Robotics 2000. At Albuquerque, New Mexico. [Web: http://www.space androbotics.org]

April 3-5, 2000: First Annual Astrobiology Science Conference. At NASA Ames Research Center, Mountain View, California. [Web: http://astrobiology.arc.nasa.gov/]

April 6-9, 2000: Year 2000 Peach State Star Gaze. At Indian Springs State Park's Camp McIntosh (just south of Jackson, Georgia). [Ken Poshedly, 1741 Bruckner Court, Snellville, GA 30078-2784. Telephone: 770-979-9842. E-mail: ken.poshedly@mindspring.com . Registration materials are online at http://aac.cjb.net]

April 29-May 2, 2000: Sixth Annual K-12 Education Workshop: At the Space Science Institute (SSI), Boulder, Colorado. [Susan Solari, Space Science Institute, 3100 Marine St., Suite A353, Boulder, CO 80303-1058. Telephone: 303-492-5184; FAX: 303-492-3789; E-mail: solari@spacescience.org ; Web: http://www.spacescience.org]

May 26-29, 2000: 32nd Annual Riverside Telescope Makers Conference. At Camp Oakes, Big Bear, California (50 miles miles northeast of Riverside, at 7600 feet in the San Bernardino Mountains). [Telephone: 909-948-2205; Web: http://www.rtmc-inc.org]

July 9-12, 2000: Catastrophic Events and Mass Extinctions: Impacts and Beyond. At the Institute of Geochemistry, University of Vienna, Vienna, Austria; includes postconference (July 13-16) field trips to impact sites. [Christian Koeberl, Institute of Geochemistry, University of Austria, Althanstrasse 14, A-1090, Vienna, Austria. Telephone: +43-1-31336-1714; FAX: +43-1-31336-781; E-mail: christian.koeberl@univie.ac.at]

July 9-14, 2000: International Planetarium Society Conference. At Montreal, Quebec, Canada. [O'Donoughe & Associates Event Management Ltd., 5486 Cote-Saint-Luc Road, Montreal H3X 2P7, Quebec, Canada. Telephone: 514-481-7408; FAX: 514-481-7379; E-mail: odon@cam.org]

July 19-22, 2000: Astrocon 2000. At the Holiday Inn Ventura Beach Resort in Ventura, California. This national amateur meeting will include the Astronomical League and the 51st A.L.P.O. Convention. [E-mail: astrocon2000@vcas.org; Web: http://www.vcas.org/astrocon/]

October 14-16 2000: Solar Eclipse Conference. At the Congress Centre Elzenveld in Antwerp, Belgium. Three days of talks will include nine international guest speakers. [Patrick Poitevin, Parelhoenstraat 10, 9000 Gent, Belgium. Telephone: +32.(0)9.245.76.62. E-mail: ppoitevin@village.uunet.be] Also, those interested may subscribe to the Solar Eclipse Mailing List by sending e-mail to listserv@Aula.com ; within the body write SUBSCRIBE SOLARECLIPSES along with your name and country.

PUBLICATIONS OF THE A.L.P.O.

A.L.P.O. MONOGRAPH SERIES

A.L.P.O. monographs are publications that we believe will appeal to our members, but which are too lengthy for publication in our Journal. They should be ordered from our Editor (P.O. Box 16131, San Francisco, CA 94116 U.S.A.) for the prices indicated, which include postage. Checks should be in U.S. funds, payable to "A.L.P.O."

Monograph Number 1. ***Proceedings of the 43rd Convention of the Association of Lunar and Planetary Observers. Las Cruces, New Mexico, August 4-7, 1993.*** 77 pages. Price: $12.00 for the United States, Canada, and Mexico; $16.00 elsewhere.

Monograph Number 2. ***Proceedings of the 44th Convention of the Association of Lunar and Planetary Observers. Greenville, South Carolina, June 15-18, 1994.*** 52 pages. Price: $7.50 for the United States, Canada, and Mexico; $11.00 elsewhere.

Monograph Number 3. ***H.P. Wilkins 300-inch Moon Map.*** 3rd Edition (1951), reduced to 50 inches diameter; 25 sections, 4 special charts; also 14 selected areas at 219 inches to the lunar diameter. Price: $28.00 for the United States, Canada, and Mexico; $40.00 elsewhere.

Monograph Number 4. ***Proceedings of the 45th Convention of the Association of Lunar and Planetary Observers. Wichita, Kansas, August 1-5, 1995.*** 127 pages. Price: $17.00 for the United States, Canada, and Mexico; $26.00 elsewhere.

Monograph Number 5. ***Astronomical and Physical Observations of the Axis of Rotation and the Topography of the Planet Mars. First Memoir, 1877-1878.*** By Giovanni Virginio Schiaparelli, translated by William Sheehan. 59 pages. Price: $10.00 for the United States, Canada, and Mexico; $15.00 elsewhere.

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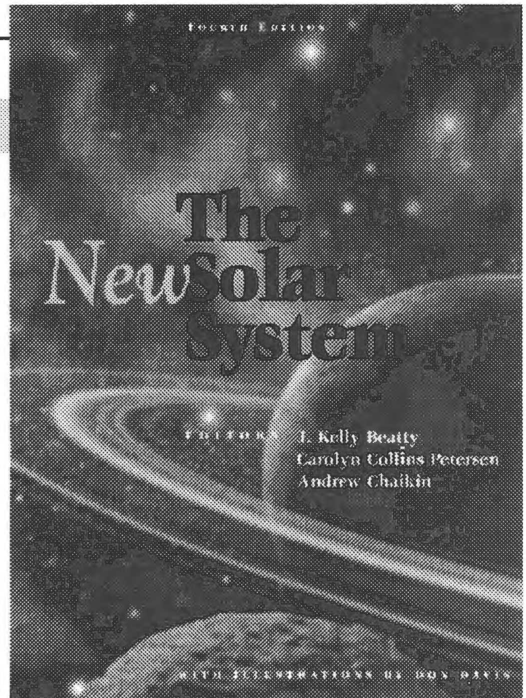

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