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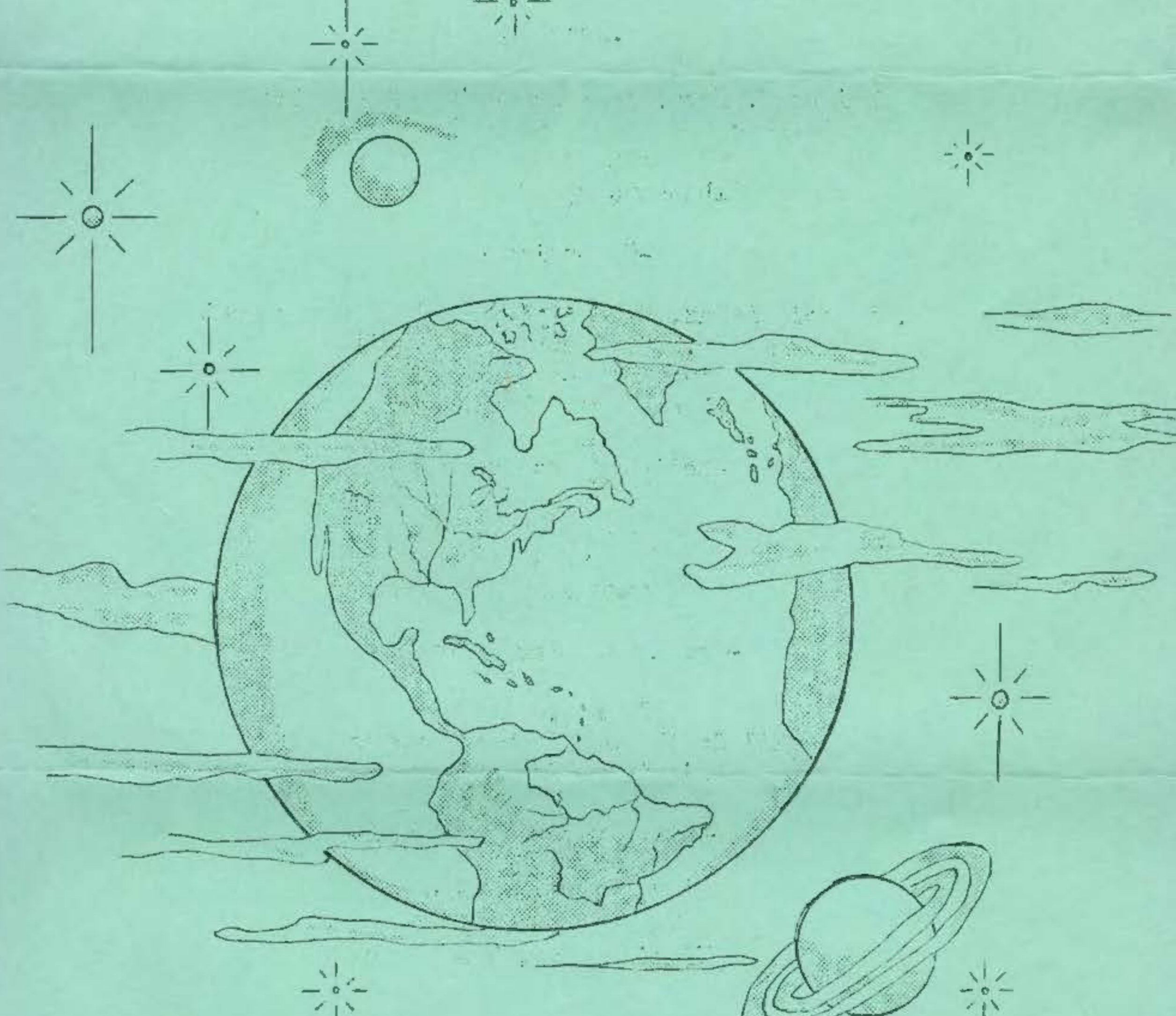
THE STROLLING ASTRONOMER

(ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS)



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S U B S C R I P T I O N R A T E S

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SOMETHING NEW HAS BEEN ADDED

Almost from the inception of The Strolling Astronomer nearly three years ago the editor and others have wondered about illustrating the periodical with drawings, charts, etc. On this page we are very pleased to exhibit in the periodical itself drawings and a map prepared by members. These have been copied photographically from the originals directly upon the stencil by The Stevens Agency, 202 South Broadway, Albuquerque, New Mexico. We hope you like the new feature!

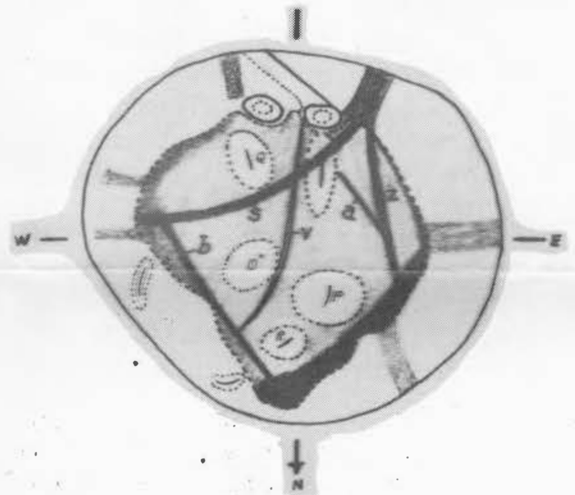

Fig. 1.

The accompanying chart is a preliminary map of the lunar crater Conon prepared by E. J. Reese in November, 1949. It is based upon a large number of observations and drawings by himself and other members of the A. L. P. O., chiefly in 1947-49.

(Dates and times below by U.T.)

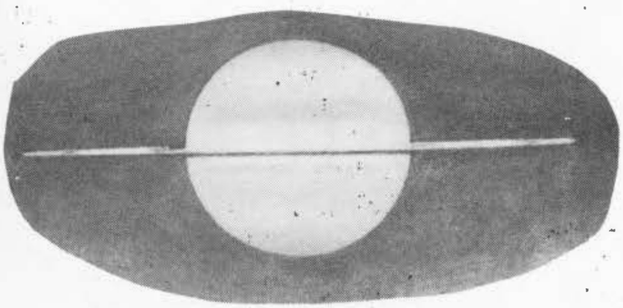

Fig. 2. Saturn. S. Murayama. 8-in. refr. November 29,1949, $21^h\ 0^m$.

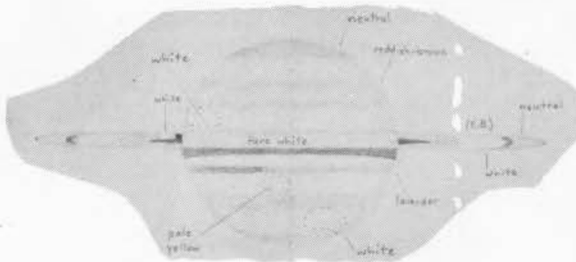

Fig. 3. Saturn. F.E.Brinckman. 6-in. refl. November 30,1949. $12^h\ 58^m$.

ig.4.Mars.D.O'Toole. -in.refl.November 24. 949.14^h5^m.C.M.=259°.

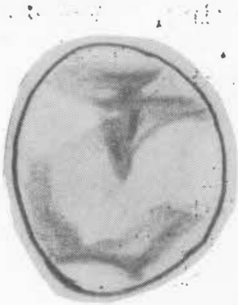

Fig.5.Mars.T.R.Cave 8-in.refl.November 19,1949.10^h40^m. C.M.= 257°.

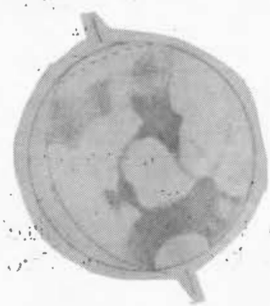

Fig.6.Mars.E.E.Hare. 12-in.refl.December 28,1949.12^h31^m. C.M.= 270°.

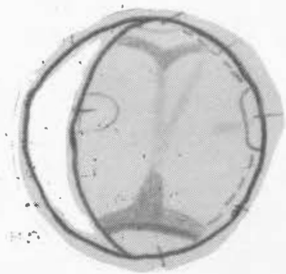

Fig.7.Mars.W.H.Haas 6-in.rfl. November 30,1949.13^h13^m. C.M. =188°.

PRINCIPLES OF ENVIRONMENTAL ADAPTATION AS APPLIED TO POSSIBLE LUNAR PLANTS

By James C. Bartlett, Jr.
(continued from January issue)

The Problem of a Lunar Atmosphere. Can life exist in *vacuo*? Nearly every one will say "No", of course - but the answer is "Yes". It not only can but does; and if you are handy with a vacuum pump, an Erlenmeyer flask, and know your microbiology, you can grow whole colonies of active organisms in or on a culture medium above which the air has been completely exhausted. These remarkable blobs of living matter are the anaerobic bacteria, to which life-giving oxygen is as fatal as chlorine would be to an animal. Yet, like all living things, they *require* oxygen. How do they obtain it? By reducing oxides. The free gas acts as a virulent poison to strict anaerobes. In combination they can use it. Hence by this singular and very unorthodox arrangement it is possible for these organisms to live in an airless environment. They can, however, live in air from which all oxygen has been removed, in an atmosphere of pure hydrogen or in a mixture of various gases non-toxic to them (not necessarily so to *us*).

Insofar therefore as a principle of adaptation exists, one of the most formidable objections to lunar life is demolished at once. Is it necessary to infer from this fact that on an airless moon the only possible types of living organisms would be forms resembling anaerobic bacteria? By no means. People who make such inferences fail to realize that there is no *necessary* relation between the simplicity of an organism and its size, metabolism, and morphology. A bacterium may average only 0.0001 of an inch long, and it is a single cell - but so is an ostrich egg. Certain marine forms of algae (the brown algae) are very simple plants, yet may attain to lengths of over a hundred feet. A humming bird, vastly more complicated both as to organism and metabolism, may fit into a teaspoon.

In passing it may be remarked that we are actually under no rigid necessity to believe that the moon is truly airless. The example of anaerobic bacteria was quoted simply to show that *even if such were the case* the possibility of life is not ruled out. It may be difficult to understand the apparent lack of physical manifestation at the limbs if a lunar atmosphere does exist, but it is *impossible* to understand many reputable observations if a lunar atmosphere does *not* exist.

The Problem of Lunar Temperatures. Is the moon extremely hot or extremely cold? Apparently no one is quite sure. Langley thought that the noon temperature never got above freezing. Very's precise measurements indicated a noon temperature of 200°F. Pickering thought it about 32°F. Pettit and Nicholson found it somewhat above the boiling point of water, about 214°F.

Charity forbids a recitation of all the assigned night temperatures, but in passing it may be remarked that the midnight temperature has been given as -243°F. (Pettit and Nicholson) while measurements during eclipse have indicated a temperature drop from +160°F. to -110°F. *in a single hour.*

Assuming, however, that such extremes of temperature do exist we may ask if there is any known principle whereby living matter might be adapted to them. There is. Under experimental conditions protoplasm has been known to survive the temperature of liquid hydrogen, which averages -418°F. and therefore 175°F. colder than lunar midnight according to Pettit and Nicholson. At the other end of the scale, protoplasm may remain active and vigorous in water hot enough to scald the hide off an elephant. We have positive evidence, therefore, that protoplasm could survive the most extreme temperatures thus far ascribed to the moon. The principle involved is what is known as sporulation.

Certain types of bacteria have the power of forming what are called spores. These seem to be in the nature of impervious, impalpable, and practically indestructible shells secreted by and organized within the body of the cell. Encapsulated in its spore a bacterium can survive extremes of cold hardly to be imagined. When the going gets rough the protoplasm simply retreats into the spore, excludes all water, dries out, and closes down for the season. Yet it remains fully alive if inactive, and as soon as favorable conditions are restored it opens for business as usual.

The application of this principle to a lunar vegetation is obvious. Nor is it necessary to believe that the principle is applicable only to reproductive spores and that lunar plants therefore must all be "annuals". Large vegetative parts, especially if woody, could remain above ground during the lunar night while the protoplasm might perhaps withdraw into the ground and encapsulate at the base of the plant. An approach to such a device is seen terrestrially in the downward winter movement of sap, though sap, of course, is not protoplasm.

The probable temperature range through which protoplasm may survive is thought to be from -459°F. to +320°F. Its active phase, however, appears to be from about 32°F. to 194°F. Note that the thermal upper limit is only 18° below the temperature of boiling water. Hence if the lunar noon temperature actually reaches 212°F., organisms apparently could continue to develop or remain active almost up to this point. But when the point had been passed, would they then perish? Not necessarily. Sporulation, or its equivalent, could carry protoplasm well past the boiling point of water in safety.

It is a remarkable fact that more or less naked protoplasm, as in the form of certain malodorous sulphur bacteria, may remain comfortable and active in water up to 167°F. (not to mention certain free-swimming, siliceous plants, the diatoms). Just how remarkable is seen from the rule that the higher the water-content the shorter is the time and the lower is the temperature at which protein will coagulate - and it is to the coagulation of their protein that we ascribe the lethal effect of boiling water on vegetative bacteria.

The active bacterial cell contains from 75% to 98% of water; yet egg albumen with only 50% of water will coagulate at 132.8°F. The sulphur stinkers, however, with a much higher water content thrive at a much higher temperature - and so far as we can see, the only protection they have against what would seem to be a lethal temperature is the thinnest pellicle or membrane imagineable!

Mention has been made of the fact that when a bacterial spore develops the protoplasm excludes most if not absolutely all of its water. The reason for this will now be apparent in relation to temperatures above the boiling point of water. Let us grant that the lunar noon temperature goes to the assigned limit of 214°F. This is still 123°below the thermal death point of protoplasm protected by a spore. For bacterial protein in the dry state it requires from 2.5 to 3 hours of heating at 347°F. before death is assured.

The principle of protection employed by protoplasm against both extreme cold and extreme heat suggests rather forcibly that the assumed lunar temperature range is by no means as lethal as is popularly supposed. With the possible mode of application of such a principle to organized lunar protoplasm we need not be concerned. The principle exists. In an environment where its need is manifest we may agree with the philosophers that a *modus operandi* would be forthcoming.

The Problem of Lunar Water. Can life exist without water? In a resting phase (sporulated) the answer appears to be "Yes". In an active phase the answer appears to be "No".

Protoplasm is essentially a water solution of colloids, and for its active manifestations liquid water appears to be essential. Hence if it can be shown that water does not exist on the moon in any form, the possibility of active vegetation would be rightly considered negative. Unfortunately, direct observation cannot answer this question completely. That no large bodies of water exist is obvious. Moreover, the most liberal calculations of lunar atmospheric pressure appear to rule out the possibility of liquid water existing anywhere on the surface. It may be remarked, however, that on sound chemical grounds the complete absence of water on any planetary body below the dissociation temperature of water is almost inconceivable. The reason is elementary. Water is a compound of two of the most common of chemical elements, hydrogen and oxygen. Moreover, it is a very stable compound.

The average chemical composition of the universe appears to be everywhere about the same. Specific differences are relative rather than absolute. Thus helium stars are not stars composed entirely of one element, helium, but simply stars in which that element is peculiarly abundant. Chemical analysis of meteorites shows a composition not radically different from that of the earth. If stellar processes are mainly nuclear and subatomic, planetary processes are mainly molecular and chemical. Water is the active promoter of chemical processes by virtue of its being very nearly a universal solvent. To suppose, therefore, that water is completely absent from a cold planetary body is to the highest degree doubtful.

Chemical and physical considerations indicate the probable presence of water on the moon, possibly liquid at subsurface depths or vaporous above the surface, most certainly as water of crystallization, and quite possibly as magmatic water.

(To be continued)

RECENT OBSERVATIONS OF VENUS

By T. R. Cave, Jr.
(All dates and times in Universal Time)

The planet Venus has attracted considerable observational attention during the last several weeks. We wish to welcome Mr. Sadao Murayama and Miss Hisako Koyama of the Tokyo Science Museum to the Venus Section. They have contributed some very excellent and artistically beautiful drawings of the planet. These have been forwarded to the Recorder by Mr. Haas as have also recent observations of Venus by Mr. E. L. Forsyth of Fallbrook, Calif., and Mr. L. E. Armfield of Elyria, Ohio, the prominent variable star observer.

The following list contains the last month's observers and the telescopes they employed: Mr. L. E. Armfield, 4" refr.; Dr. J. C. Bartlett, Jr.,3.5" refl.; Mr. L. Bellot, 6" refl.; Mr. P. D. Bevis, 6" refl. & 10" refl.; Mr. F. E. Brinckman, 6" refl.; Mr. T. R. Cave,Jr., 8" refl.; Mr. P. O. Chorley,3.5" refl.; Mr. T. A. Cragg, 6" refl. & 12" refr.; Mr. E. L. Forsyth, 6" refl.; Mr. W. H. Haas, 6" refl.; Mr. E. E. Hare, 12" refl.; Mr. L. T. Johnson, 10" refl.; Miss H. Koyama, 8" refr.; Mr. H. LeVaux, 6" refl.; Mr. R. Missert, 6" refl.; Mr. S. Murayama, 8" refr.; Mr. A. W. Orton, 6" refl.; Mr. D. O'Toole, 6" refl. & 3.5" refl.; Mr. E. J. Reese, 6" refl.; Mr. S. C. Venter, 2.75" refr.; and Mr. E. K. White, 7.5" refl. Mr. Arthur W. Orton, the well known amateur astronomer of San Bruno, Calif. has submitted his recent observations and some interesting comments on Venus. Space this month does not allow for a complete and comprehensive digest and analysis of the group's recent observational activities on Venus. The Recorder shall endeavor to discuss much of this material in a later issue.

THE DARK HEMISPHERE - Last month we discussed a few interesting views of some peculiar appearances of the dark hemisphere of Venus. There now appears to be very little doubt as to the objectivity of a recent and striking change which has occurred on the dark or unilluminated hemisphere of Venus; as to its nature and cause we are very uncertain. Several observers have seen this hemisphere as lighter than the background sky, and nearly as many others have found it definitely darker than the sky. We reported last month that Haas first called the Recorder's attention to the dark hemisphere on Dec. 11. Mr. L. T. Johnson writes that he suspected the dark side to be lighter than the sky on Dec. 7 at $22^h 15^m$. There is strong evidence that this peculiar appearance, either darker or lighter than the sky, was strongest near Dec. 11-12. Haas reported it difficult on Dec. 18-19, and it was always darker than the sky to him then and on subsequent dates. Cave found it faintly visible on Dec. 20 and lighter than the sky-background. There is also a question as to its visibility between Dec. 7 and 11; for on Dec. 10 it was invisible to Forsyth, though he probably did not especially look for it. O'Toole, observing on Dec. 19 at $0^h 40^m$, writes: "It was partly cloudy at the time of the observation, and near sunset, and as a result the clouds possessed a pinkish hue. One of these clouds passed over the field but leaving Venus faintly visible; I was amazed to see the effect of the dark hemisphere more pronounced than I have ever seen it before or since - much more than with a red filter". O'Toole found the dark hemisphere darker than the sky on this date but lighter than the sky on Dec. 25. Bevis on Dec. 26 found it darker than the sky but found the reverse on Jan. 6 at $1^h 20^m$. Several other observers have seen this peculiar appearance well; Hare found the bright crescent bordered by a dark area on Dec. 28, and Brinckman observed areas of varying tone on the dark side on Jan. 7. Cragg has recently seen the dark side lighter than the sky and so well illuminated as to suspect "belt detail" which could be traced onto the illuminated crescent, a most striking observation; his best view was on Jan. 4 at $1^h 45^m$. Cragg suggests that near Dec. 28 the peculiar appearance was gaining rapidly in prominence. Haas, however, found it difficult on this date and subsequent ones. The "lens" area mentioned on pg. 13 of the January issue was usually observed by several persons who succeeded in seeing the dark hemisphere; in subsequent reports when this area is discussed it will be referred to as "Area A", Haas' nomenclature. To any who are still not convinced as to the dark hemisphere's objective visibility Mr. Haas directs attention to L. E. Armfield's observations. Mr. Armfield at the time of his remarkable observations was entirely unaware of the recent findings by A.L.P.O members. To quote in part from his letter: "At 6:05 P.M., E.S.T., [Dec. 29, 23^h 5^m U. T.], I had just begun to observe Venus when my attention was arrested by an occurrence which I had never witnessed before in seventeen years of observing. The darkened disk of Venus was entirely visible as though it were faintly luminescent". Armfield adds that it had much the appearance of "earthshine" on the moon, when the latter is about two days old. The next evening at very nearly the same time Armfield again observed the same appearance.

E. K. WHITE'S MICROMETRIC WORK - Mr. Haas has reduced Mr. White's micrometer measures, which White obtained at Kimberley, B. C., Canada using his 7.5" reflector and an excellent homemade filar micrometer. White measured the "breadth of phase" and "diameter" of Venus. Haas has employed the formula:

$$b_c = 180^\circ - i + 0^\circ\!.4,$$

where b_c is the angular computed "breadth of phase" determined by i, the sun-Venus-earth angle. Here 0°.4 allows for the fact that the sun's rays are converging, not parallel. If b_o is observed angular breadth of phase, b.p. is measured breadth of phase, and r is measured radius of Venus, one can derive a formula:

$$\sin (b_o - 90^\circ) = -\cos b_o = \frac{b.p.}{r} - 1$$

Here the sign of cos b_o is chosen so as to make both sides in the above equation have the same sign, where b_o ranges from 0° to 180°. In this discussion "breadth of phase" is the distance from the center of the limb to the center of the terminator, and "diameter" is the distance between the two cusps. Here are White's measures:

Date	Time (U.T.)	b.p.	2r	b_o	b_c
1949, Oct. 23	23^h 23^m	10".3	19".4	93°.6	104°.4
Nov. 6	24 00(approx.)	12.6	22.0	98.3	97.7
Nov. 13	23 00	12.1	24.1	90.2	94.0
Nov. 16	0 00	13.6	25.7	93.3	92.9
Nov. 18	0 00	14.2	27.8	91.3	91.8
Nov. 19	23 30	12.6	25.2	90.0	90.7
Nov. 20	22 45	11.6	24.2	87.6	90.1

Haas states regarding these measurements: "We do appear to have some evidence here that the observed breadth of phase is less than the geometrical value, but it is scarcely conclusive. Are we dealing only with the invisibility of the dimly lit terminator or with an effect of the atmosphere of the planet?"

BARTLETT'S CRATER-LIKE OBJECT - Dr. James C. Bartlett made a most remarkable observation of Venus on Dec. 1 at $23^h 16^m$. Using his 3.5" reflector under fair seeing he noticed just south of the north cusp "a singular formation, sharply defined, which seemed to be a vast amphitheatre and to this extent resembled a lunar walled plain. The interior was filled with a mass of unintelligible detail". Bartlett feels that this object was just beyond his aperture and had no resemblance to Venusian atmospheric detail. This object was very near the same location on the terminator where Bartlett observed a deep indentation on May 9, 1948. [An identity in geographical position naturally depends upon what we assume to be the period of rotation of the planet. - W.H.H.]

REMARKS - In the next issue we shall discuss Haas' recent observations of a terminator cloud-bulge and his mathematical determination of the altitude of the cloud. We shall also report further on the dark hemisphere and the peculiar "Area A". The Recorder wishes to acknowledge the assistance given him by Mr. Louis Bellot of Long Beach, Calif., in some of the analysis of recent Venus work. It is requested that all observations of the current inferior conjunction be submitted to the Recorder as soon as they are completed.

LAST VIEWS OF JUPITER IN 1949

by Elmer J. Reese

SEB Disturbance. Mr. S. Murayama communicates the following interesting account of this disturbance as observed by him and his colleagues in Japan: "As for the disturbance in the SEB Interior Zone, I saw it first on July 23 as a small dark spot projecting southward from the north component of the SEB. The longitude of this spot was determined as 152° (II). This may have been the same feature that Mr. Hare observed (about 10 hours earlier at 156°). On August 4 two of our colleagues found an irregular marking between the two components in the same longitude. Since then we have observed the rapid growth and advancing motion of the disturbance relative to System II longitude, but we could not follow the rapid and complicated changes sufficiently. I have derived a rotation period of the preceding end of this disturbance as $9^h 53^m.1$ from the earlier records, but it seems to have increased to $9^h 54^m.5$ by the end of August."

Our observations accord very well with Murayama's findings. There are now 175 transits in our file pertaining to the disturbance in the Interior Zone. The preceding end of the disturbance drifted in decreasing longitude (II) from 132° on July 27 to 279° on November 10. This represents a period of $9^h 54^m.3$. The longitudinal drifts of the five best-observed markings in the disturbance yield a mean rotation period of $9^h 54^m.4$. E. E. Hare informs us that the SEB disturbance produced a feature much like the 1948 "dark wedge" which then followed the Red Spot Hollow. On October 18 he observed the preceding end of a dark wedge-shaped section of the SEBn at 138° (II). The south edge of the dark wedge widened into the Interior Zone and was very bumpy. Hare saw the preceding end of a similar wedge at 148° on October 23. Beautiful drawings by O'Toole show the preceding end of a dark wedge-shaped section of the SEBn near 154° on October 22 and near 143° on November 1.

Red Spot and Hollow. The Hollow was rather bright and prominent in November while the Red Spot itself was very faint or invisible. A drawing by Hare on November 6 at $23^h 52^m$ shows the general appearance of the Hollow and vicinity to be almost exactly the same as it was in May and June of 1948 - the bright

Hollow was completely surrounded by a dark border, and the SEBn was very irregular and broken immediately following the Hollow. Five drawings of the Hollow by Brinckman, Cragg, and L. T. Johnson from October 28 to November 16 are unusually interesting since each drawing shows a pair of thin, dark, parallel streaks within the Hollow. The position and orientation of these streaks on various dates suggest that the Red Spot region is a vortex in the Jovian atmosphere rotating in a counterclockwise direction in a period of 10.7 days. Five observations are hardly enough to rule out the possibility that the observed streaks were merely a chance arrangement of different streaks rather than the same pair moving with constant angular velocity around the center of the Hollow. In his letter of October 12, Hare states that he found no evidence of rotation of an elongated white rift which he observed in the Red Spot from September 10 to 22. It is possible, however, that the rift observed by Hare was in reality a whitish cloud at a high level in the Jovian atmosphere and consequently did not share the Red Spot's possible rotary motion. Drawings of the Red Spot Hollow by Cave and O'Toole on November 21 at $1^h 20^m$ suggest the presence of the dusky Red Spot in the northeast part of the Hollow. This appearance is unusual since the Red Spot, when visible, is usually located in the southern part of the Hollow.

The most recent longitudes (II) of the Red Spot Hollow obtained from central meridian transits follow:

Observer	Limiting Dates	Prec. End	Center	Fol. End
Brinckman	Sept. 19	----	241° (1)	----
Cragg	Nov. 4	----	244 (1)	----
Haas	Oct. 1-Dec. 20	220° (7)	239 (3)	252° (4)
Hare	Oct. 9-Dec. 1	231 (4)	244 (3)	256 (3)
O'Toole	Nov. 21	234 (1)	245 (1)	257 (1)
Reese	Oct. 2-Dec. 15	229 (9)	242 (8)	255 (8)

Six transits by Reese in October placed the preceding end of the rapidly fading Red Spot at 234° and the following end at 264°. Two by Haas that month placed the preceding end at 237° and the following end at 261°.

EZ Festoons. Near the end of the apparition some very extensive festoons were observed in the equatorial region. The majority of these dark streaks extended obliquely across the EZ from northwest to southeast. They were seen to connect dark humps on the south edge of the NEB to dark spots on the SEBn. On October 28 at $2^h 20^m$ Cragg found a very prominent festoon on the central meridian. The festoon was distinctly double being divided into two thin, dark streaks by a narrow white rift. Each component extended from the NEB to the SEBn; however, the eastern component had a small branch leaving it at the EB. Was that portion of the festoon which curved into the EB at a different level in the Jovian atmosphere than that portion which continued on to the SEBn? On November 9 Hare observed a prominent festoon extending from the south edge of the NEB at 250° (I) all the way to the STB at 285° (I)!

Belts and Zones. In November the SEB was frequently found to be as conspicuous as the NEB between longitudes (II) 130° and 220°. The STB faded rather remarkably in late October. For the most part, this fading seemed to be confined to those longitudes in which the SEB was darkest. Despite good seeing conditions, Bartlett could not discern the STB on October 22 at CM (II) 132° nor on October 27 at CM (II) 174°. On November 1 at CM (II) 142° Cragg found the STB extremely faint and broken. His drawing suggests that the STB was obscured by bright clouds and haze from the STrZ. A most remarkable observation was made by Cragg on November 4 at $2^h\ 15^m$ with the Red Spot Hollow on the central meridian. Two large dusky areas were apparently obscuring both the STrZ and the STB from the west limb almost to the preceding end of the Hollow. Hare noticed nothing unusual here on November 6 at $23^h\ 52^m$ with the Hollow again on the central meridian! The zones were in the following order of decreasing average brightness during October and November according to 38 sets of estimates by Bartlett, O'Toole, and Reese: STrZ, NTrZ, STeZ, EZ, NTeZ. The two tropical zones averaged very nearly equal in brightness and were by far the brightest zones on the planet. The brightness of the tropical zones, however, varied greatly in different longitudes (II). Between 80° and 180° the STrZ was much brighter than the NTrZ, while the NTrZ was much the brighter between 200° and 350°. O'Toole found the NTrZ very dull and pinkish near 113° on October 10, while Cragg found this zone extremely brilliant near 216° on November 2. During most of the apparition, the STrZ was clear and bright except for dusky columns occasionally seen at or near the preceding and following end of the Hollow. On October 20, however, Cragg observed a dark area in the STrZ near 315° (II) which greatly resembled the Red Spot. This dusky area was confirmed by Reese on October 24 when transits placed the preceding end at 303° and the following end at 331°. Subsequent views of this region by Hare indicate that the dusky area contracted into a thin column in the STrZ which remained practically stationary near longitude (II) 319° from November 9 to December 8. Several very brilliant spots hav been seen in the NTrZ by Bevis, Cragg, Hare, and O'Toole. Bartlett, Murayama, and O'Toole have seen a number of dark condensations and projections on the south edge of the NTB. Markings on the south edge of the NTB deserve close attention since a very abnormal current in the Jovian atmosphere is known to exist at that latitude (JRASC, Vol. 35, No. 8, pp. 330-336).

Occultation of Jupiter II by Jupiter III. This occultation, which occurred on October 16 (December issue, page 3), was also observed by E. E. Hare. This observer agrees with Haas that first contact occurred at $0^h\ 59^m$ and that the occultation was total.

Transits. Our records of Jupiter in 1949 now contain a total of 3369 transits by twelve observers. Hare obtained 1075 transits and thereby becomes one of the very few American observers to secure more than a thousand transits in a single apparition.

THE CRATERS ON THE MOON

By Lincoln Lapaz

(FOREWORD. The following article was originally published in Scientific American for October, 1949. It is reproduced here by the kind permission of the editors of that magazine.)

The tendency of the pendulum of opinion to overswing is quite as noticeable in the scientific world as elsewhere. Only a few years ago D. M. Barringer and his associates were waging an uphill but eventually successful campaign in the pages of the Scientific American to prove that one terrestrial meteorite crater (and that the most obvious one) actually had its origin in meteoritic impact. In the July issue of the same magazine Ralph B. Baldwin takes the position that all of the millions of craters on the moon are meteorite craters. Furthermore, Baldwin's extravagant views have been sanctioned in the first published review of his recent book, The Face of the Moon (see Fred L. Whipple, Sky and Telescope, August, 1949, pp. 258-59).

The satisfaction felt by meteoriticists that scientists of the caliber of Baldwin and Whipple are now actively engaged in the development of meteoritics, a field too long ignored by the geologist and the astronomer, must be tempered by concern that hasty acceptance of such extreme views as Baldwin's react to discredit the new science. This letter has its origin in such concern. Its purpose is to raise a number of objections which either render most improbable Baldwin's thesis that all lunar craters are of impact (i.e., extrinsic) origin; or which bring out certain redundancies or inadequacies in the evidence Baldwin has presented in support of his views; or which make clear that in his precipitate abandonment of all intrinsic theories of lunar crater formation, he has entirely escaped coming to grips with the most modern and, in the writer's opinion, the best-founded explanation of the craters on the moon, exclusive of the so-called ray craters.

Summarized briefly, these objections are as follows: 1) It is extremely unlikely that the observed distribution of craters on the moon arose by chance, as would necessarily be the case if these craters had been produced by a random fall of meteorites on the lunar surface. 2) Contrary to Baldwin's conclusion that only meteoritic impact explosions could produce on the moon craters with the characteristics observed in the lunar craters, the most recent intrinsic theory of the origin of these craters not only provides craters which conform quite as well as explosion craters to the various empirical relations discovered by the study of individual lunar craters, but also actually predicts such general lunar features as the polygonal rather than circular shape of most of the large craters. 3) Baldwin, by adopting C. C. Wylie's estimates of the mass of the meteorite which created the great crater at Canyon Diablo, Ariz., is enabled to ascribe even the largest of the lunar craters to the impact of meteorites of amazingly small size. Actually the estimates of Wylie have been shown to be quite unrealistic. Hence the impact explosions of such cosmic pebbles as Baldwin describes are not competent to produce the huge craters credited to them. 4) Baldwin cites the relationship between crater-diameter and rim-height as evidence for the explosive origin of the lunar craters in addition to evidence afforded by the diameter-depth relation. However, the relation between diameter and rim-height is a simple consequence of the diameter-depth relation in view of Schröter's Law and the proportionality between rim-width and crater-diameter.

Only the first two of the above objections can be developed in any detail in this letter. Objection No. 1 is based on the fact that were the lunar craters, as Baldwin supposes, the result of meteorite impacts on the face of the moon, the centers of these craters would constitute a set of points distributed at random over the lunar surface. It is evident that falling meteorites would strike at random on the surface of such celestial bodies as the earth and the moon. However, in the case of the moon, the distribution of crater-centers is not at all random. This follows not from the easily perceived nonuniformity of the distribution in question, as some writers have supposed, but from discrepancies existing between the observed distribution of the lunar craters and the distribution predicted by the theory of probability.

(To be concluded)

MARS, SATURN, AND CRATER CONON

Mars is now close enough to repay careful and regular watching by those able to observe late in the night. The angular diameter will increase from 10".1 on February 1 to 12".9 on March 1. Quantity ⊙ will change from 72° on February 1 to 84° on March 1, the season thus being late spring in the northern hemisphere. The north pole will be tipped toward the earth by 21 degrees throughout February. This month's discussion of Mars is based upon observations by F. E. Brinckman, Jr. (6-inch refl.); T. R. Cave, Jr. (8-inch refl.); W.H. Haas (6-inch refl.); E. E. Hare (12-inch refl.); L. T. Johnson (10-inch refl.); S. Murayama (18-inch refl., 8-inch refl.); D. O'Toole (6-inch refl.); and T. Saheki (8-inch refl.) The 18-inch reflector mentioned is at the Tanakami Observatory in Japan.

An important recent observation of Mars was made by Mr. Tsuneo Saheki of Osaka, Japan, near 19^h 30^m on January 15 (U.T. here and later). Using 400x and 500x on an 8-inch reflector in good seeing, he remarked a dull, yellowish gray cloud-bulge on the south limb of Mars. Writing on January 20, Saheki gives the Martian geographic coordinates of the cloud's center as longitude 202°, latitude 58° south. He tells us that the angular height of this projection above the surface of Mars was 0".16, corresponding to an elevation of more than 60 miles, and that the diameter of the cloud was about 900 miles. The cloud-bulge first began to appear near 19^h 0^m on January 15. Bad seeing terminated observations near 20^h 0^m, and subsequent days were cloudy in Japan. Saheki further writes that though he frequently records white or yellowish white cloud-projections, he has "never seen such a strange cloudy mass in my observations since 1933". Its dullness and its gray color suggest to him that it may have the same explanation as Antoniadi's "cloud of volcanic ashes" over Deucalionis Regio in 1909 and 1911 (Memoirs B.A.A., Vol. XX, pp. 37, 48, and 126, 1916). In those years Antoniadi found Deucalionis sometimes red, sometimes gray; he proposed that it was at times obscured by gray clouds, perhaps composed of volcanic dust. We urge our readers to examine closely the portion of Mars where the cloud was seen. We are eager to receive observations of this region, whether of "normal" aspect or otherwise. It is precisely in matters of this kind that our current international program on Mars is of great value, for only a world-wide chain of observers can keep all portions of the planet under constant examination.

The north cap was brilliant in December and January; and the surrounding polar band was wide and conspicuous, but not extremely dark. We have already reported how several observers found the diameter of the north cap to be near 40 degrees from mid-September to mid-December, 1949. L. T. Johnson also concurs; he gets 39 degrees as the average of measures of five drawings from September 21 to November 15. More recent work has clearly revealed the spring melting. Estimating at the telescope the size of the north cap relative to that of Mars, Hare obtained 34 degrees on December 28. Johnson secured an average of 34 degrees by measures of three drawings from December 17 to 30. Writing on January 12, Saheki stated that the melting was proceeding regularly, that the diameter was then 26 or 27 degrees, and that the melting-curve was parallel to the 1933-48 mean-curve. Brinckman found a diameter of 38-40 degrees from a drawing on January 8. Haas secured by measuring drawings these average values: December 24-January 7, 26 degrees (4 drawings); January 10-January 23, 24 degrees (5 drawings). We might note that ⊙ was 53° on December 20, 60° on January 5, and 66° on January 20. In an excellent view on December 17 at C.M. 349° Johnson saw distinctly two parallel north polar bands preceding Acidalium, the northern one being the darker. Haas may have seen the same appearance imperfectly twice in other longitudes; and it is here interesting that this observer usually draws a thin, very dark streak adjacent to the cap in the broader polar band.

The south cap was usually dim and diffuse and was rapidly variable in size and brightness. Near longitude 63° on January 17 and 18, however, Haas thought it very plain and the brightest that he had yet seen it at this apparition. The use of color filters indicated to Haas on January 17 and 18 that the south cap was a yellow cloud (dust), but on January 23 filters indicated that it was then a blue cloud (vapor).

Bright areas on the disc have been common, especially in low latitudes near both the limb and the terminator. A few examinations with color filters have shown that some of these are dust clouds and that others are vapor clouds. Clouds have also revealed themselves by veiling surface features. As examples, from December 8 to December 11 Saheki and Murayama found Cerberus canal very faint and apparently covered by yellow clouds; it was much darker to Saheki both before and after this interval. Brinckman on January 8 drew nothing of the southern maria near longitude 142° in a view good enough to show part of Propontis extremely dark. O'Toole found the north polar band invisible following Acidalium on December 22 near C.M. 356°, when there was a huge cloud not far away on the limb. The November obscurations of Syrtis Major by Martian clouds described on pages 9 and 10 of the January issue were apparently not repeated in late December; at any rate, Hare saw this famous mare very clearly on December 24 and 28 (Figure 6 on pg.1).

Thoth-Nepenthes canal has been clearly seen by several observers (Figures 4 and 6 on pg.1); it is wide, and Saheki has discerned here and in Casius a "knotted structure". Elysium has been whitish in recent months. Saheki found Amazonis Regio darkish in December. In his splendid view on December 17 Johnson drew Acidalium detached from the north polar band, and O'Toole may have seen the same aspect less clearly on December 22. On January 18 and 20 Haas was rather surprised to find a white lane running northeast from Lunae Lacus in apparently the position of Nilus canal. Its appearance was not unlike that of Antoniadi's Tractus Albus on his 1909-37 map. The lane was brighter near the limb than near the central meridian. Was it a transient feature? A drawing by Saheki on December 8 shows a truly remarkable amount of detail. It is interesting to note on this drawing that some regions enclosed by several canals are somewhat more dusky than neighboring areas. The southern maria have been fairly dark and distinct in most of the best views of Mars. A number of canals have now been independently recorded by two or more observers.

The careful observation of colors on Mars is an interesting kind of study. It is here advisable to employ reflecting telescopes only, and color filters of known transmissivities may be very helpful (note Dr. Bartlett's discussion of their use on pg.3 of January issue). Only a few results have been reported so far. Brinckman on January 8 found the north polar band blue-green, as it has frequently been in the past when the cap is melting. Hare on December 30 called Mare Cimmerium light blue. Saheki on December 8 found Sirenum indigo brownish and Cimmerium faint blue-gray (in accord with Hare); he has also seen blue or green in the shaded Amazonis. Drawings in color are always attractive, of course.

We request readers able to do so immediately to begin a careful watch of the two Saturnian shadows. Careful notes upon their visibility and appearance are wanted and are valuable for information they supply upon the appearance of small planetary features under actual conditions of observation. The shadow of the rings on their north side is now growing smaller and should be watched until it theoretically vanishes early in March (it may become invisible sooner). The shadow of the ball on the rings will dwindle as we approach the opposition of March 7; the ring-arms are now so narrow that this shadow may give information about the visibility of spots (the other shadow of lines). It is possible that false shadows, or contrast-effects, may be seen on both arms of the rings near opposition.

This month's discussion is based upon observations of Saturn by these colleagues: F. E. Brinckman, Jr. (6-inch refl.), T. R. Cave, Jr. (8-inch refl.), W. H. Haas (6-inch refl.), E. E. Hare (12-inch refl.), L. T. Johnson (10-inch refl.), R. Missert (6-inch refl.), D. O'Toole (6-inch refl.), E. J. Reese (6-inch refl.), and T. Saheki (8-inch refl.).

When in transit near the central portions of its primary, satellite Titan looked very dark to Johnson on December 30 and to Cave on January 15. Hare on December 30 called Titan black near the central meridian and found it still dark only 2" from the limb. Another transit of Titan will occur from 4^h 20^m to 5^h 37^m on February 16. It will be interesting to hear from our readers whether they can detect other satellites of Saturn and their shadows in transit.

On pg. 11 of the January issue we described a curious difference in brightness found between the east and west arms of the rings with color filters. Continuing these studies, Haas carried out 13 examinations from December 22 to January 23 with Wratten Filters 25 (red), 58 (green), and 47 (blue). In 10 of the views, including all those prior to January 20, the blue filter showed the west arm (left in simply inverted view) the brighter. There was very seldom much difference with the other two filters or with no filter; but there is evidence that the west arm grew progressively less blue, or more red, relative to the east one from late December to late January. Brinckman on January 8 had these results: no definite difference with no filter, CC6 (blue), or X1 (green); west arm definitely the brighter with C5 (dark blue) and 85 (orange); west arm perhaps the brighter with A (deep red). Brinckman noted the difference in brightness in blue to be less than near the end of November, 1949, and thus independently is in accord with the trend found by Haas. Johnson on December 25 found the two arms alike with filters G (yellow) and X2 (green); he suspected that the west arm was the brighter with filter A (deep red). We remind properly equipped readers that photographs of Saturn with color filters are very much desired in this problem. An explanation of the very curious appearance is also desired.

In our last two issues we listed central meridian transits of the terminal ends of a darker section of the North Temperate Belt followed from November 3, 1949 onward. The following (right) end is shown on Brinckman's drawing of November 30 reproduced as Figure 3 on pg. 1. Haas considers that these additional transits by himself relate to this same darker section:

Date	Prec. end central	Fol. end central	Conditions
1949, December 22	13^h 17^m, U.T.		bad
December 27	10 42	11^h 36^m, U.T.	poor to fair
December 29	11 33	12 21	poor
1950, January 4	13 37		fair
January 7	10 2		rather poor
January 18		10 20	fair to good
January 20	9 40	10 34	fair

The motion of the darker section continues to be most remarkable, and a very careful study of its motion is hence important. Originally near 10 hrs., 14 mins. on November 3, the period of rotation had shortened to the amazing value of about 9 hrs., 47 mins. by December 22 and had reached the still more amazing value of about 9 hrs., 40 mins. by January 20! The darker section has been harder to see during the last month than it was in November. In fact, it was several times looked for without success when it must have been well-placed on the planet's disc; thus Missert saw nothing of it from 6^h 20^m to 7^h 37^m on December 30, O'Toole could only suspect North Temperate Belt detail at 14^h 50^m on December 13, and Reese saw no definite darker section from 10^h to 12^h on December 16 in an excellent view.

The most noticeable change in the belt-pattern in recent weeks has been the development of a north component of the North Temperate Belt. Thus Hare on December 24 found that the doubled N.T.B. resembled the doubled South Equatorial Belt except for color. The south component of the N.T.B. was darker and stronger than the north component. It is rather uncertain when the doubled appearance developed. It may be pertinent that Hare suspected a darker southern edge to the N.T.B. as long ago as December 1. Reese in an excellent view on December 16 clearly divided two very close components. Haas first glimpsed a doubled aspect on December 24 and 29 and often saw it clearly in January, but even in January the belt looked single in some longitudes. Brinckman, Hare, and Reese have seen an extremely thin Equatorial Band with certainty; Reese thought it very dark on December 16. Hare has had remarkable success in detecting difficult belts with his excellent 12-inch reflector. He has perceived two South Temperate Belts between the South Equatorial Belt and the South Polar Band and two belts, one very narrow and one rather wide, between the N.T.B. and the shaded North Polar Region. Most difficult of all was a broken and very thin belt in the North Tropical Zone, the bright space between the N.T.B. and the shadow of the rings. Brinckman and O'Toole have apparently drawn Hare's wide northern belt, while Saheki may have depicted one of Hare's S.T.B.'s. The ball remains more dusky south of the S.E.B. than north of the rings. Several observers agree about the presence of such delicate detail as humps on the north edge of the S.E.B., darker spots and sections and bends in the N.T.B., and brighter areas in the Equatorial Zone.

Saheki, Brinckman (Figure 3 on pg. 1), and Johnson agree that the north edge of the shadow of the rings definitely bends northward at the limbs of the planet. Moreover, Johnson on December 17 and 30 saw a narrow wedge of light between the projected rings and their shadow at the west limb, presumably the less dark shadow of Ring C. He computes that the maximum width of this wedge at the limb was 0".22 on December 17 and 0".26 on December 30. It is excellent independent confirmation that Saheki on December 25 drew a bright wedge at both limbs but broader at the west one. No one has yet reported being able to see with certainty the Crape Band just south of the projection of Rings A and B on the ball. Computations by Hare and Johnson assign to the Ring C projection a width of only about 0".1 in recent months. However, past studies have indicated that the Crape Band is really the shadow of Ring C. This shadow has been totally concealed by the rings themselves recently, but a strip of it is now becoming visible; therefore, a close watch should be maintained upon the Crape Band during February and March. Here again important information on the visibility of narrow bands can be secured.

Figure 1 on pg. 1 is a preliminary map of the lunar crater Conon by E. J. Reese. The nomenclature on this map (Reese's own) has been used in past issues in referring to features in Conon; it will also be employed in the future in this periodical. On this map p, q, and r are very low hills or mounds. Feature o is a bright area of unknown topographical nature. Object v is a cleft, and object b is a fault. Feature s is a dark streak but is not thought to be a cleft. Observations of Conon are primarily desired between colongitudes 20° and 45°. Accordingly, good evening dates by local civil time to study it in this country in the near future are February 26, February 27, March 28, April 26, and April 27. If we can secure a large number of observations of this one lunar crater in a short period of time, that will aid greatly not only in the study of lunar changes but also in the examination of the subjective errors to which all observers are exposed. Each observation should include a description of fault b, whether continuous or broken, and a statement of the order of decreasing conspicuousness of dark streaks seen on the floor, using the nomenclature of Figure 1. A drawing and a general description of the crater are very desirable but are not essential. The observations should be mailed promptly either to the editor or to Mr. Reese, whose address is 241 S. Mount Vernon Ave., Uniontown, Penna. May we count on your aid?

Reese outlines the following suspected changes in Conon during the years 1946-1949:

1. Fault b appears to be growing more prominent. Do we have an example of active faulting on the lunar surface?

2. In some lunations fault b apparently has been obscured in places by an overlying haze between colongitudes 24° and 45°. In other lunations b has looked very black and unbroken.

3. Streak s usually appears much more conspicuous than cleft v near colongitude 30°. Nevertheless, in some lunations s has been invisible near this colongitude even when cleft v was seen. (In testing relative conspicuousness it is best slowly to rack the eyepiece out of focus and to note the order of disappearance of the features being compared.)

4. The brightness and position of area o (W. H. Pickering's "cloud" on the floor, see Popular Astronomy, Vol. 28, pg. 389 et. seq., 1920) are apparently variable in a fashion independent of the solar illumination. Although a straight line through the centers of features o and p prolonged eastward usually passes over a point midway between the craters Beer and Timocharis, this line has been estimated to deviate as much as 14 degrees from its mean position.