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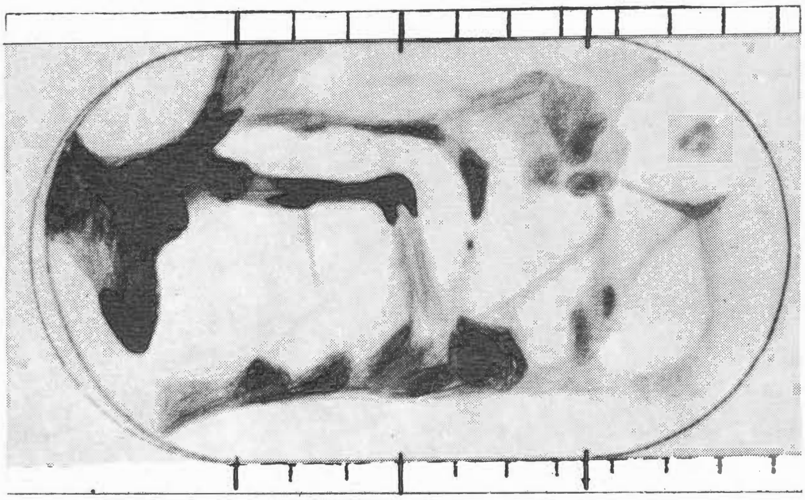

A continuous drawing of Mars on an extended orthographic projection by Clark R. Chapman with a 10-inch reflector on November 22, 1960, 4 hrs., 15 mins. to 10 hrs., 45 mins., Universal Time. Features shown include, from left to right, Syrtis Major, Sinus Sabaeus, Margaritifer Sinus, Mare Acidalium, Aurorae Sinue, an unusual Ganges-Lunae Lacus dark development, and Solis Lacus. See also page 33, first paragraph, in this issue for a description of Mr. Chapman's procedure. Seeing a variable 7, transparency 3-4, diameter of Mars 13.3 seconds, central meridian of longitude on Mars 315 degrees to 50 degrees.

THE STROLLING ASTRONOMER

Pan American College
Observatory
Edinburg, Texas

IN THIS ISSUE

DIMENSIONS OF THE LUNAR DOME KIES 1

By: Joseph Ashbrook

There is a serious lack of quantitative information about the properties of lunar domes--diameters, slope angles, and heights. Such data are helpful in defining what a dome is, and essential for subclassification and for meaningful interpretation. This missing information can be easily gathered by amateur observers, without special equipment. To illustrate some of the methods, this article discusses in some detail the well-known dome between Kies and Mercator. This dome is shown in Figure 1.

This object is named Kies 1 by Patrick Moore and P. J. Cattermole (1) in their catalogue of domes. The first question is the selenographic position of the dome, as fairly accurate coordinates are needed in evaluating slope observations. Moore and Cattermole's positions are too rough for this purpose; for Kies 1 they give Xi = -.361, Eta = -.460, some distance southwest of the true place. Much more reliable positions will be readily available from the forthcoming supplement to G. P. Kuiper's Photographic Lunar Atlas, this supplement to consist of accurately gridded photographs. Meanwhile, good coordinates can be scaled from the IAU atlas, from which I find -.365, -.452, which are adopted for this article. As a check, I measured -.366, -.453 from sheet E6-a (ungridded) of the Kuiper atlas. This last position was found by Maedler's second-order method.

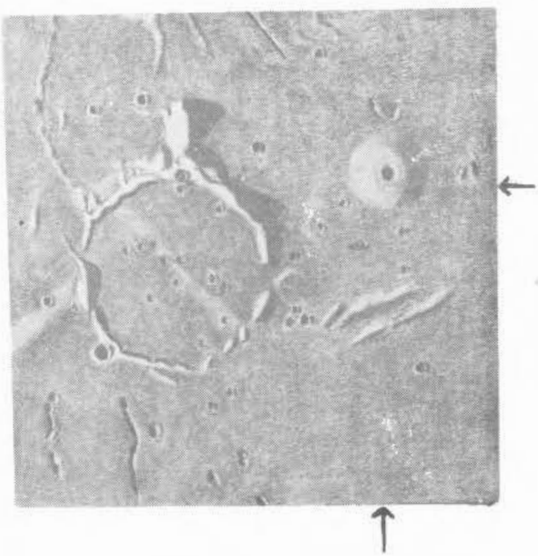

FIGURE 1. Drawing of Lunar Crater Kies and Vicinity by Alika K. Herring. 12.5-inch reflector at 275X. August 2, 1960. $3^h 30^m$, U.T. Seeing 5-7 on a scale of 0 to 10, with 10 best. Transparency 5 on a scale of 0 to 5, with 5 best. Colongitude = 26°.5. The arrows point to the lunar dome Kies 1, discussed by Dr. Joseph Ashbrook in his accompanying article.

The diameter of a dome is easily found visually without a micrometer, by comparison with nearby craters whose sizes are known. The observation consists in estimating the ratio between an apparent diameter of the dome and the parallel diameter of a comparison crater. For example, if the crater has a diameter of 10.0 kilometers, and the dome's diameter is estimated as 0.55 of this, the dome diameter is 0.55 x 10.0 = 5.5 kilometers.

The diameters of the comparison craters can be taken from J. Young's list (2), or measured from photographs. The values actually used by me for Kies 1 are given in Table 1.

Table 1. Comparison Craters for Diameter Estimates

Crater	Diam. in kms.
Koenig	22.1
Bullialdus B	21.9

Table 1.-continued.

Crater	Diam. in kms.
Kies A	16.4
Nicollet	15.8
Kies B	8.7

Table 2 summarizes visual diameter estimates of Kies 1 on seven nights, with 6-inch and 10-inch reflectors at 200X.

Table 2. Visual Diameters of Kies 1

U.T.	Diam. in kms.	No. of Comparisons
1958, July 26.021	10.8	5
Sept. 22.959	10.6	1
Dec. 20.955	11.4	1
1959, July 29.373	10.9	2
Aug. 13.994	10.1	3
Dec. 9.959	10.9	3
1960, Jan. 8.935	10.6	2
Weighted mean	10.7 ±0.2 kms.	

For comparison, the diameter of Kies 1 was also measured from Kuiper's Atlas, the scale being again found from nearby craters. Sheets E6-a and E6-d gave 12.6 and 13.0 kms., respectively. The mean, 12.8 kms., is significantly larger than the 10.7 kms. found visually. Perhaps the telescopic estimates have not included the extreme margin, visible on the photographs as a slight change of brightness. In any extensive study of dome dimensions, the possibility of a systematic difference between photographic and visual diameters should be looked into.

Information about the vertical cross section of a dome can be gathered by watching the progress of its shadow near sunrise or sunset. The dome can be imagined as a slight swelling of the lunar surface, with gently sloping sides. Soon after sunrise, the shadow retreats down the eastern flank; at the edge of this shadow, the slope angle of the surface is equal to the angular elevation of the sun. The sunlit upper part of the dome has a slope less than the sun's altitude, while the still-shadowed lower portion is on the average steeper. As the sun's altitude increases in the lunar morning, the shadow will finally completely disappear when the slope angle at every place on the dome's eastern side is less than the solar altitude.

In noting the progress of the shadow, a convenient method is to estimate from time to time the fraction x of the dome's east-west diameter that is covered by black shadow. Care is to be taken to distinguish between true, black shadow and the dark gray shading which represents grazing illumination by sunlight. At the time when $x = 0.25$, the sun's altitude can be taken as equal to the average slope of the dome flank.

At a point on the moon whose selenographical latitude is B and longitude is L, the sun's altitude h_0 is given by the formula:

$$\sin h_0 = \sin b \sin B + \cos b \cos B \sin (C + L).$$

Here b and C are the sun's selenographical latitude and colongitude, respectively, and are taken from the American Ephemeris. The two latitudes must be used with their proper signs, positive when north and negative when south. A negative computed value of h_0 means that the sun is below the lunar horizon. Colongitude is always measured toward the east, up to 360°; lunar longitudes are positive to the west and negative to the east.

The observations of this type for Kies 1 are summarized in Table 3, where the letters M and E refer to morning and evening illumination, respectively.

Table 3. Slope Observations of Kies 1

U.T.	Solar Altitude		x	Remarks
1960, Aug. 2.038	0°.6	M	0.4	
1960, Aug. 2.042	0.7	M	0.38	

Table 3.-continued.

U.T.	Solar Altitude		x	Remarks
1960, Aug. 2.059	$0\overset{\circ}{.}85$	M	0.33	
1960, Aug. 2.083	1.1	M	0.28	
1959, Dec. 9.959	1.2	M	0.25	
1960, Aug. 2.101	1.3	M	0.25	
1959, Dec. 10.006	1.7	M	0.2	
1959, Sept.26.417	5.0	E	0.0	West foot gray; no umbra
1959, July 29.373	5.4	E	0.0	No umbra
1960, Jan. 8.935	5.7	M	0.0	East foot dark, but no umbra

From Table 3, it follows that the average slope angle of the eastern side of Kies 1 is about $1\overset{\circ}{.}3$. The summit is very nearly a flat, horizontal surface (apart from the well-known central pit). Furthermore, even the steepest parts of the eastern and western flanks nowhere have slopes greater than about 5°, except possibly in very limited areas.

The height of Kies 1 can now be estimated by multiplying the radius of the dome, 6.4 kms. from the photographs, by the tangent of the average slope angle, $1\overset{\circ}{.}3$. It turns out that the summit of the Kies dome is approximately 145 meters higher than the surrounding plain.

The new data make the Kies dome somewhat smaller and even flatter and lower than in Baldwin's brief description (3): "One [dome], lying between Mercator and Kies, is 2,000 feet high and 9 miles broad. The mean angle of the outer slope is $4\overset{\circ}{.}8$." Baldwin does not tell how his numbers were obtained, and there is no way to judge their precision.

On the other hand, the new slope data for Kies 1 are similar to recently published values (4) for the very large dome Maraldi d, near Vitruvius. This is 60 kms. in diameter, and has an average slope of $1\overset{\circ}{.}9$, with 4°-5° on its lower parts and with a few localized steeper places around the margins. Maraldi d can be usefully regarded as a scaled-up version of Kies 1.

Readers who would like to try diameter and slope observations of other domes might consider the two east and north of Arago. The eastern, Arago 1, is centered on Xi = +.343, Eta = +.109, corresponding to L = $+20\overset{\circ}{.}2$, B = $+6\overset{\circ}{.}3$. The coordinates of the northern, Arago 2, are Xi = +.363, Eta = +.133, or L = $+21\overset{\circ}{.}4$, B = $+7\overset{\circ}{.}6$. These positions were measured by the writer from photographs. For both the Arago domes, the following comparison craters are useful; their diameters, taken from Young's catalogue, are in kilometers: Arago, 26.4: Maclear, 21.1; Manners, 16.9; Ross, 26.7; and Sosigenes, 18.4.

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4. Joseph Ashbrook and Ernst Both, Strolling Astronomer, Vol. 13, Nos. 11-12, 137-140, 1960.

Postscript by Editor. We express our thanks to Dr. Ashbrook for his clear and informative discussion of a very worthwhile amateur lunar program. Surely no one who reads this article need ever complain again of a lack of observational problems on the lunar surface. It will be most gratifying if a goodly number of our members undertake and report the investigations of the lunar domes Arago 1 and Arago 2 described in the very last paragraph, for which all necessary data are there supplied. Quantitative studies of this kind have been much neglected in amateur studies of the lunar and planetary surfaces, even in some professional work.

A LOOK AT ASTRONOMY IN RUSSIA

By: Patrick Moore

In the summer of 1960 I received an invitation to go to the U.S.S.R. and deliver some lectures about the Moon. The invitation came via the Academy of Sciences, and was decidedly unexpected; apart from some correspondence with Dr. Kozyrev, and personal acquaintance with Professor Alla Masevich when she came to England earlier in 1960, I had had no previous contact with Russian astronomy or, indeed, with the Soviet Union or anything connected with it. However, I was delighted to accept, and on October 3 I duly flew to Moscow.

I cannot speak Russian, and I am equally unfamiliar with German; I am fairly comfortable in French, but clearly had to have an interpreter. I was fortunate in having Gregory Molyikov, whose English was absolutely fluent and who was moreover a most agreeable companion. When I lectured, the system was that I gave an introduction in English; Gregory Molyikov then read the actual lecture in Russian, while I did any demonstrations and showed the slides; and the question and answer period at the end was coped with by means of simultaneous translation.

At the headquarters of the Astronomical Council, in Moscow, I renewed my acquaintance with Professor Masevich, whom I was very glad to see, and also met many other leading Russian astronomers--among them Professor Mikhailov, whose fame is world-wide, and who (to my relief) speaks almost perfect English. It is clear that the Council organizes Soviet astronomy very well indeed, and does not neglect the amateurs, of whom there are many.

One point which interested me was a plot of all the reported "landing positions" of Lunik II on September 13, 1959--including my own tentative positional observation. The scatter is considerable, and the Russians consider that the general evidence is so slender that the visual observations on this occasion were of little or no value. With this I am bound to agree. My own observation was admittedly uncertain, and I never had much faith in it.

The chief Moscow observatory is the Sternberg, close to the vast University building. I was cordially greeted by the Director, Professor Martinov, and his colleagues. The Observatory is very well equipped; all the instruments are Soviet made, and are obviously very good, though I was unable to make any practical observations owing to bad weather (in fact, I was cursed by cloud during my whole period in Russia). I also met eminent men such as Dr. Bronshten, Dr. Khromov, and Professor Lipski. Professor Lipski has just completed a new chart of the Moon's hidden side, based on some 30 photographs--which I saw--taken from Lunik III. I was particularly glad to see that he had Dr. Wilkins' lunar map beside him, and said that he found it invaluable, as it was much the best for checking and correlating between the familiar and averted sides. I am only sad that Dr. Wilkins did not live to see it. I lectured at the Sternberg, dealing with theories of the Moon, and became involved in many interesting discussions. I also lectured at Moscow's excellent Planetarium, which is as good as any I have seen, and is deservedly popular; it has a daily audience of 3,000 people--including many youngsters. The interest in astronomy, as well as in space research, is very marked.

From Moscow I went to Leningrad. Here, of course, lies the Pulkovo Observatory. It has been completely rebuilt since its destruction by German shelling during the war, and has many optical and radio telescopes, including a fine 26-inch Zeiss refractor. There is also a lunar and planetary laboratory, headed by Professor A. B. Markov, with whom I had several long and interesting conversations, and who (like everyone else) was kindness itself. Professor Markov has just edited an important book about the Moon, and has himself made many contributions of great importance.

Pulkovo has a long and honorable history; and its future career will, I am sure, be equally fruitful. Unfortunately the climate at Leningrad is

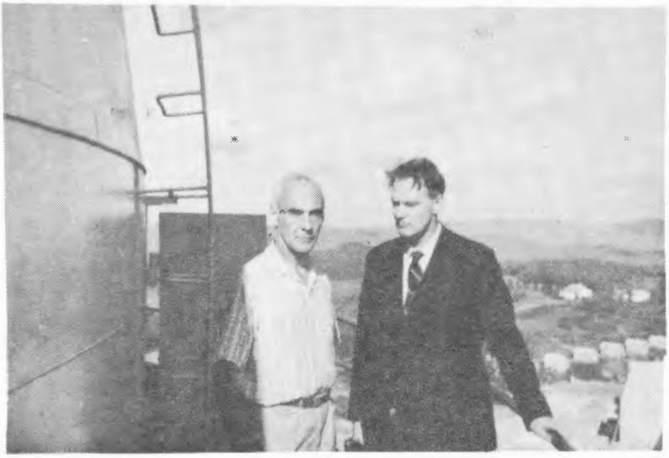

FIGURE 2. Dr. N. T. Kozyrev (left) and Patrick Moore on balcony of 102-inch dome, Crimean Astrophysical Observatory, U.S.S.R. Figures 2, 3, 4, 5, and 6 are photographs contributed by Patrick Moore.

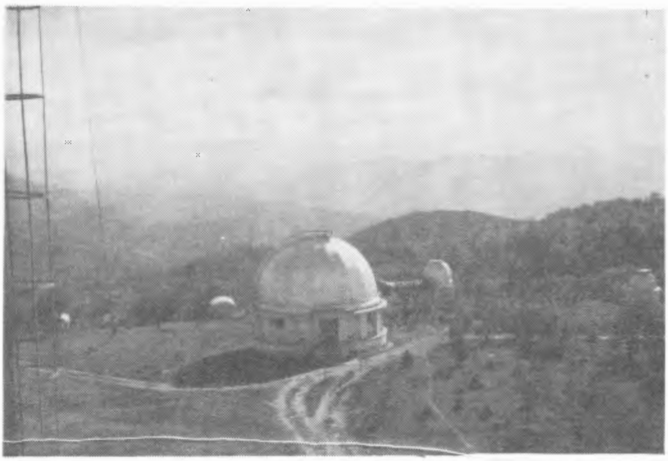

FIGURE 3. Dome of 50-inch reflector, Crimean Astrophysical Observatory. Taken from balcony of 102-inch dome.

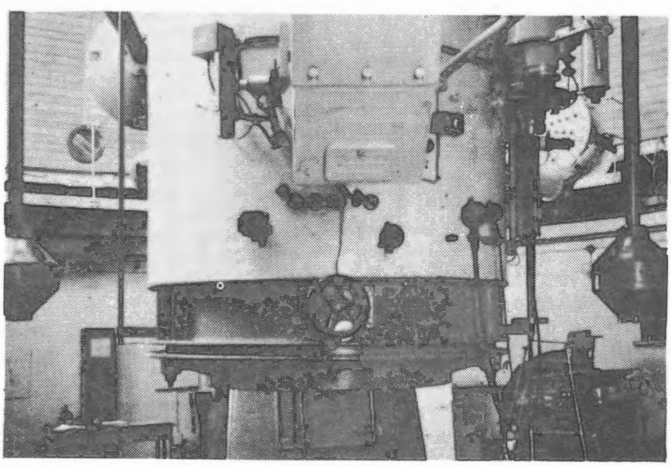

FIGURE 4. 50-inch reflector, Crimea. This telescope made the famous November 3, 1958, Alphonsus spectrograms.

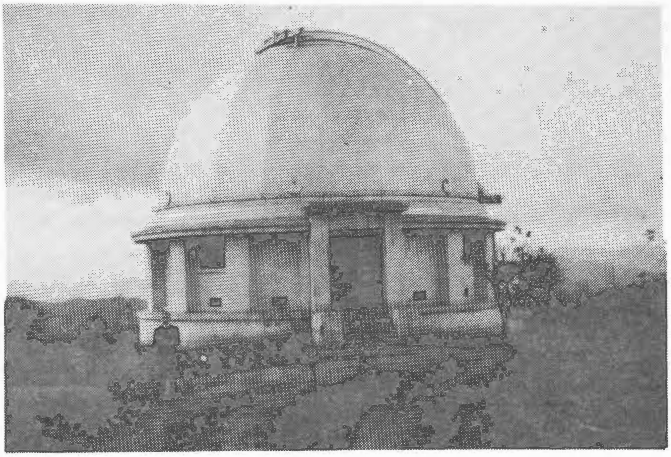

FIGURE 5. Dome of 50-inch reflector, Crimean Astrophysical Observatory.

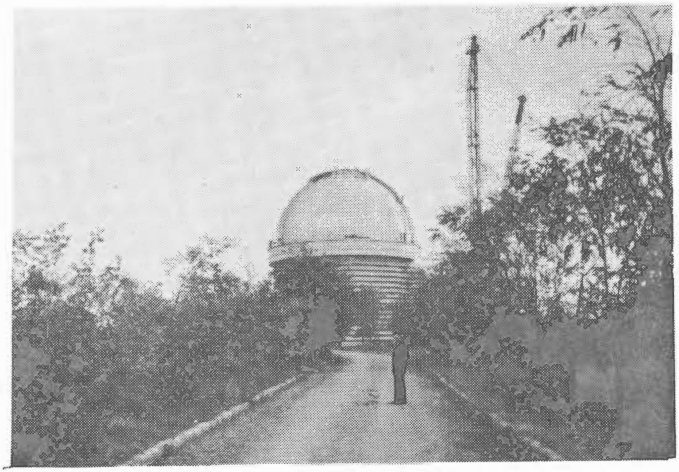

FIGURE 6. Dome of 102-inch reflector, Crimea.

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not good; during the summer the sky never becomes dark, while in the winter there is a great deal of cloud and fog. Wisely, the Russians are moving their main attention to the south part of the Soviet Union. Professor Sharonov, of Leningrad University--where there is a small observatory--told me, rather wryly, that in Leningrad the only tolerable months for astronomical observation were March and October! Professor Sharonov is another great authority on planetary studies. He is particularly interested in Mars, and is one of the few Russian astronomers I met who does not think that the dark Martian areas are necessarily due to vegetation. It is a reminder that the problem is still not definitely cleared up.

I flew from Leningrad to the Crimea, and stayed at the Crimean Astrophysical Observatory. The main emphasis here is on solar research; and of course the Director, Professor Severny, is one of the leading solar physicists of the world. I delivered my lecture, as I had done at Sternberg and Pulkovo, and spent several days at the Observatory.

I was extremely glad to meet Dr. Kozyrev, whose name is familiar to everyone. Unfortunately he speaks no English; but Gregory Molyikov interpreted nobly, and in any case we could manage quite well. In the evenings, when we wandered forlornly into the domes of the 102-inch and 50-inch reflectors and looked at the clouds, each of us must have known what the other was thinking about the Clerk of the Weather! Examination of the famous Alphonsus spectrograms leaves me in no doubt that the outbreak of 1958, November 3 did actually occur just as stated (not that I had ever doubted this). I also asked Dr. Kozyrev about the later report of activity there in 1959, when I had myself been observing the area without seeing anything unusual. Dr. Kozyrev said that this observation was uncertain, and depended on one possible line in a spectrogram. Nothing was seen visually, so it is not surprising that my own observations were negative.

The 50-inch reflector, used by Kozyrev for these observations, is a superb instrument (Figure 4); it again is a German Zeiss. It has, however, been dwarfed by the new 102-inch, which has been set up in a dome nearby (Figure 6). During my stay, the new dome was almost finished, though workmen were still running round like ants and scaffolding was much in evidence. The reflector itself is, of course, a skeleton, with a Palomar-type mount; the optics were made in Leningrad. As well as its main rôle in astrophysics, it will be used for some lunar and planetary work. Professor Severny and Dr. Kozyrev are at present designing some special auxiliary equipment for it, to be used in this research. The results should be most interesting. There are, of course, many other instruments at the Crimea, as well as workshops and other observatory "essentials." The climate is good, and I have no doubt that the clouds retreated as soon as I did! Yet the new 236-inch reflector, now under construction and expected to be ready well before 1970, is not going to the Crimea. After expeditions had been sent to all parts of the Soviet Union, it was decided to erect the giant telescope in Asia. I hear that one favored site is Novosibirsk, near Omsk, though I am not sure whether this decision is absolutely final.

There was much else of interest to see; space prevents my describing features such as the amateur-built planetarium in the Palace of Pioneers at Leningrad, the "Chamber of Curiosities" from which Mikhail Lomonosov observed two centuries ago, and the satellite tracking station at Zwinegorod, near Moscow. Suffice it to say that I was greatly impressed both with Russian astronomy and with Russian astronomers.

One point should, I feel, be made. I am not a professional astronomer, and make no claim to eminence; I am merely one of many thousands of modestly-equipped amateurs. As I stressed, I had almost no previous connections with Russian astronomy, and in fact I have more than once written critical articles about various aspects with which I did not agree. Moreover, I was equally devoid of any other connections; nobody could be less of a Communist than I am. Yet it would be impossible to over-emphasize the courtesy and friendliness with which I was greeted everywhere I went. I have mentioned a few names--Mikhailov, Masevich, Martinov, Bronshten, Khromov, Lipski, Sharonov, Kozyrev, and Severny, for instance--but the list could be greatly extended; and all these world-famous men went to an immense amount of trouble to make me welcome and to help me in every way they could. This also applied to the non-scientists, of whom I met many. I did indeed spend an enjoyable fortnight as well as an instructive one.

I was left in no doubt as to the flourishing state of Russian astronomy. Neither was I left in the slightest doubt that the Soviet astronomers are extremely willing and anxious to co-operate with those in Western countries as well as Eastern. They have much to contribute in "pure" astronomy as well as in astronautics, and it is greatly to be hoped that their spirit will spread until it covers all fields of human activity. This is no idle dream. I am convinced that it can, and will, come true.

Postscript by Editor. We are much indebted to Mr. Moore for his informative and highly readable description of his recent visit to Russia. Knowing that some of our members travel to other countries from time to time, we shall welcome similar articles in the future. Ordinary snapshots of good quality will serve splendidly to illustrate such accounts. Of course, descriptions of visits to the United States by colleagues overseas will be equally very welcome. Naturally all articles of this kind for The Strolling Astronomer should highlight astronomy, and particularly lunar and planetary astronomy.

THE CONSTITUENTS OF THE ATMOSPHERE OF VENUS

By: Brian Warner

(Paper read at the Sixth A.L.P.O. Convention at San Jose, California, on August 24, 1960.)

That Venus has an atmosphere is certainly not disputed at the present time. There is, however, still much speculation concerning the quantities of the individual constituents, and, indeed, about the presence of certain of these constituents. From the point of view of interpreting visual observations of the disc of Venus it is of extreme importance to know what the atmosphere and surface conditions on the planet are like; especially what the atmosphere is composed of, for this determines the local temperature distribution and hence the meteorology of the planet. This paper is intended to provide a short summary of the present state of knowledge of the active constituents in the atmosphere of Venus.

The first example that comes to mind of the importance of knowing as much as possible about the Cytherian atmosphere is the effects of the considerable quantities of Carbon Dioxide--discovered in this atmosphere by Adams and Dunham in 1932 (1). Carbon Dioxide has the property that it will allow short wavelength radiation to pass through it but absorbs long wavelengths. As a result of this, any temperatures that are measured for the upper atmosphere of Venus (and these are the temperatures that usually are determined) will not be in any way connected with the surface temperatures on the planet. Wildt has shown (2) that the known amount of Carbon Dioxide in the Cytherian atmosphere can raise the surface temperature by up to 50°C. <u>above</u> that temperature which the planetary surface would attain if it had no atmosphere. Since his calculations were based on the quantity of Carbon Dioxide being about 400 metre atmospheres, we can probably expect an even higher increase of temperature; for the present accepted amount is nearer 1 km. atmosphere.

The presence of ozone would also fundamentally affect the meteorology of the planet, since this gas is an effective absorber of short wavelength radiation. This particular gas has never been detected in the absorption spectrum of Venus and it probably exists only in very small quantities, if at all. The presence of free oxygen would automatically imply the existence of ozone, but here again molecular oxygen has never been detected.

Although the last paragraph has described negative results, there are a few positive results that indicate the existence of three more constituents of the Cytherian atmosphere. These are Nitrogen, Carbon Monoxide, and Atomic Oxygen.

N. A. Kozyrev has obtained a spectrum of the Ashen Light of Venus (3). The Ashen Light has been seen by visual observers for well over a century, and it now appears that it is caused by an auroral-like excitation of the high atmosphere of Venus. Kozyrev was able to identify bands of molecular Nitrogen in his spectrum. As the amount of Carbon Dioxide mentioned above (1 km. atmosphere) is nowhere near the total quantity of gas that surrounds Venus (about 6 km. atmospheres), Kozyrev's results indicate that Nitrogen may be the primary constituent of the Cytherian atmosphere. This would at least make it a little more similar to the Earth's atmosphere.

From this same spectrum Urey and Brewer (4) have claimed to find evidence for Carbon Monoxide bands. A comparison of the Kozyrev spectrum with the Carbon Monoxide bands in question shows that this identification is based on the weakest of correlations. An alternative explanation of the unidentified bands in this spectrum is clearly required and just such an explanation has been given by myself (5) in <u>The Monthly Notices of the R. A. S.</u> In this paper I show that there is a statistically significant number of coincidences of emission features in Kozyrev's spectrum with lines, and in particular pairs of lines, in the atomic oxygen spectrum. Whilst this far from proves that molecular Oxygen exists on Venus, it is useful in that it shows that it is unnecessary to assume a further major constituent of the Cytherian atmosphere to produce the Kozyrev spectrum. I do not class atomic

Oxygen as a major constituent because it probably arises as a result of photodissociation of the Carbon Dioxide (as suggested by Urey and Brewer). Urey and Brewer do show that two absorption features discovered by Kozyrev may be due to Carbon Monoxide, and this gas would also result from the photodissociation of Carbon Dioxide.

There may be a number of other minor constituents of the Cytherian atmosphere, but it is certain that they cannot affect the overall meteorological structure. Urey (6) has shown that it is very unlikely that any methane, ammonia, or hydrogen could exist in the free state.

Finally, we come to what is, at least from the visual observers' point of view, the most important component of the Cytherian atmosphere--this is water. In a recent balloon flight, Ross and Moore (7) have shown, by spectroscopic means, that there is probably a large quantity of water in the atmosphere of Venus, and this confirms the views held by Menzel and Whipple (8). We may therefore safely conclude that the dense clouds on Venus are composed of water, though not necessarily as pure water as that found in terrestrial clouds. From a preliminary estimate I find that at least 10^{14} grams of water must exist in liquid form in the Cytherian atmosphere (otherwise we should be able to see through it to the planet's surface), and there is probably more than 10^{18} grams of water in the planet's atmosphere as a whole (that is, including water vapor). This compares with 10^{19} grams of water in the Earth's atmosphere.

It is interesting to note, as a concluding remark, that interpretations of visual observations over the past few years have practically necessitated the assumption that the Cytherian clouds are composed of water. Many ideas put forward in The Strolling Astronomer have been along these lines.

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VENUS - LADY WITH A PAST

By: James C. Bartlett, Jr.

(Paper read at the Sixth A.L.P.O. Convention at San Jose, California, on August 24, 1960.)

The late John Buchan, Lord Tweedsmuir, once remarked that there is a wonderful lot of widsom in the world which owes nothing to Universities. His Lordship was not implying that Universities should be abolished, but simply pointing up the fact that what, for want of a better term, may be called instinct often comes closer to the truth than complex and informed reasoning. So it is that all of us, I think, have never been quite satisfied with more recent theories as to the state of Venus as a world, though the theories themselves are apparently soundly based on demonstrable principles.

Quite early in the history of this fascinating beauty, astronomers saw in her a sister--if not precisely an identical twin--of the earth. In her pearly atmosphere they beheld an aerial envelope akin to our own and did not hesitate to ascribe her clouds to ordinary water vapor, and her shadowy spots to a girdle of oceans from which this vapor is derived. Gruithuisen appears to have discovered the apparent polar caps, which he pronounced to be composed of snow and ice; and though such a view has become unfashionable in our times, it may be recalled that Trouvelot freely subscribed to it[1] and that as late as the closing decade of the 19th Century these controversial caps are prominent features in the drawings of Mascari. Moreover, they appear more or less regularly in many subsequent observations down to our own day. What may be termed the landscape of Venus was not neglected, and as early as 1700 La Hire reported surface "inequalities" which he compared to "the celles of the moon."[2] Schroeter discovered mountains to which--doubtless because of his imperfect measuring apparatus--he ascribed extravagant heights of from 27 to 28 miles.[3] Others saw in the dusky spots not seas alone, but also continents. Add to this that early measurements of the rotation yielded periods all close to 24 hours, and you will see that the image of Venus was but a mirrored reflection of the earth. Here was not merely a sister to Terra; here was in fact another Terra, complete with an aqueous envelope (the spectroscopes of Tacchini, Ricco, and Young confirmed it),[4] polar caps, seas, continents, and mountains.

Even the celebrated "ashen light," i.e. the luminescence of the dark side, was given a terrestrial flavor. First discovered in 1643 by Riccioli, and seen subsequently and repeatedly by an historic parade of imposing witnesses, it required an explanation. Such explanations ranged all the way from lightning discharges to the glare of belching volcanoes, and Safarik even suggested a phosphorescence of Venusian seas. The incomparable Gruithuisen had an even earthier view. In his opinion the illumination of the dark hemisphere was just that, a faery gleam from countless bonfires lit to celebrate political and religious rites of the Venusian populace. A little later, however, he considered that it is due to the burning over of jungle lands to provide new agricultural acreage.[5] Apparently the imaginative Muenchener was not quite sure.

How much of this speculation was justified by observation? We may pass over Gruithuisen's "bonfires" in charitable silence, though his polar caps would appear to have a more substantial basis in reality. We may--if we are so disposed--smile away La Hire's "celles" by pointing to the cumbercome 16-foot long, non-achromatic refractor with which he observed them. Less easy to gloss over are the observations by De Vico of the Jesuit College at Rome, who in 1841, using a fine Cauchoix achromatic of $6\frac{1}{4}$ ins. aperture, repeatedly observed near the terminator a ring mountain closely resembling a lunar prototype; the same was also figured by Denning in 1881.[6] And while the present writer scarcely deserves to stand in such company, it may be recorded that on a very fine evening in 1949 he also beheld a crater-like object close to the terminator near the northern cusp, apparently the same (to judge from position) as that marked by the Romans over a century earlier.

As to mountains and mountain systems the record is replete with evidence, surely quite as good as any put forth to explain other celestial appearances. Schroeter often recorded jagged outlines of the terminator and paid particular attention to the South Cusp Indentation, where he located his famous 27-mile high mountain mass. We may reasonably question his estimate of height, but no observer well acquainted with the planet would care to deny that some major inequality exists in that region (the writer favors the existence of a high plateau). Maedler, De Vico, Langdon, Denning, Zenger--these are just a few of the observers of terminator irregularities suggesting major mountain systems. Nor must we forget the Baron van Ertborn who frequently observed a detached point of light on the night side of the South Cusp Cap, for all of the world like a lunar peak rising into sunshine from the black depths of night at its base. But the point to notice is the readiness of the earlier observers of Venus to find obvious and natural explanations for her phenomena, explanations based upon a close terrestrial analogy. Later we shall examine some not-so-obvious and highly unnatural, or at least highly unlikely, explanations for the same phenomena.

Yet it is not to be supposed that the earlier portraits of Venus were accepted by all of her admirers. The elder Herschel, for instance, fell upon Schroeter's 27-mile high mountains in a furious assault which produced rather more heat than light;[7] but this was merely a criticism of detail. More revolutionary changes were in the offing. Questions began to be asked which have not been without echo in our day. How was it that surface details were so plainly visible to some observers but not to others? Worse. Among those who were so confident of the markings it became fashionable to construct more or less detailed maps. The rub was that the maps of different observers bore virtually no resemblance, so that an uninstructed person viewing them might well conclude that they represented charts of different planets. The ferment thus engendered perhaps prepared the way for the acceptance of novel ideas soon to be presented. The suspicion that Venus might not be such a sisterly relative after all was strengthened by the spectroscopic work of Janssen and Vogel, neither of whom could detect any but doubtful traces of free oxygen or water vapor. Moreover the albedo of the planet, as determined by Zoellner and Mueller, was so extraordinarily high--about that of fresh snow--that this value was difficult to accommodate to any concept of a rough, diversified surface. Of course it was recognized that the reflective surface must be that of cloud rather than of land or water; but if so, how could any surface markings be seen through such a dense layer?

Then in 1877 Schiaparelli made a strange announcement. In the pure Milanese air he was able to observe the planet under very favorable conditions, and as a result of his study of certain streak-like markings he concluded that the planet rotated in the same period that it orbited the sun, some 225 days. In other words the day and year were equal, and Venus kept one side perpetually turned to the sun. If this were true--and it speedily received abundant confirmation--the portrait of Venus as an earth-like beauty had been drawn in false colors. No sister she, but at best an outlandish cousin. It is true that in 1900 Bélopolsky found a period of $24^h\ 42^m$ from the Doppler effect, and as late as 1922 a photographic study by Rordame yielded 24^h; but the long period had found favor.

Perhaps the most vigorous protagonist of Schiaparelli's 225-day period was Percival Lowell, who announced confirmation in 1896 and again in 1909. Moreover, Lowell discovered a strange system of markings totally unlike anything to be expected. These took the form of streaks radiating outward from a central spot much like spokes from the hub of a wheel. Not only did this "spoke system" confirm the 225^d period, but it gave a clue to the real nature of the planet. The Lowellian portrait, like _The Picture of Dorian Gray_, was disconcerting. Venus, he announced, was not a belle but rather a hag--and a much wrinkled hag at that. Her charms--like those of many an earthly beauty--were all illusions, cunning artifices which a close inspection was sufficient to unmask. Barren, sun-baked, dusty; that--according to Lowell--was the real nature of this wanton of the skies. As to her delicate nocturnal sheen, the famed "ashen light," it was not the radiance of life but the phosphorescence of death; the pale reflection of starlight from the perpetually frozen surface of a universal glacier.[8]

Lowell's views on Venus did not go unchallenged; nevertheless, they formed an important contribution to the growing conviction that Venus was a world totally unlike the earth. Then how to reinterpret her features in terms of the new conceptions? Take the clouds. If these were no longer to be aqueous, then they must be composed of dust; and the face which Venus turned ever sunward was therefore a parched desolation on which no living thing moved and no living thing grew.

But spectroscopes had in the past given at least some slight indication of the presence of water vapor. Perhaps, therefore, water vapor really did exist. Then how to account for its apparent scarcity? By locking it up in plastics, said Wildt. This plastics theory of Wildt was perhaps the strangest ever to be advanced; and yet granting the premise, one had also to grant the result. The atmosphere of Venus is rich in CO_2. It is also strongly irradiated by solar ultraviolet. If now we grant the third ingredient, H_2O, we have a reaction which produces CH_2O and O_2. In fine--formaldehyde. This formaldehyde gas then reacts with more water vapor to form dense white polymer precipitates. Hence the Venusian clouds are natural plastics![9] What happens to the free oxygen? It is taken up by the highly heated surface materials.

But Dr. Suess had another idea. The Venusian clouds are not formaldehyde precipitates, nor precisely dust. Instead they are composed of common chlorides--including sodium chloride--and perhaps other salts.[10] Thus we have a choice between a world fit only for undertakers and one in which we find our salt not on the table but in the skies. Yet again if we grant the premise the result follows. The premise in this case is that formerly oceans existed on Venus but have long since boiled away. Their salts were carried skyward by strong convection currents, a process known to exist to some small extent on the earth.

Are such pictures accurate? The principles seem unassailable; and yet who can really believe that a world the approximate size of the earth is one vast dust bowl? Or that a sea of clouds is really a sea of plastics? We find such conceptions strange, not because they exceed the possibilities but because somehow they run counter to that feeling which Lord Tweedsmuir called "wisdom."

The period which followed the disenchantments provided by Schiaparelli and Lowell produced, as we have seen, some highly unlikely pictures of Venus as a world; yet here and there a surer instinct prevailed. We cannot know how Wildt's formaldehyde theory would have been received by Arrhenius, the famous Swedish chemist, had he lived to see it; but we do know that with little or no physical evidence in support, the latter regarded the clouds of Venus as aqueous in nature and the surface as a kind of steamy swamp. Somehow that seems much more likely.

Take D. H. Menzel. Observing that "It would be difficult indeed to account for complete nonexistence of water on Venus," [11] he went on to speculate that vast oceans probably occur on the planet; but as to life, he was firmly negative. Later Menzel and Whipple were to team up on a new theory of Venus in which the aqueous nature of the clouds was affirmed most strongly. It must be noticed that in thus supporting what may be termed the natural view of Venusian conditions, these latter day students actually had no more positive evidence to go on than did those of an earlier age, who made their conclusions solely on the basis of appearance. It is true that the Pic du Midi observations showed a polarization that was incompatible with dust clouds but agreeable to water vapor clouds, but clouds composed of other liquid particles might be substituted. What the rationalists, so to speak, had in common with earlier workers was a certain feeling, an instinct if you will, that clouds composed of water are a little more likely than clouds composed of embalming fluid.

How stands the portrait of Venus today? The new brush strokes have just been laid on, and it is yet too early to discern the emergent form. Will she be, as of old, a new and even fresher beauty or a crone more hideous than even Lowell imagined? Before we learn the answer, it is well that we realize the difficulties.

One thing is certain. We do not now know anything at all positive about the world which lies hidden beneath her shining veil, and we must give up hope of knowing through a contemplation of her past. For in her past Venus has been a coquette, now revealing--but never very fully--more often concealing--and usually very fully--her fugitive charms. And not only a vixen but a mysterious vixen. Consider that here is a planet on which it is possible to see markings which day after day show no change in relation to the terminator, and also markings which <u>do</u> show such change. Consider that here is a planet which shows no measurable polar compression, thus indicating a very slow rotation; but also a planet the temperatures of whose day and night side are virtually the same, thus indicating a rapid rotation.

And here again is a planet with which the spectroscope seems powerless to deal; a planet whose spectrum has yielded Doppler effects, as interpreted by men of equal competence, which yield rotation periods as far apart as 20 hrs. and 225 days. [Periods as long as 225 days, of course, rest upon negative evidence only as far as the spectroscope is concerned, namely a <u>lack</u> of detectable Doppler shifts.--Editor.]

And a planet which presents a radially-streaked appearance to some observers, to others only vague, shadowy blotches, and to still others only a featureless sheen of silver.

Such has been Venus in the past. What of the future?

The recent astonishing break-throughs in technology have at last provided wholly new and highly novel instruments of investigation: radio, radar, and, soon to come, the controlled, deep space probe which will be instrumented to measure the magnetic field of the planet, to sound her fathomless depths of air, and even to sample and to analyze it. Many mysteries are scheduled to vanish before too many years. Some preliminary work with the new means has already been done, and it is of particular interest to note that so far as it goes this work tends to restore the earth-like picture of Venus and to discredit the more fanciful portraits of the post-Schiaparelli years.

Take radio observations. J. D. Kraus has found a rotation period of 22 hours by this method. How this is to be reconciled to the lack of polar compression or to the spectrum measurements of Lowell and Slipher, which indicated 225 days, provides us with another mystery; though we may notice that the radio result brings us again into harmony with early visual work, which commonly found periods close to 24 hours. As to spectroscopic measurements we may notice that Bélopolsky in 1900 found a period of 24^h 42^m by this method, and Evershed in 1919 one of 20^h; but Wolkow, in 1949, found a period of 60 days through spectrum studies. [Again, a period like 60 days cannot really be determined by an observed lack of Doppler effects. --Editor.] Kraus again detected signals which greatly resembled static produced by lightning, thus adding another homey touch to our new picture of Venus. And what more likely than thunderstorms in a turbulent atmosphere loaded with watery clouds?

Most revealing of all, perhaps, was the recent balloon-telescope-spectroscope ascension which produced among other things clear and unmistakable evidence of water vapor in the Venusian atmosphere. The significance of this result must be understood in connection with the height at which the data were obtained, a height at which masking effects by terrestrial water vapor were entirely eliminated. We thus firmly established instrumental evidence of water on Venus, and at the same time explained why the spectroscopes of earlier and earthbound workers yielded such indecisive and even negative results.

Surface conditions yet remain conjectural; though Mayer and associates at the Naval Research Laboratory have interpreted a steady hissing at 10,000 megacycles to indicate a surface hotter than boiling water. This does not seem quite likely, and perhaps the results may yet be interpreted in a different way.

At any rate the newer studies have restored, at least in part, the early picture of Venus so blurred by later speculation. We now seem assured of water; of electrical discharges in the atmosphere; of the existence of a hydrosphere from which the water vapor and clouds are derived; and, by inference, of a cycle of rain and evaporation essentially similar to the water cycle as we know it on earth.

It is likely that a planet so similar to ours in these respects is totally dissimilar in all others? I do not think so. Speculation about the environment of other worlds, always a popular, albeit a risky, sport in astronomy, moves this writer at least to make a few suggestions for what they may be worth: That when the first space probes reach Venus there will be found a world not only of oceans but also of continents; and that the continental land masses will be found to be diversified into depressions and elevations as on earth, i.e., into plains, valleys, and mountains; that the surface temperature, though high, will be well within the range of life possibility; and that far from being devoid of all vital activity, Venus will be found to be the teeming abode of complex organisms. Indeed, if some of the radio broadcasts being received are to be understood literally, we may be in for an even greater surprise.

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OBSERVATIONS OF THE MOON'S SHADOW AT THE OCTOBER 2, 1959, SOLAR ECLIPSE

By: William H. Glenn

In the May-August, 1959, issue of The Strolling Astronomer, (1) the author listed as one possible observing program that could be carried out at the October, 1959, eclipse, the making of careful visual and photographic observations of the moon's shadow projected against the earth's atmosphere just before, during, and after totality. Very little work had been done in this regard up to the time of the 1945 eclipse, when Prof. John Q. Stewart of Princeton University Observatory carried out a program of photometric and visual observations at Malta, Montana, and also distributed a questionnaire to observers throughout the northwestern states in order to obtain observations of the shadow. (2) One of the most interesting results of his program was the obtaining of an observation of the moon's shadow projected against the earth's atmosphere as seen from a point about 320 miles from the path of totality, much farther than had ever been thought possible before.

Since the circumstances of the 1959 eclipse in the United States made it extremely favorable for observations of the shadow, the writer, with the kind permission of Prof. Stewart, revised the questionnaire that had been used in 1945 with the purpose in mind of making it applicable to the 1959 eclipse. The questionnaire requested observations of the moon's shadow and the general illumination at totality, identification of the faintest stars visible at totality, and weather conditions. Observers outside, as well as inside, the path of totality were requested to look for the shadow, and were instructed to observe at the time that totality was occurring in Massachusetts (10:50 U.T.). Efforts were made to distribute the revised questionnaire to amateur groups, colleges, and individual observers in the following regions: A, the path of totality; B, a belt about 100 miles wide comprising a westward extension of the path of totality beyond the sunrise point of the total phase. (The central line of this westward extension can be roughly described as falling along a path approximating a line drawn connecting Salem, Mass., Albany and Buffalo, N.Y., Hamilton, London, and Sarnia, Ont., and Port Huron and Muskegon, Mich.); C, other locations outside the path of totality in the eastern states and Canada. By eclipse time, over 450 forms had been distributed to locations in the following states and provinces: Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, Ohio, New York, New Jersey, Pennsylvania, Virginia, West Virginia, North Carolina, Ontario, and Quebec.

As a result of the above efforts, a total of 16 questionnaires and letters was received. In addition to these, 6 more questionnaires, plus a list of locations that had reported negative results, were forwarded to the writer by Prof. John W. Stewart of the University of Virginia, who is also currently making a study of the shadow phenomena at this eclipse. (3) Of the reports received, several gave estimates of the general illumination as well as of shadow observations. These illumination data will be discussed separately later.

As can be seen from the table at the end of this paper, almost all observers were frustrated by clouds. Only a few locations reported at least partially clear skies, but observers at those sites did succeed in obtaining some interesting results. The poor weather conditions throughout the eastern states apparently account for the small number of reports received. Many observers probably felt that it would serve no purpose to submit reports of cloudy skies. Apparently only a few ground observers within the path of totality itself were successful in seeing any part of the shadow; and none, to the knowledge of the writer, saw the corona. Nahant, Lynn Beach, Phillips Beach, and Marblehead, along the coast, were totally overcast at mid-eclipse, as was Mt. Wachusett, some distance inland. Aircraft observers were more successful. A fine photograph taken from an American Airlines plane at an altitude of 30,000 feet, and showing the totally eclipsed sun and the moon's shadow projected against the sky appeared on the front page of the October 2 Boston Daily Globe; (4) and some successful photographs were obtained from the air by a party that was attempting to observe the Zodiacal Light in the westward extension of the path of totality in Ontario. (5).

Profs. John Q. Stewart and John W. Stewart had originally intended to observe at Marblehead; but as a 5 A.M. weather report indicated that the best chances for some clearing were in New Hampshire, they drove to Nashua. Observing from a hilltop in a pasture about 4 miles west of the city, and about 3 miles inside the northern edge of the path of totality, they were faced at the time of totality with a sky that was better than 95% obscured by altostratus clouds, with some lower stratocumulus to the east. A light shower was in progress between their observing site and the rising sun. Prof. John W. Stewart has written to the author that before totality, the effect was one of a gradual dimming, like the house lights in a theatre being turned off. At the end of totality, the illumination returned abruptly as the shadow "dropped into the ground." The illumination returned much more abruptly than it had dimmed before totality. A streak of clear sky on the western horizon was saffron color just before, and red during, totality. A similar streak to the north had yellow color. To the west, the observers were looking under the shadow, while the yellow color to the north came from regions outside the shadow. Overhead, it was quite dark on the overcast, and no detail of the shadow's edge could be seen.

Prof. John W. Stewart also mentioned a report from Dr. Kattwinkel, of West Newton, Mass., who drove to Rindge, N.H., in the extreme northwestern corner of the path of totality, and had a wide patch of clear sky overhead during totality. He saw Venus and other stars during totality, but did not look for the falling shadow in the air. He did, however, notice the asymmetry in the decrease and increase of illumination before and after totality that was so conspicuous at Nashua.

The writer, observing with the Amateur Astronomers Association party on the coast at Phillips Beach, Mass., Lat. 42°28' 20"N., Long. 70°53' 10"W., was faced with a complete overcast. A driving rain began to fall about 15 minutes before totality, and continued until after 8:00 A.M. (E.D.T.). The sun was never seen at all during the entire time of the eclipse. As the author stood on the beach just before and during totality, however, it was possible to watch the changing light intensity in spite of the cloud layer. During totality and for about 5 minutes before it there was the slightest suggestion that the light of the sky and ground was taking on a slightly yellowish tinge, similar to that which occurs occasionally during heavy thunderstorms in the summer. During totality itself, there was a suggestion of the shadow, projected darkly against the clouds, like a truncated V in the east; but the sky was bright in the west (as bright, that is, as in the other directions except east). The edges of the shadow projected against the clouds were not sharp, of course; and the appearance was very vague, but this appearance was confirmed independently by Kenneth Weitzenhoffer, who observed at East Point, Nahant, several miles south of Phillips Beach. It was not really dark during totality; the writer could read the large numbers on a Bulova Timer at mid-totality in spite of the overcast. One of the most interesting observations made by the writer, however, was the very sudden return of light at the end of totality--much more sudden than the gradual decrease in illumination during the moments just prior to totality. The return of the light was so rapid and startling that the author made an attempt to clock third contact by timing the instant of light return, using the Timer. At the end of totality the shadow, projected against the clouds, seemed to drop towards the horizon and disappear within a second. The writer was facing south at the end of totality. The brightening of the clouds, which was first noticed by the writer when it was south of the zenith, seemed to spread rapidly eastward across the sky and downwards towards the horizon. The appearance of the end of darkness was almost like that of a shade being rapidly drawn back, as the projection of the shadow on the clouds "fell to earth." The rapid return of brightness, the apparent dropping of the shadow towards the horizon, and the slower darkening at the onset of totality can all be explained by remembering that the shadow was falling down through the atmosphere towards the observer, tangentially to the earth's surface.

A successful observation of the shadow from a point just west of the path of totality was submitted to the writer by Messrs. Byron E. Waterman, Richard Defouw, and Garland Allen of the Mt. Hermon School, Mt. Hermon, Mass. These observers carried out their observations from Crag Mountain, Lat. 42°37' 34"N., Long. 72°25' 10"W., at an elevation of 1,503 feet above sea level. This location is not far from Mt. Hermon, Mass., and is about 14 miles west of the geometrical sunrise line of the eclipse as plotted in U. S. Naval Observatory Circular #77, and about 5 miles north of the westward projection of the central line. The effects of dip and refraction would certainly have allowed these observers to see the totally eclipsed sun if their weather conditions and horizon had been perfect. Fortunately, sky conditions for this group of observers were far better than most other groups in the area experienced. Mr. Defouw reports, however, that the entire horizon was ruined by stratus clouds to an altitude of about 10°-15°, and that cirrus clouds slightly obscured the sky to an altitude of 45° in the east. The stratus clouds were always dark gray and black. The cirrus clouds appeared pink immediately before and after totality, but became almost invisible during the total phase. The shadow was first seen in the east about 45 seconds (6) before totality and, according to Mr. Defouw, is believed to have developed first in the east and then to have expanded westward across the sky. (7) It appeared grayish black, granular, and dusky, in contrast to the rest of the sky, which appeared unaffected by the eclipse. The motion and changing shape of the shadow were not observed entirely, but Mr. Defouw does remark that the shadow "did extend parabolically from the eastern horizon to about 35° from the western horizon." Mr. Defouw is also fairly certain that the western sky was brighter than in the east. He further notes the very sudden disappearance of the shadow approximately 45-60 seconds after totality. The observations above were confirmed by Mr. Waterman, who also describes the shadow as being parabolic in shape, and reports it as being seen "almost to the western horizon, i.e., to within 35° of it." During totality, Venus, Sirius, Rigel, and probably Betelgeuse were seen by Mr. Defouw; and Mr. Allen identified Procyon. (8)

All other reports, except one, received from points near the westward extension of the path of totality, carried negative results because of cloudy skies. Among the locations in this category were Mt. Greylock, Mass.; Syracuse, Rochester, Newark Valley, Randolph, and Buffalo, all in New York; Cleveland, Ohio; and London, Ontario. From Saginaw, Michigan, the most westerly location to report, Mrs. Deborah S. Ernsberger reports a sky obscured by nimbostratus clouds in the east, altocirrus and nimbostratus in the north, west, and south, and slight alto-fracto-cumulus in the zenith. No shadow was seen, although Venus and Orion could be identified. During totality, and immediately before and after, the western, northern, and southern skies were gray; and in the east the clouds were pink. At Ithaca, N.Y., about 27 miles south of the westward extension of the path of totality, Elizabeth H. Smith found her sky completely covered by nimbostratus clouds, with a ceiling of about 1,000 feet. No discrete shadows in the sky could be found, but during totality an orange patch was visible on the horizon 20° north of east. At 5:51 A.M. (E.S.T.) the orange patch was gone, but a pale pink was noted at the zenith.

The only positive report received from a point near the westward extension of the path of totality was submitted by Sidney R. Weeks of Schroon Lake, N.Y., about 98 miles north of Albany. Mr. Weeks observed from a location two miles west of Schroon Lake, at an altitude of 1,500 feet above sea level. (9) At his location, a heavy cloud bank completely obscured the eastern horizon to an altitude of perhaps 10^o. Approximately 15 seconds before totality was due in Massachusetts, (10) Mr. Weeks saw darkness in the sky in the east to south directions. (11) The entire east to south quadrant darkened as though twilight were falling, and the entire area assumed a pinkish hue. The remainder of the sky remained pale yellow at the eastern horizon, and pale blue above. The northern boundary of the shadow was well defined and definite, although it could not be termed "sharp." To the west, the shadow gradually blended into the unshadowed sky, and seemed to terminate almost exactly on a line from the zenith to the southern horizon. To the south, the shadow extended to the horizon. Although the sky to the north and northeast was still bright at this time, the ground appeared depressingly gloomy, "as though the dawn had given up." No celestial objects were seen with the exception of Venus, which brightened noticeably. Sirius and the bright stars of Orion were looked for, but were not seen. The dark pinkish area of the sky faded and disappeared very suddenly, more rapidly than it had appeared, at approximately 30 seconds after the period of totality. It faded in a southeasterly direction; but, of course, it showed no sharply defined edge or boundary at the time. The cloud bank on the horizon was dark gray before and after totality. The sky was pale yellow in the east before and after, and pale blue elsewhere. During totality both clouds and sky in the east to south quadrant were substantially darker, with a reddish tinge extending to the zenith and meridian.

Most other locations outside the path of totality reported negative results. At West Point, N.Y., about 91 miles south of the westward extension of the central line, Capt. Merle G. Sheffield made a concentrated attempt to observe the shadow projected against the sky. The horizon was obscured by fairly high scattered clouds in all directions, and in addition lower clouds were moving overhead and towards the northeast. Capt. Sheffield reports a general darkening that occurred at 06:50 (E.D.T.), but there was nothing to indicate a particular direction for the shadow. Although Capt. Sheffield had about 10 observers located at various points around the post, none of them saw anything but the general darkening at totality. The clouds showed color in the northeast, east, and southeast, and considerable graying occurred as totality progressed. The end of totality was recorded at 06:51 (E.D.T.) by a general coloration of the clouds and greater amount of light. The sequence of colors on the clouds before, during, and after totality was: gray, purple, rose, purple (during totality), rose.

The southernmost observer to report, Bobby Ward, a teen-age observer in Hobbsville, N.C., who was fortunate enough to have partially clear skies, looked for the shadow for about 10 minutes before and after the time totality was due to occur in Massachusetts. The negative result was probably due to his great distance from the path of totality as well as to clouds in the eastern part of the sky. All other locations except the one listed below reported negative results.

In the New York City area, 188 miles west-southwest of Boston and about 125 miles due south of the westward extension of the path of totality, skies were only partially cloudy at the time of totality. John Bortle, of Mt. Vernon, N.Y., 15 miles north-northeast of midtown Manhattan, was favored with a sky where the eastern horizon was only partly obscured by a low cloud bank. Observing from a roof of a building in Mt. Vernon, he was faced at 10:25 U.T. with an eastern horizon partly obscured by a low cloud bank extending to an altitude of about 5^o. A very large cloud hid the entire area of the eclipse. Mr. Bortle reports that at 10:49.5 U.T. (12) he noticed a smoky gray shadowy half disc about 30^o north of east (Figure 7). It had a striking similarity in color to gray chimney smoke, but its shape was unmistakable. Its boundaries were not sharply defined, but it was clearly seen by both his mother (who was observing with him), and himself. In some parts of the disc the color intensity seemed slightly different than in others, though this may have been due to very distant thin clouds. The disc was in excess of 6^o in diameter, and slowly descended as it was watched. It appeared very much like the shadow cast by a cloud on a humid day. A large protrusion of clouds crossed it almost centrally. The base of the disc seemed to rest on a very low cloud bank on the eastern horizon, and an additional dark region could be seen extending northward in azimuth from the disc. This extension had the appearance of a half cylinder in the heavens,

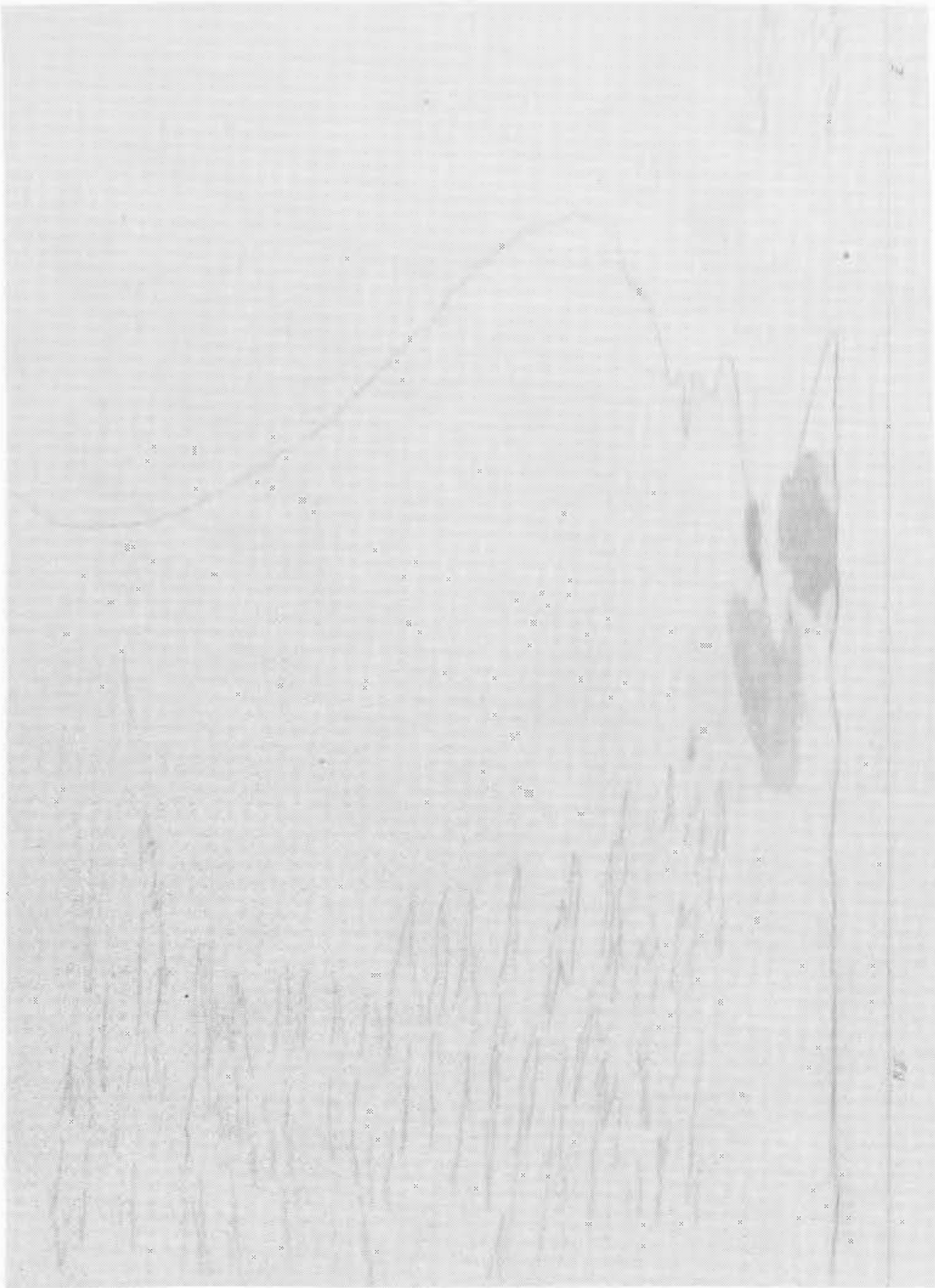

FIGURE 7. Pencil sketch by Mr. John Bortle of presumed shadow of moon as observed in northeastern sky from Mount Vernon, New York, near $10^h\ 50^m$, U.T. on October 2, 1959. Slight contrasts on the original drawing may be further lessened in reproduction. See also discussion in Mr. Glenn's article.

and could be seen extending about 10 or 15 degrees to the north of the half disc, where it became intermixed with clouds. The half disc showed fairly good contrast against the background sky, and was somewhat more prominent in intensity than the cylinder. (13) All during the observation the half disc was seen to descend, and at 10:52.0 U.T. its top disappeared below the cloud bank. It did not change its azimuth during the time it was kept in view. The sketch made by Mr. Bortle and reproduced here (Figure 7) gives some idea of the very low contrast presented by this phenomenon.

One of the most interesting problems involved here is that another group of observers, the Amateur Astronomers Association party on the RCA roof in midtown Mahattan, only 15 miles from Mr. Bortle at Mt. Vernon, did not see the shadow, although 4 observers selected and instructed in advance by the writer were specifically looking for it. From the RCA roof, heavy cumulus obscured the eastern horizon to an altitude of about 10^{o} from about azimuth 60^{o} in the north-northeast to azimuth 135^{o} in the southeast; and some hazy cirrus-like overcast was seen from the southern horizon to the zenith. The sky was clear to the north and west, however. The clouds to the east appeared dark smoky gray with pale pink cirrus showing through breaks in them at the upper edge. No shadow was seen, however. Why this is so is hard to understand. The time that Bortle gives for the disappearance of the half disc, 10:52.0 U.T., is one minute later than the time of third contact in Massachusetts, which would have occurred at about 10:50:58 U.T. at the tip of Cape Ann. This fact, combined with the appearance of the phenomenon, seems to indicate that what was seen may actually have been the shadow. The most likely explanation for the failure of the group on the RCA roof is that the slight contrast of the shadow against the background sky, which is pointed out very well in Bortle's sketch, caused it to escape the attention of the A.A.A. observers. When seen from a considerable distance through a moisture-laden atmosphere, such as occurred on October 2nd, the shadow is apparently of such a very ephemeral nature that it is extremely difficult to detect.

It can be seen from the above reports that shadow observations near the sunrise and sunset points of future total eclipses should still be of considerable interest. It is still not clearly established how far from an eclipse path the shadow can be seen projected against the atmosphere, how far beyond the sunrise or sunset line of the eclipse the shadow can be seen, what changes in appearance, color, and light intensity occur when the shadow enters the earth's atmosphere, and, at a sunrise eclipse, how long before totality, and at what distance above the observer, the shadow can first be seen when it enters the earth's atmosphere. Certainly these factors depend on the condition of the earth's upper atmosphere and on the atmospheric conditions between the shadow and the observer's location, as well as on the geometry of the situation. It is unfortunate that the 1959 eclipse was the last sunrise eclipse to be visible in the U.S.A. this century. Future observations of this phenomenon will have to be carried out in other countries.

TABLE I - Reports Received by William Glenn

Location	Observers	Weather	Shadow Observational Results and Comments
Nahant Beach, Mass.	Ann E. Stitt Anthony G. Stitt	Total overcast	Negative. Some estimates of overall darkness made.
Phillips Beach, Mass.	Wm. H. Glenn and A.A.A. Party	Total overcast. Stratocumulus.	Negative. Suggestion of shadow against clouds noted.
Crag Mountain, Mass.	Richard Defouw Garland Allen Byron Waterman	Stratus to 10^{o}-15^{o} altitude. Cirrus to 45^{o} in the east.	Positive. Some photometric work done. Estimates of darkness made.

TABLE I--continued.

Location	Observers	Weather	Shadow Observational Results and Comments
Northfield, Vt.	Leighton B. Gough	Low hanging heavy clouds. Almost complete cloud cover from 6:00 A.M. to 7:30 A.M. (E.D.T.).	Negative. Estimate of darkness made.
Seymour, Conn.	H. Kushpinsky, Jr.	Intensive cloudiness.	Negative.
Schroon Lake, N. Y.	Sidney R. Weeks	Clouds to altitude 10° in east.	Positive. Shadow seen in south to east quadrant.
Syracuse, N. Y.	Howard Scott	Clouds.	Negative.
Ithaca, N. Y.	Elizabeth H. Smith	Completely cloudy.	Negative. Some color seen in sky.
Buffalo, N. Y.	Malcom Hults Bryce McMichael	Complete cloud coverage.	Negative.
Cleveland, O.	V. J. Slabinski	Fog and misty clouds. Fog allowed second magnitude stars to be seen.	Negative.
London, Ont.	William Wehlau	Completely cloudy.	Negative.
Mt. Vernon, N. Y.	John Bortle Mrs. Bortle	Clouds to altitude 5° in east.	Positive. See sketch (Figure 7).
New York, N. Y.	Jane Douglas Donald Bradley Mary Churns Richard Priest Walter Redmond Stephen Ungar	Heavy clouds (cumulus) to about 10° above horizon in east, northeast, and southeast. Clear above this to zenith.	Negative. Light meter readings and timings of star disappearance carried out in addition to shadow work.
Weirton, W. Va.	D. F. & G. F. Lowry.	Cloudy.	Negative.
Hampton, Va.	Richard L. Stutts	Overcast.	Negative. Slight darkening of sunrise.
Hobbsville, N. C.	Bobby Ward	Clouds in eastern part of sky where sun rose.	Negative. Some stars seen at 10:50 U.T.

TABLE II - Reports Sent to William Glenn by J. W. Stewart

Location	Observers	Weather	Shadow Observational Results and Comments
Randolph, N. Y.	Merrill Maines Bonnie Van Sickle Judy Brace Howard Zollinger Kern Shenefiel Bill Hoxie	Complete overcast; very low clouds--cumulonimbus.	Negative. Some pink and blue coloration with yellowish cast seen in south-southeast at sunrise. Otherwise the sky was grey.

TABLE II--continued.

Location	Observers	Weather	Shadow Observational Results and Comments
Mt. Graylock, Mass.	C. A. Schweighauser	Almost total fog. Visibility not more than to 50-100 ft.	Negative. Noted decrease of illumination at 6:51 A.M. (E.D.T.) and some color on the fog after end of totality.
Saginaw, Mich.	Mrs. D. S. Ernsberger	Some cloudiness.	Negative.
Lawrenceville, N. J.	Gifford Havens	Overcast--stratus.	Negative. Light meter gave no readings from 6:40 to 6:55 A.M. (E.D.T.) Possible slight increase in brightness at 6:52 A.M.
West Point, N. Y.	Capt. Merle G. Sheffield & Party	Scattered clouds on horizon were fairly high. Lower clouds were moving overhead.	Negative.
Nashua, N. H.	John W. Stewart	Better than 95% overcast. Altostratus and some stratocumulus clouds.	Negative.
Rindge, N. H.	Dr. Kattwinkel	Wide patch of clear sky overhead during totality.	Negative. Didn't look for shadow. Saw Venus and stars.

TABLE III

The following locations were also mentioned by Prof. John W. Stewart, but no detailed reports were supplied.

Location	Observer	Comments
Montreal, Que.		Negative shadow observation. Weather condition not reported.
Newark Valley, N. Y.		Negative shadow observation. Weather condition not reported.
Philadelphia, Pa.		Negative shadow observation. Weather condition not reported.
Princeton, N. J.		Negative shadow observation. Weather condition not reported.
Richmond, Va.	Mrs. J. W. Stewart	Negative shadow observation. Weather condition not reported.
Charlottesville, Va.	A number of students.	Negative shadow observation. Weather condition not reported.

TABLE III--continued.

Location	Observer	Comments
Marblehead, Mass.	Prof. Theodore G. Mehlin	Negative shadow observation. Rained out.

The following locations also reported negative results to the author:

Lynn Beach, Nahant, Mass. - Rain.
East Point, Nahant, Mass. - Rain.
Mt. Wachusett, Mass. - Overcast.

Footnotes

1. See also the Proceedings of the Nationwide Amateur Astronomers Convention, 1959, pp. 3-15.
2. See J. Q. Stewart and W. L. Hopkins, Jr., "Observations of the Total Solar Eclipse by the 'Princeton Party' and Volunteers," Popular Astronomy, Vol. LIII, No. 10, December, 1945, and Vol. LIV, No. 1, January, 1946.
3. See J. W. Stewart, "The Total Solar Eclipse of 2 October, 1959," Weatherwise, Vol. 12, No. 4, August, 1959.
4. This picture was also reproduced on the front cover of the November, 1959, issue of Sky and Telescope.
5. See Richard Tousey, Naval Research Reviews, November, 1959, p. 16.
6. Timing was done by means of a watch with second hand.
7. This observation seems to contradict what would be expected by the geometry of the eclipse situation. Since the shadow is falling through the atmosphere towards the observer, it would be expected that the shadow would be seen in the sky above the observer first, and then appear to expand downward.
8. Messrs. Allen and Defouw have also stated that the light change during the eclipse was definitely asymmetrical, and state that it darkened before the eclipse more rapidly than it lightened afterward. This is exactly the opposite of what was observed by Glenn and Stewart, and is not supported by photometric observations made by Spitz. See Sky and Telescope, November, 1959, p. 4.
9. Mr. Weeks gives the approximate coordinates of his observing location as: Lat. 43° 49' N., Long. 73° 49' 20" W.
10. Timing was done by means of an ordinary watch with a second hand, set against radio time before leaving home for the observing site. Mr. Weeks writes concerning the timing that "there is room for error, of course, especially in the time of appearance, for, frankly, I had abandoned hope of seeing anything and was photographing Venus with the aid of a 3" refractor when I noticed the sky darkening."
11. Mr. Weeks writes: "Darkness, as I recall, seemed to spread from the horizon north and westward." This again is contrary to the geometry of the eclipse situation, but is similar to what was observed by the Mt. Hermon School group. See footnote 7.
12. Timing was done by means of a pocket watch with second hand that was set against telephone time about 7 hours before the eclipse, and checked again about 10 minutes after 4th contact. The total error in that period of time was about 5 seconds.
13. Bortle reports that although his mother could see the half disc, she could not see the northward extension. The contrast of this region against the background sky must therefore have been very low, and must have required a trained observer to detect it.

Postscript by Editor. We are indebted to Mr. Glenn for an excellent report of these efforts to see the moon's shadow near sunrise at the October 2, 1959, solar eclipse. We hope very much that our colleagues all over the world will continue and refine this kind of study as future eclipses give opportunities. Mr. Glenn's address is 5634 Delafield Avenue, New York 71, New York.

EROSION ON THE SURFACE OF MARS

By: Dr. S. Miyamoto
Kwasan Observatory, Kyoto, Japan

Abstract. In the Martian world surface rocks are weathered by moisture aided by the large amplitude of temperature changes, and weathered substances are then carried away by the wind. Provided that the dark areas are somewhat lower than the bright deserts and less arid, wind erosion acts to extend the dark areas and to develop the system of joints or cracks covering the deserts into the so-called canals. The importance of the correlation among the surface markings, moisture, and atmospheric circulation is emphasized.

Introduction. Since the discovery of canals on Mars by G. V. Schiaparelli in 1877, they have been observed with great interest as the most remarkable feature of the Martian surface. Nowadays, no observer suspects Martian man behind artificial watercourses. However, there still remains the problem of why such a network of straight and dark lines covers the Martian deserts. The canals must be explained as a natural phenomenon without inventing the technology of Martian man.

With respect to the nature of the canals there is no consensus of opinion among observers. The long and straight "ditches" once recorded by Schiaparelli and by P. Lowell may not be real. According to E. M. Antoniadi, (1) the canals are resolved, under good seeing conditions, into somewhat irregular trains of dark and diffuse patches. This point of view is supported by modern observers such as A. Dollfus, S. Ebisawa, and others. The author subscribes also to this point of view and wishes to give a geological interpretation to this characteristic feature of the Martian surface.

Evidence of Erosion on the Martian Surface. The Martian surface is subject to erosion. It may be concluded theoretically from the surface conditions: First, Mars has an atmosphere. Although the pressure is estimated to be only about 80 mb. at the surface, we observe that the wind blows and the atmosphere as a whole undergoes a general circulation. The diurnal and seasonal temperature changes are much amplified compared to our earth, because of the thin atmosphere of Mars. The planet is extremely arid by our terrestrial standards but is not completely devoid of water vapor. In addition, moisture is not limited to any particular districts. This fact may be understood by remembering that in winter the polar caps cover both maria and deserts and extend sometimes down to latitude 40°-45°, and also by noting the fact that drifting clouds cover a wide geographic range.

That erosion is actually taking place can also be inferred through observational facts: Yellow clouds often observed are believed to be sand storms. The existence of sand in desert areas means the decomposition of rocks by weathering. The reddish color of bright desert areas means the oxidation of iron. For example, iron in black mica in granite or in pyroxene in a basalt unites with oxygen and water to form limonite, which makes a brown stain on the surface of the rocks. The existence of limonite was concluded from polarization observations by A. Dollfus. (2)

Let us first consider the mode of weathering. On our terrestrial surface, even in the desert areas, the effect of water is the most important factor. The composition of the constituent minerals is changed by chemical attack, resulting in decomposition of the rock. The effect of freezing water is also very great. The disintegration of rock takes place by mechanical break-up into smaller pieces. The weathered debris are removed by some process. On our earth, even in the desert areas, stream erosion is almost always the most important agent. On the other hand, in the Martian world erosion by wind may be of primary importance, since there is no flow of water in this world of extreme dryness. This point may be, in fact, the characteristic feature of erosion on Mars and may create a unique landscape.

Assumptions about the Martian Original Crust. We shall study how erosion has changed the original crust of Mars. For definiteness, we suppose that the original crust was similar to those of our earth and the moon.

Namely, the original magma solidified at the surface to form the crust. At that time we assume that a magmatic differentiation took place: The light-colored and light-weight granitic mass differentiated from, and floated over, the remaining heavy and dark basaltic layer. The former made up the bright areas (continents of our earth), and the latter the maria. The granitic mass may be identified with deserts on Mars. As is well known, a granitic mass is hard and brittle. By cooling, it may become covered with a mesh of joints and cracks as is seen in the lunar bright regions and, in a lesser degree, on our continental masses. On the Martian original "terra," we may reasonably expect numerous scars from the degassing process, such as craters in the lunar world.

Another assumption is concerned with orogeny. Mars is rather flat, and high mountains are scarcely observed. Hence, we assume that there has been no orogeny, permitting one-sided action of erosion on the Martian surface.

Supposing the original crust of Mars to be such, we shall next study how erosion has affected and changed the original Martian surface.

Erosion of Desert Areas. Consider the weathering of granite by decomposition. Feldspars are the most abundant and easily affected constituent minerals. When they decompose under the action of water and carbon dioxide, the chief product is clay. On the other hand, another constituent, quartz, is harder and turns into sands and gravels without changing its composition. The mechanical disintegration of granite accelerates the chemical decomposition mentioned above: As the diurnal temperature change is very large on Mars, repeated freezing and thawing of water in cracks or in pore spaces exercises breaking action. The effect may be confined to the surface zone, but chemical agents attack each newly made crack and extend the disintegration.

Thus although the rate of weathering on the arid Martian surface is very slow, disintegration and decomposition gradually break into pieces the mountain masses, and wind carries away the clay and sand produced. Hence, although the estimation of the actual time scale is very difficult, without orogeny the Martian "terra" gradually turns into a flat desert. It will be of interest if someday in the future we find, by visiting the Martian world, ruined craters half buried under the desert sands.

Erosion of Maria and Canals. Basalt is also affected by weathering. In the earth's arid regions, moisture in the form of dew penetrates to slight depths below the surface of rocks, dissolves minerals a little, and then draws back to the surface by evaporation, forming a desert varnish, on the surface of the rocks, made up chiefly of manganese and iron oxides. This desert varnish is a protective cover against further weathering in our terrestrial case. However, under Martian conditions, it becomes loose and crumbly rather than pasty as a consequence of diurnal heating and cooling. Sooner or later, the products will be deflated by wind.

It must be emphasized that the rate of weathering is controlled by the humidity. Basalt in the maria may be as easily affected by erosion as granite in the very arid highlands, because these low-lying lands have higher humidity, if they are not even ancient marshes. Moreover, according to observations, temperature is somewhat higher than in the deserts.

At a later epoch of Martian history, when life has evolved in the maria, weathering will surely be accelerated further. In fact, decay matter from lichens and mosses, for example, furnish acids that help to decompose the minerals in the rocks.

Putting aside the effect of life, the rate of weathering would be faster in the maria than in the deserts. The products of weathering are carried away in our terrestrial case by running water. However, in the extremely arid Martian world, deflation by wind is the most important agent. The debris are distributed over a wide range by the wind. Provided that weathering is faster in the maria than in the deserts, the result of wind deflation is not to bury the low-land maria but to deepen them. A characteristic feature of wind deflation is, in fact, not always to smooth out the relief. On the contrary, under some conditions, it acts in the opposite direction. As is well known, the Gobi Desert and other arid basins of Central Asia are deepened by wind deflation. The wind carries much of the finest material across the mountains and drops it outside the region of interior drainage. Returning to the problem of the Martian surface, we see that the role of wind erosion is not always to bury maria and clefts in the deserts, as the low-lying land and valleys are less arid and hence decompose more rapidly; and the products of such decomposition are scattered by the wind. Suppose that there exists a walled plain with a dark floor, like Plato on the lunar surface; it may possibly develop into an Oasis or Lacus, an isolated dark patch amid a desert, such as Zea Lacus, Nodus Gordii, etc. Some of the clefts may develop into canals, being favored by erosion, when they are properly located as regards the course of moisture. Of course, most of the original clefts may have vanished from the surface, buried under the sands of deserts.

Martian Geography. Phaethontis, Electris, Eridania, and other bright areas in the southern hemisphere have oval forms. Xanthe and Cydonia in the northern hemisphere are connected by the bright Achillis Pons. These geographical features suggest the idea that the dust of the deserts spreads, burying the surrounding dark areas. Symplegades Insulae, extending from Zephyria into Mare Cimmerium, may or may not be an analogy to terrestrial alluvial fans. The northern shorelines of Mare Sirenum and Sinus Sabaeus each consist of a chain of arches concave to the maria, suggesting again the invasion of dust from desert lands. However, in these cases there is some reservation because shorelines are everywhere very sharp. On the contrary, these shorelines may perhaps be interpreted as a challenge of moisture from dark zones against the bright highlands: The maria drive a wedge into the deserts, and at the tip of the wedge a canal often extends deep into the deserts. In fact, we see the canal Gorgon extending northward from Fusca Depression in Mare Sirenum. Phison from Sinus Sabacus and again Hiddekel and Gehon from the tips of Sinus Meridiani are other examples.

In general, inspecting the Martian surface, we are impressed by the face that the junctions of canals with maria are not abrupt; rather both merge into each other in a most natural way.

With respect to the Martian canals, earlier observers often recorded canals within the maria as well as over the deserts. Canals in the maria are difficult to explain, if not impossible, in terms of our hypothesis. However, canals in the maria may be an almost perfectly random distribution of very diffuse dark patches and may be quite different in nature from those in the deserts.

Concluding Remarks. (I) According to our interpretation, the Martian maria and canals can be enlarged under favorable conditions by erosion. This opinion is partially in disagreement with the current view that they would be buried under the dust of deserts carried by sandstorms for very many years without some regenerative powers of living substances. From our point of view, we expect more weathering products in the maria and canals than in the deserts under favorable conditions so that when storm or wind redistributes uniformly such debris over all the surface, dust in the maria is transported, in a statistical sense, to the deserts.

Thus the existence of dark areas cannot be referred to as evidence of the existence of life on Mars. However, dark areas are lowlands with higher humidity; and also there exists plenty of carbon dioxide in the atmosphere, so that these districts are not hopelessly severe for plant life. In other words, Martian erosion prepares favorable conditions for life development. In fact, the existence of organic substances was detected spectroscopically by W. S. Sinton. (3)

(II) Our interpretation given in this paper is that moisture governs not only the possible plant growth on the Martian surface but also the geological features of the surface. Unfortunately, we are not at present well acquainted with the seasonal and general circulation of the Martian atmosphere. However, it seems probable that the drifting course of vapor and the topographical relief, and hence the surface markings, are closely related.

Seasonal changes of maria and canals are naturally related to the migration of moisture. Rather, we can get some information about the latter from the observation of the former in order to study the atmospheric circulation.

In addition to the well known seasonal changes, secular changes may also be expected. A remarkable development of Nodus Laocoöntis in recent years may be referred to as an example. Sandstorms may possibly bury some dark region, and such a district may someday recover its darkness through secular fluctuations of climatic conditions. In this respect, the most interesting regions may be the two great vapor courses connecting the southern and northern hemispheres, namely, the Syrtis Major - Nodus Laocoöntis region and the Mare Acidalium - Niliacus Lacus region.

(III) The Martian surface is a dusty world. Not only are the bright deserts covered with sand and dust, but the dark maria are also covered with their darker weathered debris. Furthermore, these maria may possibly be covered with soil, containing organic carbon coming from decayed vegetation.

Finally, the author is very grateful to W. H. Haas for his invaluable advice and critical reading of this manuscript.

References

(1) Antoniadi, E. M., La Planète Mars. Paris, 1930, Chapter V.
(2) Dollfus, A., Thésis. 1955.
(3) Sinton, W. S., Lowell Obs. Bull. No. 103, 1959.

FIRST REPORT ON MARS, 1960-1961

By: Ernst E. Both

Originally it had been planned to publish a number of shorter reports in a special bulletin of the A.L.P.O. Mars Section; but due to the rather poor response of our observers, the publication of such a bulletin will have to wait until more members express their interest. So far the following persons have submitted their observations:

Both, Ernst E., Buffalo, N. Y., 8-inch refractor, 27 drawings.
Chapman, Clark R., Buffalo, N. Y., 10-inch reflector, 23 drawings.
Johnson, Craig L., Boulder, Colorado, 4-inch reflector, 2 drawings.
Schneller, Kenneth, Cleveland, Ohio, 8-inch reflector, 4 drawings.
Westbrooke, William J., San Francisco, California, 4-inch reflector, 12 drawings.
Zuzze, Stephen, Fresh Meadows, N. Y., 6-inch reflector, 2 drawings.

Our most sincere appreciation is expressed to all these members.

I. General Remarks:

In the following pages only observations extending to December 9, 1960, will be discussed. Moreover, since the observations of Chapman and Both form a rather homogeneous series, the present report concerns itself exclusively with the work of these two observers. The work of Westbrooke and Johnson will be evaluated in a later, special report on small apertures, while the observations of Schneller and Zuzze will be treated in our final report.

Winter in the northern hemisphere of Mars began on July 2, 1960, ($\eta = 358^\circ$), while the beginning of spring occurred on December 8, 1960, ($\eta = 88^\circ$). During this period the apparent diameter of the disk increased from 6."0 to 14."7, and the latitude of its center varied between -17.°2 (July 2), +7.°9 (November 12), and +6.°1 (December 8). Since the observations to be discussed here were made primarily after September 1, 1960, they refer to mid- and late winter conditions prevailing in the northern hemisphere (southern mid- and late summer).

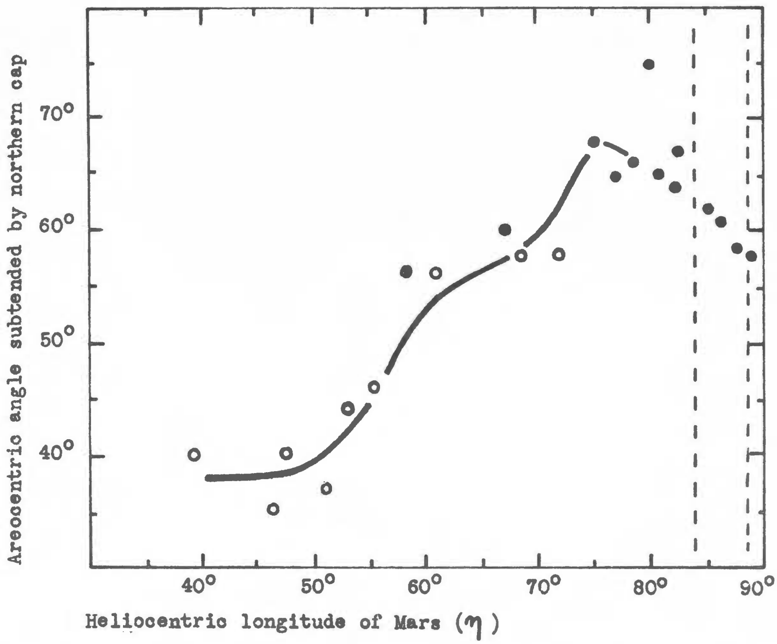

FIGURE 8. Size of the North Polar Cap of Mars, September-December, 1960, according to observations by C. R. Chapman (open circles) and E. E. Both (filled circles). See also text of article by E. E. Both in this issue.

Names of surface features used in this report are those of the new IAU nomenclature (1). In cases where these are found to be insufficient, the designations of E. M. Antoniadi will be drawn upon (2). Seeing is reported on a scale of 0 - 10 (utterly worthless - perfect) and transparency on a scale of 0 - 5 (completely worthless - very clear). Intensities of surface features are on the de Vaucouleurs scale of 0 - 10 (0 is mean surface brightness of a polar cap; 2 is average brightness of the "continents" near the center of the disk; 10 is brightness of the sky background). The intensities are, however, not corrected; if sufficient material is available, a special report on corrected intensities will appear at the end of the current apparition. Other abbreviations used are (these will be used in all other reports): SPC = south polar cap; NPC = north polar cap; p = preceding or direction of decreasing longitude; f = following or direction of increasing longitude; CM = central meridian; η = heliocentric longitude of Mars; d = apparent diameter of the planet's disk; De = latitude of the center of the disk. The following relation exists between η , the heliocentric longitude used in this report, and L_s, the areocentric longitude used by many observers and defined to be 0° at the vernal equinox of the northern hemisphere:

$$\eta - 88.^\circ3 = L_s.$$

II. Early Observations by C. R. Chapman:

May 19, 1960, 9:15 U.T., CM = 30°: The south polar cap was still rather large (late southern spring) and brilliant. Southern hemisphere rather dark, northern one somewhat featureless. [On May 8 and 30 W. H. Haas found a brilliant S. cap (smaller on May 30), a bordering dark band, northern limb whitenings, and poorly seen large maria.--Editor.]

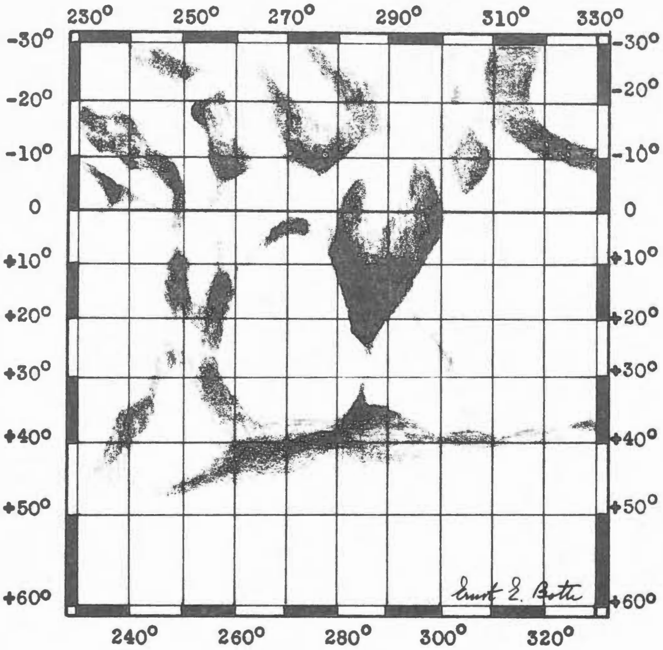

FIGURE 9. Chart of Syrtis Major and the area around Thoth on Mars, based on drawings by E. E. Both and C. R. Chapman, October-December, 1960, $\eta = 42^\circ - 90^\circ$. See also text of "First Report on Mars, 1960-1961." Chart drawn by E. E. Both.

June 19, 1960, 11:00 U.T., CM = 110°. Southern cap now smaller but still bright. Mare Sirenum dark and well shown; Amazonis bright; Solis Lacus not shown (a spurious observation by Johnson, June 17, 10:00 U.T., CM = 114° shows a southern cap of about the same size as does Chapman; also a dark Mare Sirenum and a small and dark Solis Lacus).

July 9, 1960, 10:45 U.T., CM = 269° (17-inch reflector, Pan American College Observatory, Edinburg, Texas, 625X and 975X). Small but brilliant SPC with dark fringe. Hellas prominent, Syrtis Major dark. Antoniadi's "Crocea" and "Oenotria" well developed. Moeris Lacus very small, opening into the Syrtis. Nepenthes very faint. "It seems likely the regions following Syrtis Major were <u>bluer</u> than the regions preceding, using a yellow filter..."

August 16, 1960, 7:00 and 8:40 U.T., CM=204° & 228°. Neither the southern nor the northern cap is shown; polar areas blank, although prominent in light blue (Wratten 38). The Mària Cimmerium and Tyrrhenum are not too pronounced, but they are clearly shown. Trivium Charontis and Cerberus are well indicated on the first drawing. The second drawing shows a "probable projecting cloud" at the sunset limb (estimated position about long. 195°, lat. -10°, between Zephyria and Aeolis), which appeared bright in light blue.

III. The North Polar Cap, September 7, 1960 - December 9, 1960.

Fig. 8 shows the mean areocentric angle subtended by the NPC plotted against increasing heliocentric longitudes of the planet (the two vertical broken lines indicate the transition from northern winter to northern spring). The angle subtended by the cap at the center of the disk was measured on the available drawings, each circle representing the weighted mean (according to seeing conditions and number of observations for the date) of at least two measures. According to K. Graff (3) such measures should be corrected because of the tendency to draw the polar cap too large. The correction involved is as follows:

Corrected areocentric angle = measured areocentric angle times cosine De.

Since the last quantity never exceeded $+8^\circ$, such a correction would be very small and was, therefore, not considered necessary in our case. The fact that the observations are fairly evenly distributed in heliocentric longitude should inspire some confidence in the curve even though it represents the work of only two observers. A relatively steady increase in the size of the cap to $\eta = 80^\circ$ is clearly indicated; but the decrease around $\eta = 84^\circ$ will need confirmation, although observations made after the limiting date of this report seem to show that the cap is indeed decreasing. At the same time polar "veils" and "haze" make it difficult at times to determine the exact extent of the cap.

The only abnormal condition is found at $\eta = 80^\circ$, where the cap measured 75°, reaching down to latitude $+55^\circ$ or less. Observations relating to this extreme size were made by the Recorder and seem to be partly corroborated by the descriptions of Chapman. Three drawings made by the Recorder on November 22, 1960, at 9:30, 11:00, and 12:00 U.T. (CM's 32°, 54°, and 68° respectively) show a very large polar cap (diameter 79°, 75°, and 72° respectively) which seemed to fuse with the pronounced brightness of the sunrise limb (see Fig. 11, drawings H & I). Photographs taken by Lyle T. Johnson with a 16-inch reflector on November 22, 1960, 9:10 and 9:15 U.T. (i.e. 20 to 15 minutes before Both's first drawing), CM's 27° and 28° respectively, show the cap to have a diameter of about 72°; and they thus confirm the observations of the Recorder. (These photographs were published in Space Science, Vol. X, January 1961, p. 7. Unfortunately only the published drawings are yet available to the Recorder).

If we now compare the present curve (Figure 8) with the average behavior of the northern cap, we find that the recorded sizes are perhaps somewhat excessive. The reason for this is that the curve shown evidently does not relate to the size of the actual cap alone (which may be presumed to consist of ground deposits and low altitude "haze") but rather to the combined effect produced by the cap as defined, plus the higher altitude haze of the polar regions. This opinion seems to be supported by the observations of Chapman and Both, who found the cap generally larger in blue light than with orange or red filters. Unfortunately, no quantitative observations were made, so that it is impossible to determine the size of the cap in light of different colors. Maximum size seems to have been reached around $\eta = 75^\circ$ to 80°, which accords well with the generalized picture given by de Vaucouleurs (4). According to W. H. Pickering, "the northern cap reaches its maximum size at about $\eta = 70^\circ$ ... after an interval of 28° or 50 Martian days from the time it began to form" (5), which again is in fair agreement with our results.

Generally speaking the cap presented a picture of uniform brightness but was never found to be "dazzling" or "brilliant" as seen in white light (intensities generally around 0, 0.5, and 1.2). Occasionally the cap consisted of two components (Chapman, October 5 and 28, 1960; Both, October 28, 1960), with one component being brighter (either the p. or the f. component); on rare occasions it was lobed. Chapman on November 22, 1960, at 6:10 U.T., CM = 343° found that "the north cap was observed with light blue and green filters (nos. 38 and 66). It was divided into three lobes, the preceding one being largest, and by far the most brilliant. The center lobe was the smallest of the three." On nearly all occasions it was well defined with comparatively smooth edges.

IV. The Dark Area Around Thoth.

During the 1954 apparition the "new" dark area around Thoth was widely and carefully observed by numerous students of our red neighbor. According to T. Saheki (6) the development of this area had been followed by Japanese observers since 1935, who named it "Nodus Laocoöntis." To these observers it seemed to reach its maximum size and darkness already in 1952, and had begun to fade by 1954. In 1954 the area was centered at long. 255°, lat. $+30^\circ$, as measured by E. Pettit and R. S. Richardson (7), having a maximum width of about 25° and covering an area of 580,000 square miles. Detailed maps and descriptions based on the work of A.L.P.O. members were published by D. P. Avigliano (8).

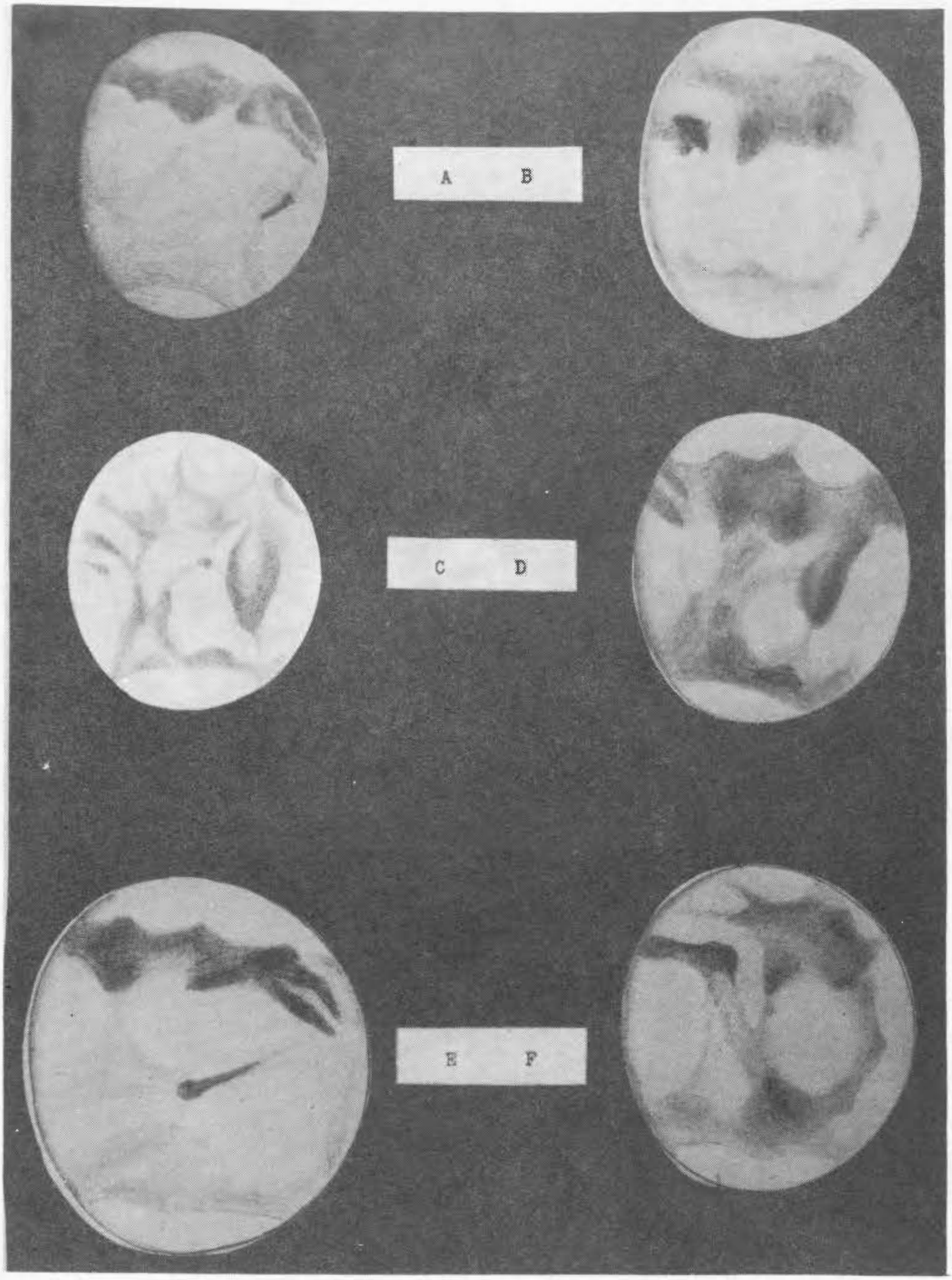

FIGURE 10. Drawings of Mars in October-November, 1960, by Clark R. Chapman with a 10-inch reflector and Ernst E. Both with an 8-inch refractor. See also text.

Drawing	Observer	Date	U. T.	Seeing	Transparency	C.M.	Diameter
A	Chapman	1960, Oct. 3	11^h10^m	4	3-4	164°	9".2
B	Chapman	1960, Oct. 18	11 10	4	3-4	21	10.1
C	Both	1960, Oct. 28	9 30	7	3-4	263	10.9
D	Chapman	1960, Oct. 28	9 20	6-7	3-4	261	10.9
E	Chapman	1960, Nov. 7	10 40	4-6	3-4	187	11.8
F	Chapman	1960, Nov. 17	4 40	3-4	3-4	7	12.8

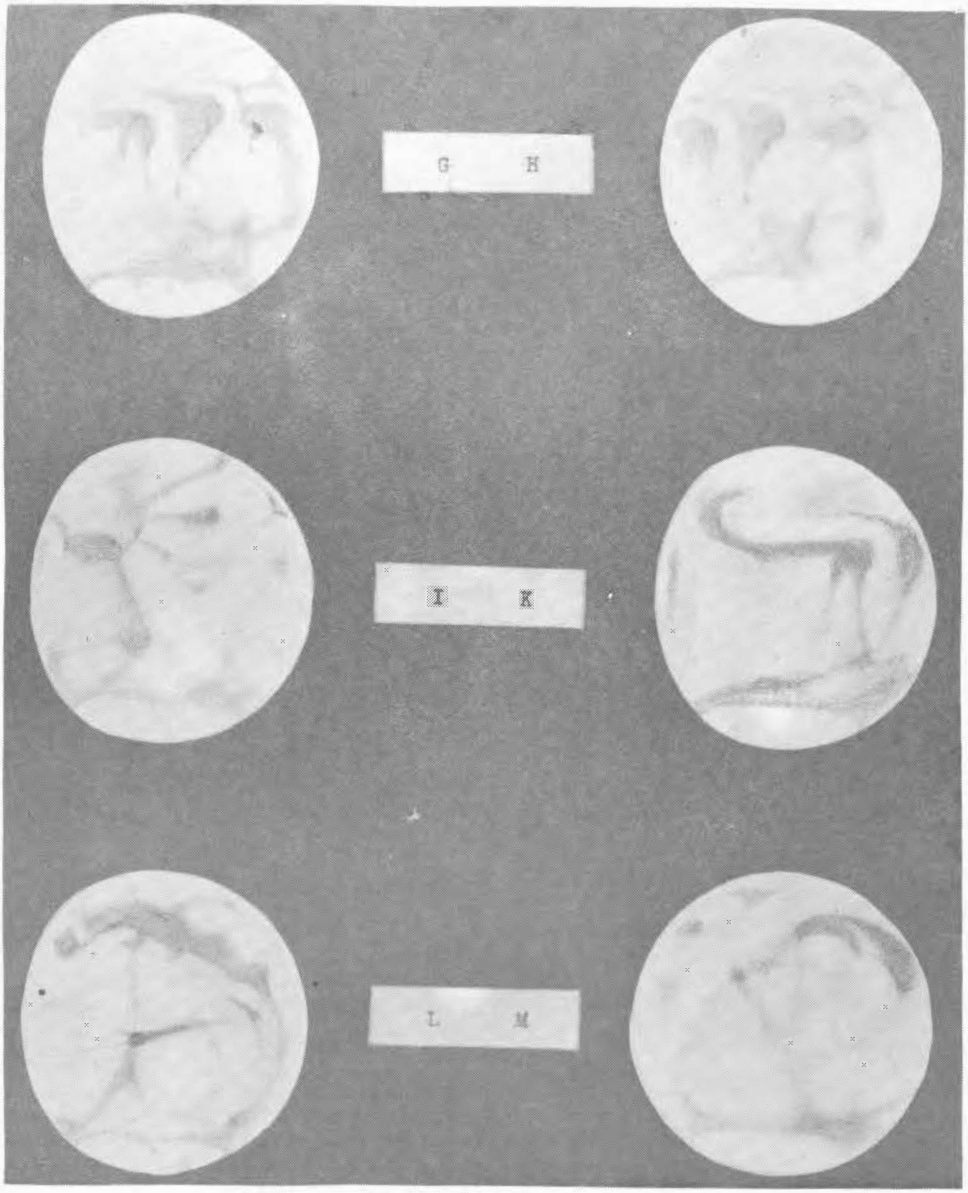

FIGURE 11. Drawings of Mars in November-December, 1960, by Ernst E. Both with an 8-inch refractor. See also text.

Drawing	Date	U. T.	Seeing	Transparency	C. M.	Diameter
G	1960, Nov. 18	$6^h\ 0^m$	6-5	4	17°	12."9
H	1960, Nov. 22	9 30	5-6	5	32	13.3
I	1960, Nov. 22	12 0	5-6	4	69	13.3
K	1960, Nov. 27	9 0	5	3-2	339	13.8
L	1960, Dec. 4	4 0	4-5	4	203	14.4
M	1960, Dec. 9	2 30	4-5	3-2	137	14.8

The present apparition provides the first opportunity since 1954 to study this area again effectively, and preliminary results are given in Fig. 9, a special map constructed from 12 drawings. The Thoth area is shown here to lie between longs. 245° and 260°, lats. +10° and +30°, consisting of two condensations, the preceding one reaching farther south than the following one. The center of the area lies in long. 252°, lat. +20° according to values obtained from drawings by superimposing an orthographic net. Longitude determinations from transits timed by the Recorder gave the following tentative results:

p. condensation, center: long. 249°.39 (one timing).
Center of Thoth area: long. 254°.90 (two timings, average).

In these transit observations a micrometer wire was set according to the position angle of the axis as given in the American Ephemeris, and the times when the spots crossed the wire were recorded. Since there were only three individual determinations, no great weight may be attached to them, although the method seems to be quite accurate. [Since the probable error of the best of Martian CM transits is likely to be several minutes, it is usually pointless to express the longitudes to decimal fractions of a degree.--Editor.]

From our preliminary findings the following observations present themselves:

1. The "new" dark area around Thoth is still located in approximately the same longitude.
2. However, the area has shifted toward the equator by about 10° in latitude.
3. Its size has diminished from a maximum width of 25° in 1954 to a width of 15° in 1960.
4. It seems to have split more definitely into two individual components which, however, are still connected by brighter material.
5. The preceding (eastern) condensation may eventually break out into the Mare Cimmerium; this seems to be indicated by the fact that this component is closer to the equator and by the fact that it is connected with the mare by a diffuse though obvious streak (Antoniadi's "Triton"?).
6. The following (western) condensation is connected with the Mare Tyrrhenum by a rather broadly diffused streak (Antoniadi's "Parnes"?).
7. Compared with the two condensations, the area immediately to the north of them (toward Casius) is seen to be brighter (seasonal?) and almost divorced from them. The two components are about equally dark.

Perhaps it ought to be remembered in this connection that the entire Casius-Thoth-Nepenthes area has undergone non-seasonal changes in the past, particularly in 1888 and 1911-1912 (9) so that the most recent darkening did not come as a complete surprise. Indeed, we plan to show in a later report that this darkening may have had its beginning at the apparition of 1911-1912, starting from Casius and spreading slowly toward Thoth and to the equator.

V. Other Observations.

In Figures 10 and 11 are reproduced 12 drawings of Mars made between October 3, 1960, and December 9, 1960. Drawings A, B, D, E, and F were made by C. R. Chapman with a 10-inch, f/6 Cave reflector, while drawings C, G, H, I, K, L, and M were made by E. E. Both with an 8-inch, f/15 Lundin refractor. Chapman used a magnification of 300X; Both used a magnification of 375X, except for drawing C (500X) and drawings K and M (250X).

The drawings are largely self-explanatory and should speak for themselves. Attention is only drawn to drawings C and D, made independently by the two observers on the same night at practically the same time. The agreement is excellent except for obvious differences in style. The interesting and somewhat unusual development of Antoniadi's "Ganges" and the Lunae Lacus (see drawings B, F, G, H, and I, as well as the front cover of this issue) merits particular attention and is in need of painstaking observation. It will be discussed in detail when more material is available.

This front cover, to which attention is directed, is an "extended drawing" made by Chapman on November 22, 1960. Of the method Chapman writes: "This extended drawing is drawn with the theoretical southern--most visible part of the disk as the upper boundary. For this reason the greatest defect is not symmetrically placed. This is an extended orthographic projection. The drawing is centered on the time scale so that the apparent CM is in phase with time; however, on the CM scale below the time scale, the true CM for that time is plotted. To find the longitude of a feature on the drawing as corresponding with the time scale, add about 4°.8 to the figure in the CM scale (this has been done above the drawing where the plotted meridians do correspond with the drawing)." This somewhat novel idea seems to require a great deal of practice to be used successfully. The advantages lie in the continuity of the features, but they are offset by the fact that such drawings could not be used for the determination of positions (particularly latitudes) nor for measurements of the polar cap. Such a method, however, would be particularly suited for observations of Jupiter. [It was very successfully so used by Chapman and several others in 1960.--Editor.]

Finally it is hoped that many more members will send in their observations of Mars. Photographs are especially needed, no matter how poor the quality may be.

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THE EVOLUTION OF THE MOON (ABSTRACT)

By: Dr. Dinsmore Alter

(Paper read at the Sixth A.L.P.O. Convention at San Jose, California, on August 24, 1960.)

This paper abstracts some previous hypotheses on the evolution of the moon, considering the arguments for and against each of them. It revives an old hypothesis that the moon is a captured, independent planet and considers the evidence from four viewpoints:

1. The uniqueness of the earth-moon system.
2. The relationship of the present orbit to the ecliptic.
3. The ratios of the moments of inertia of the moon's figure.
4. The surface appearance and the distribution of the maria.

The conclusion is that it is probable that the moon always has been a quite rigid body throughout the existence of the earth-moon system. The maria have evolved primarily as the result of disruptive tides during the first perigee passages. Impact-, tidal- and endo-forces all have contributed importantly to the present surface of the moon.

BOOK REVIEWS

Concise Dictionary of Science. Frank Gaynor. Published by Littlefield, Adams, & Co. Book No. 106 of the Students Outline Series. 546 Pages. Price $2.25 (paperback). Published 1960.

Dictionary of Astronomy and Astronautics. Armand Spitz and Frank Gaynor. Book No. 107 of the same series. 439 Pages. Some tables and charts. Price $2.25 (paperback). Published 1960.

Reviewed by: Ken Steinmetz

The ability to communicate thought is probably the fundamental dividing line between man and the lesser animals. Deductive reasoning and the ability to formulate progressive change or create a new concept of understanding based purely on accumulated information is made possible only by the ability of men to communicate clearly, one to the other. A dictionary, being a compilation of definitions, provides standardization of terms and hence contributes to mutual understanding and makes possible the exchange of thought and information of a precise nature. The terminology of any branch of the numberless facets of man's endeavors is peculiar to the particular facet involved. In a purely language dictionary, the correct meaning and proper usage of words as a part of the total acceptable language is usually conveyed. Yet, a slang dictionary may further define an out-growth portion of the language; and hence it becomes a highly specialized, instead of generalized, language dictionary. It is, however, a part of the whole; for it enables understanding and communication.

In the highly technical age in which we live, and which undoubtedly will become progressively more technical and specialized, scientists are having difficulty in communicating a precise meaning to colleagues who are not intimately involved in similar research. Small wonder that the amateur scientist is forced to avail himself of all possible information sources to enable his knowledge to stay reasonably abreast of the current level. And, if the amateur does not make an effort to understand the complex sanskrit of highly developed and continually narrowing veins of scientific progress and jargon, he is doomed to join the ranks of the uninformed.

On the surface, scientists appear to prefer the cloak of unintelligibility, perhaps feeling that they are free from possible censure if no one can understand their efforts. As is more probably the case, however, they do not feel a compulsion to translate the specialized language of their own scientific code into the language understood easily by the general public. It follows, it would seem, that the burden to understand falls on the amateur scientist. The Dictionary of Science, and The Dictionary of Astronomy and Astronautics are reasonably adequate and low-priced sources for such otherwise abstruse forms of knowledge. Such books provide a means by which the amateur scientist can interpret the works of others and convert them to usable terms which he can assimilate. Communication can then be accomplished. Both books provide a ready reference in the fields they cover. Both are solid, well-bound, paper-covered editions, dated 1960, measuring 5 by 8 inches. The two books differ significantly only in the pertinent subject matter. One supplements the other, for astronomy includes virtually every other science known to man. What is astronomy, is every science to some extent.

The Dictionary of Science is definitive in virtually every field of science. Adequate descriptions and definitions are given, and the technical terms of little-known sciences are given equal time. It is easy to read, handy to have. The Dictionary of Astronomy and Astronautics provides concise yet comprehensive definitions; and, where necessary, considerable space is given to a thorough explanation, as far as possible, of the subject matter. A number of tables have been included, involving a table of Constants, of Constellations, Brighter Stars, and the like.

Both books, while far from being the ultimate, do a good job of providing quick and easy answers to the questions that plague any who probe into the scientific world of today. To be able to comprehend what will be tomorrow, these books will help undertand that which is today.

ANNOUNCEMENTS

Errors in Past Issues. On p. 129 of the September-October, 1960, Strolling Astronomer, fourth paragraph, lines 1 and 3, read NTrB for NTB. On p. 129, fifth paragraph, line 1, read NTB for NNTB. The nomenclature of Mr. Cruikshank's paper on Saturn will then be consistent with Figure 8 on p. 123 of our July-August, 1960, issue, where Mr. Cragg gives A.L.P.O. standard nomenclature for Saturn. Mr. Beaufort Ragland of Richmond, Virginia, tells us that the umbral immersion time for lunar crater Herschel imputed to him on p. 165 of the November-December, 1960, Str. A. was actually secured by someone else. The Editor has been unable to check further. Mr. Lewis Dewart tells us that the A.L.P.O. Convention speaker shown in Figure 41 on p. 183 of our November-December, 1960, issue is not he. We are sorry for this error, and we should be glad to hear from anyone who can correctly identify this man. The orientation of Figure 27 on p. 176 of our November-December, 1960, issue, a drawing of Venus by Mr. Steve Almen, is obviously not the simple astronomical inversion; but we have no information from Mr. Almen or Dr. Bartlett to tell us what the orientation actually is.

Binocular Telescope. Mr. T. F. Cheaney, Box 1382, Fort Lauderdale, Florida, is much interested in designs of binocular telescopic systems. He has sent us a diagram of such a system with objectives 2.4 inches in diameter and focal lengths of 10 to 40 inches. We shall be glad to lend this diagram to any interested person.

Request for Lunar Students. Mr. Leif J. Robinson, 1411 Amapola St., Torrance, Calif., is anxious to hear from observers with telescopes 8 inches in aperture and upwards who would like to join in a statistical survey of the lunar surface. The amount of time needed is not known but might be small. Participants should have the Wilkins Moon and the Str. A. reproduction of the Wilkins map; the Kuiper Photographic Atlas is useful but not essential. Mr. Robinson would also very much appreciate lunar photographic prints with resolution of detail of 1½ miles or less between moon ages of 6 and 21 days (roughly First Quarter to Last Quarter). Such photographs should be at least 8 by 10 inches on glossy paper and must be printed for maximum contrast. Full details about photograph and instrument must be supplied. Photographs submitted cannot be returned, but all contributors will receive full credit upon publication of results.

Mr. Robinson is Chairman of the A.L.P.O. Methods Committee.

"The Lunar Straight Wall." We invite attention to a paper by Joseph Ashbrook with this title in the Publications of the Astronomical Society of the Pacific, Vol. 72, No. 424, February, 1960. This paper is a good example of the application of simple and needed quantitative techniques to determining lunar heights and slopes. The average slope of the exposed east face of the Straight Wall is found to be $41^\circ \pm 3^\circ$.

The Coming Eighth Convention of the A.L.P.O. with the League. Our next Convention will be held as part of the Astronomical League National Convention at Detroit, Michigan, on July 1, 2, and 3, 1961. Convention headquarters and meeting place will be the air-conditioned Henrose Hotel near the downtown Civic Center. A well-organized Convention Committee has already held a number of meetings, and detailed planning is well advanced; the General Chairman is Dr. C. D. Marshall, 17396 Westmoreland Road, Detroit 19, Michigan. The same Committee held a very successful Great Lakes Regional Convention last July (see The Strolling Astronomer for November-December, 1960, p. 184 and front cover). The Detroit Astronomical Society, the host society, has about 280 members, including about 90 juniors. It was started informally about 1900 and was formally organized in 1934. Details about registration, hotel rates, banquet, field trip, and professional speakers will be given in a later issue.

The Convention Committee has kindly allotted the A.L.P.O. a half day for our Eighth Convention, and we shall have at least as much room for an Exhibit as at Haverford in 1960. Our present big need is for program papers and drawings, charts, and photographs for the Exhibit--members who send in such items now, or at least as soon as practical, will save us time and trouble. All papers and exhibits should be mailed to Walter H. Haas, Pan American College Observatory, Edinburg, Texas.

We urge that as many members as possible make every effort to attend what will surely be a stimulating and informative three-day League Convention.

OBSERVATIONS AND COMMENTS

Further Note on Ruemker. Mr. Alika K. Herring has submitted this discussion: "In my previous discussion of this feature, (Strolling Astronomer, May-June, 1960, pp. 95-96 and front cover), I suggested that Ruemker was probably a giant compound dome. And while I still believe that this is most likely to be the correct explanation of its nature, there are several mysteries concerning the formation which must be solved before we can have a whole-hearted acceptance of this conclusion. One of these is why a large number of domes should group themselves together into one composite mass, while exhibiting but little tendency to do so elsewhere on the lunar surface. It is true that there are other large dome-like features, such as the large masses in Darwin and near Vitruvius, which are comparable in size to Ruemker; but in each case the surface topography is most dissimilar. In my opinion there is the distinct possibility that Ruemker may be unique, and certainly at this writing I do not know of any comparable feature elsewhere on the lunar surface.

"Another question is the apparent lack of summit craterlets on the domes in Ruemker. Statistical studies of their frequency made on other lunar domes indicate that fully one-third of them possess summit pits, yet in numerous observations I have been unable to detect a single one on the Ruemker domes.

"These questions should be well worth the attention of serious lunar observers. Those with moderate apertures might carefully scan the lunar surface since it is always possible that other large domes truly similar to Ruemker may yet be found. Certainly a concerted effort should be made to detect possible summit pits on the Ruemker domes; apertures larger than 12½ inches would probably be necessary for this purpose. The formation could be best observed when favorable librations in longitude and latitude combine to bring it near its mimimum distance from the center of the lunar disk, as occurred when my drawing was made."

Possible Peculiar Aspects of Piton. We have received some surprising observations of the lunar mountain Piton. These will be described in a later issue. We shall be extremely glad to receive observations, especially any made with red color filters, and above all photographs at these U.T. dates and times: 10^h5^m to 10^h24^m on November 12, 1960, and near 23^h20^m on December 25, 1960.

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Atlas Coeli Catalogue

By ANTONIN BECVAR

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