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NASA TECHNICAL MEMORANDUM

NASA TM-88505

p.13

THE UPPER ATMOSPHERE OF VENUS-
A TENTATIVE EXPLANATION OF ITS ROTATION

C. Boyer

(NASA-TM-88505) THE UPPER ATMOSPHERE OF VENUS: A TENTATIVE EXPLANATION OF ITS ROTATION (National Aeronautics and Space Administration) 13 p CSCL 03B

N87-13375

Unclas
G3/91 44711

Translation of "La haute atmosphere de Venus-tentative d'explication de sa rotation", L'Astronomie, Vol. 100, February, 1986, pp. 77-83.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. SEPTEMBER 1986

ORIGINAL PAGE IS
OF POOR QUALITY

STANDARD TITLE PAGE

1. Report No. NASA TM-88505	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle THE UPPER ATMOSPHERE OF VENUS-A TENTATIVE EXPLANATION OF ITS ROTATION		5. Report Date September 1986
		6. Performing Organization Code
7. Author(s) C. Boyer		8. Performing Organization Report No.
		10. Work Unit No.
9. Performing Organization Name and Address Leo Kanner Associates Redwood City, California 94063		11. Contract or Grant No. NASw-4005
		13. Type of Report and Period Covered Translation
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration, Washington, D.C. 20546		14. Sponsoring Agency Code

15. Supplementary Notes
Translation of "La haute atmosphere de Venus-tentative d'explication de sa rotation", L'Astronomie, Vol. 100, February, 1986, pp. 77-83.

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17. Key Words (Selected by Author(s))		18. Distribution Statement Unlimited-Unclassified	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassfied	21. No. of Pages 13	22.

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Abstract

The upper atmosphere of Venus seems to revolve every 4 days, while the planet rotates in 243 days. Mariner 10 UV data on the changing positions of dark spots in the upper Venusian clouds have supported estimations of speeds ranging from 120-240 m/s. High rates of acceleration and deceleration occur in the night side, the former between -110 to -90 degrees and the latter continuing to -50 degrees. Arch and Y formations have been seen repeatedly between -110 to -70 degrees. The highest are seen at about -90 degrees and the lowest at about -30 degrees. It is noted that the temperature of the cloud layer at 60 km altitude is about 20°C, the pressure is nearly one earth atmosphere and complex molecules, including O, C, H, N and S and combinations of these are present in abundance. The dark formations may be immense aggregates of living organisms. They may have an average density of their milieu, or may remain aloft on ascending currents. If the biotes feed by photosynthesis, the observed accelerations toward the dawnside may occur when the cloud swarm senses the sunlight after frowing hungry and slowing in the dark and makes a dash for the food. In situ observations are recommended if the hypothesis is to be tested.

The author, an amateur astronomer turned observer at the 1 m telescope of Pic-du-Midi, has been the first to discover the retrograde rotation of the atmosphere of Venus in four days. This article retraces the big steps of his work on the atmosphere of Venus and it is achieved by an explanation will become the envy of science fiction writers. /77*

*Numbers in the margin indicate pagination of the foreign text.

Venus has always posed enigmas to the astronomers. For a long time it was its speed of rotation on itself. Now it is the rotation of its upper atmosphere, a rotation which is carried out in 4 days, although the planet itself revolves in 243 days. All the attempts /78 made up to now in order to attempt to elucidate the mechanism of this atmospheric rotation have failed. The author is going to attempt to resolve the problem.

Analysis of the Observations of the Mariner 10 Probe

The upper atmosphere of Venus, which demonstrates dark zones in ultraviolet, revolves in slightly less than 4 days, exactly in 3.99525 synodic days [1, 2, 5, 8, 9]. Since 1973, the author has established that this movement of rotation was not regular and that, slower in the morning, it was accelerated in the course of the Venusian day [6]. The author had arrived at this result by utilizing series of photographs taken at the Observatory of Pic-du-Midi with the 1 m telescope.

In 1974, the American Mariner 10 probe transmitted several thousand excellent photographs taken in close ultravioet. These photographs demonstrated the dark formations already demonstrated from Earth, but with much more detail. Sidi, utilizing these documents, found the acceleration demonstrated by the author in 1973, this by a different method [7]. These works gave the author the idea of retaking the measurements on the Mariner 10 photographs by utilizing the pair technique that he had already followed in 1973. The author has thus undertaken this work in collaboration with Gerard Coupinot, Josette Hecquet and Jean-Louis Pieplu. They have published a note in Comptes Rendus de l'Academie des Sciences [10] summarizing the results obtained. But these results were abbreviated. The assemblage of their measurements in fact included a certain number on the terminator and slightly beyond. These measurements were highly extrapolated. They had extended the Y's and the arches in order to discover an invisible point of intersection and for this, had made the hypothesis that, in the dark portion, the branches were not subjected to notable deformations. The experts did not accept the validity of these meas-

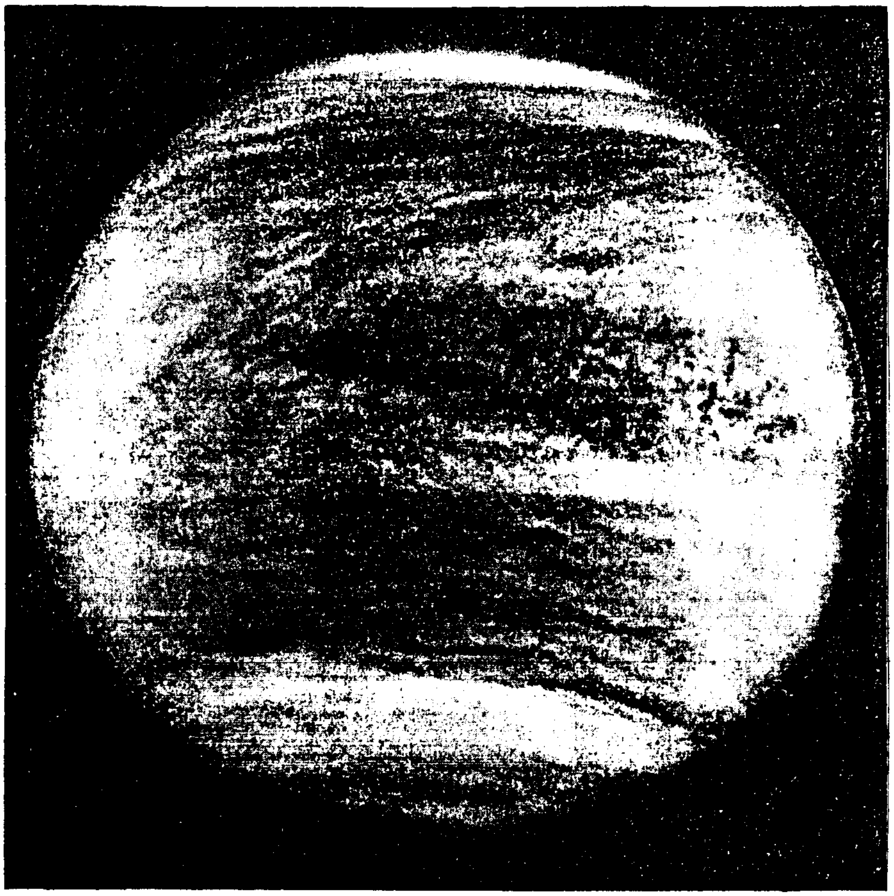

Figure 1. Pioneer-Venus 1978.
Image of the planet furnished by U.V. polarimeter (centered band passing over 365 nm), February 17, 1979 at 9 h 28 m UT. Venus is seen under a phase ange of 13°; latitude of the center of the disk: 15° South. The resolution of the image is on the order of 30 km. (NASA file, Center of Planetary and Cometary Photographs, Meudon Observatory).

urements and the authors finally published only the curves corresponding to the measurements on the visible portion of Venus. Now the author has found that the extrapolated measurements were by far the most interesting. This is why he has decided to publish them and to draw conclusions from them that will seem risky to some. Nevertheless, they furnish a logical explanation of the rotation of the atmosphere.

Figure 2 summarizes the assemblage of measurements, both direct and extrapolated, made on the Y's, the arches and the small details (hot spots, indentations), well identified on at least two successive photographs. The error bars correspond to the probable deviation (3 sigma) between the five repetitions. The circled points are the extrapolated measurements and the dashes are the corresponding curve. The curve is that of the 6th degree calculated by least squares best fitting the assemblage of points. The zero of the abscissa corresponds to the subsolar point, -90° at the rising of the Sun on Venus, the line parallel to the abscissa on the ordinate at 111 ms^{-1} corresponds to the mean velocity of the atmosphere.

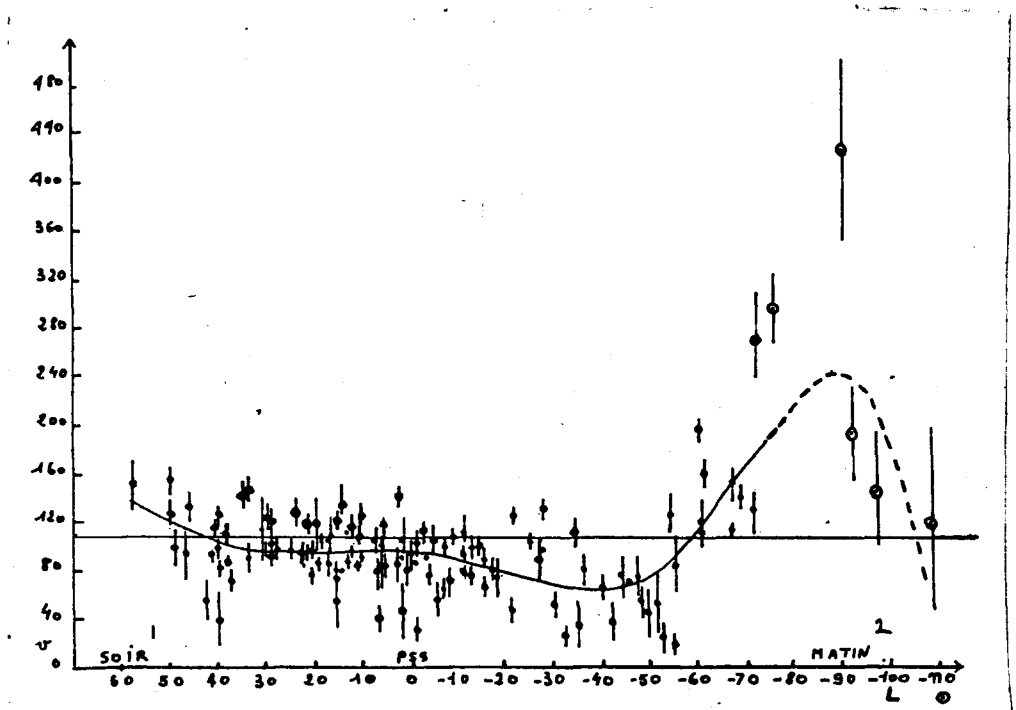

Figure 2. Velocity (ms^{-1}) of the upper atmosphere of Venus: Y, arches and hot spots.

Key: 1-Evening 2-Morning.

The furthest measurement, at -108°, that is to say 18° before the rising of the Sun, was approximately 3.5 hours and yields a velocity of 120 ms^{-1}, close to the mean. The curve then rises rapidly to 240 ms^{-1}. The maximum corresponds approximately to the rising of the Sun on Venus. The velocity then rapidly decreases up to 65 ms^{-1} in order to rise more slowly up to 120 ms^{-1}. It is this rise that the author had displayed in 1973 from photographs taken at Pic-du-Midi and that Sidi rediscovered by utilizing the documents of Mariner 10. If the figures found by the author in 1973, by Sidi and finally those deduced from figure 2 of the present work, it is seen that the agreement is remarkable: in 1973, the author found a mean acceleration of 0.59 ms^{-2}, Sidi found 0.50 ms^{-2} and figure 2 indicates 0.58 ms^{-2}. It can thus be considered that this portion of the problem has been resolved. On both sides of the subsolar point, from -50° to +50°, the mean acceleration is very close to 0.55 ms^{-2}. /79

The author had committed the error in 1973 of believing that this acceleration was induced by the solar energy and that it explained the rotation in 4 days of the upper atmosphere. All those who have followed have attempted to explain the mechanism of rotation while commiting the same error, hence the failure of their attempts. In reality the major phenomenom occurs more quickly: it is the sudden acceleration between -110° and -90°, and it is this acceleration, as will be seen, that may furnish a valid explanation for the atmospheric rotation. The acceleration of 0.55 ms^{-2} that the author had originally measured in reality was only a damping of the oscillations produced by the sudden acceleration between -110° and -90°. It will be seen in fact that a sudden deceleration immediately follows the rise and is extended toward -50°. Then the damping is followed by the rise of the velocity that the author had originally measured.

The author will thus only concern himself with the gross oscillation at the start. The first question which is posed is to know if this oscillation is real and corresponds well to a variation of velocity of the atmosphere. For this, the author has only considered the measurements made on the Y's and the arches, much more significant than those of the hot spots, and which in other respects are the only ones available between -110° and -70°. The assemblage of these measurements is reported on figure 3. The author has neglected the last four measurements in order to confine himself to the interesting zone of the rapid variations and of the beginning of slow rise (Table 1).

Tableau I /80

N°	X	Y	N°	X	Y	N°	X	Y
1	− 108	118	11	− 55	96	21	− 35	34
2	− 97	104	12	− 55	16	22	− 27	88
3	− 92	192	13	− 53	28	23	− 26	96
4	− 89	440	14	− 52	32	24	− 21	48
5	− 74	296	15	− 50	54	24	− 17	66
6	− 71	272	16	− 48	46	26	− 13	86
7	− 71	128	17	− 47	74	27	− 12	76
8	− 67	140	18	− 44	72	28	− 7	72
9	− 61	148	19	− 43	34			
10	− 60	120	20	− 39	44			

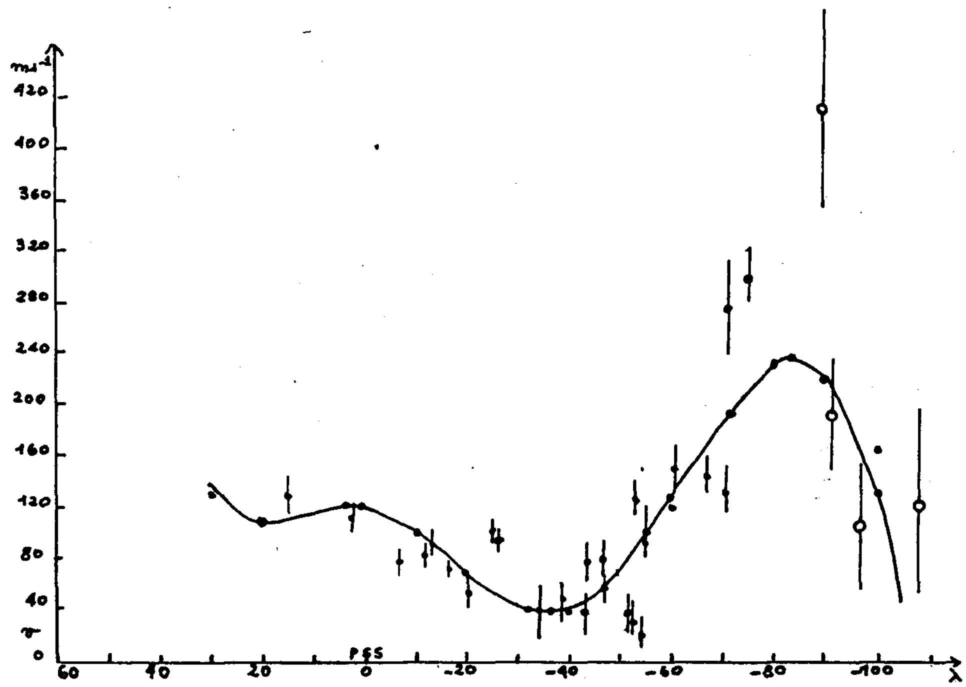

Figure 3. Velocities (ms^{-2}) of the Y's and arches in the zone of rapid variation.

The author ahs calculated, always by least squares, the best 3rd degree curve passing through the assemblage of these 28 points. It is represented on figure 4. In order to make the figure more clear, the author has only represented the curve and has not reported the points actually measured. It is seen that this curve passes through its maximum for -87°, and through its minimum for -29°. The author has then calculated this 3rd degree curve by utilizing only the paired measurements (figure 5), then by utilizing only the unpaired measurements (figure 6). The comparison of these three figures demonstrates in ob-

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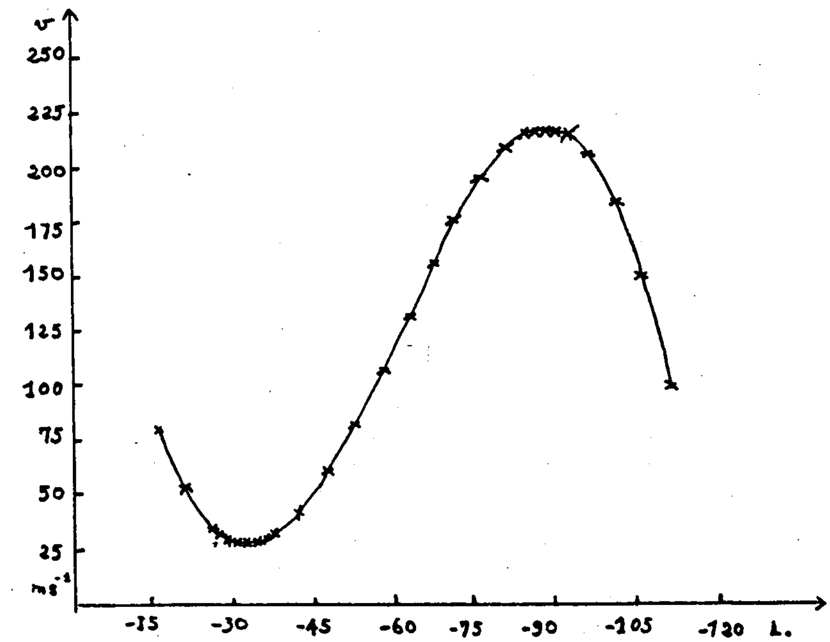

Figure 4. Curve deduced from the measurements of figure 3.

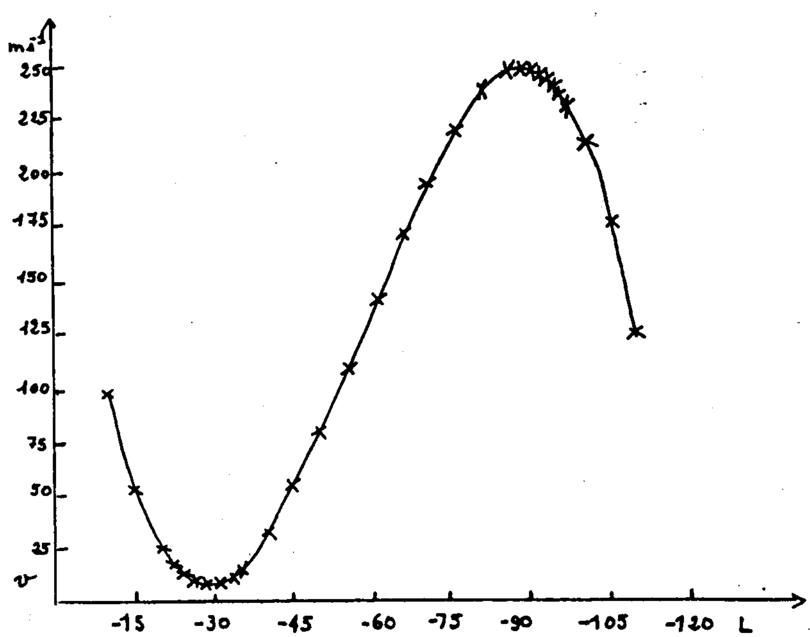

Figure 5. Curve deduced from the paired measurements of figure 3.

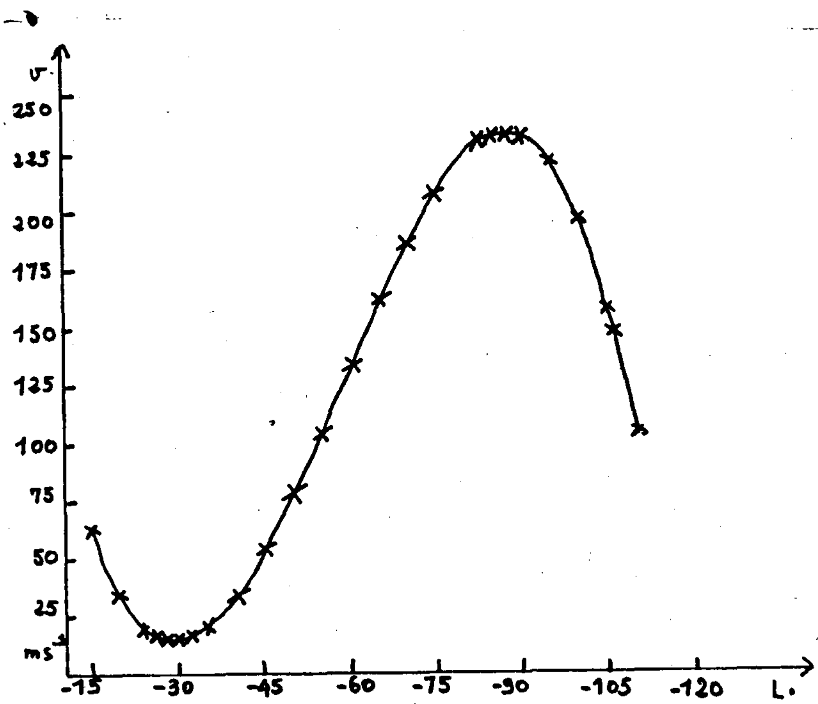

Figure 6. Curve deduced from the unpaired measurements of figure 3.

vious fashion that they translate well an actual physical phenomenon. The complete curve (paired + unpaired) passes through its maximum at -87°, the paired curve at -88° and the unpaired curve at -87°. The same is true for the minimum: that of the complete curve is at -29°, that of the paired curve at -29° and that of the unpaired curve at -31°. One could not wish for better coincidence. The coincidence between the ordinates, without being perfect, turns out to be no less satisfactory. /82

Explanation of the Phenomenon

The reality of the variations of velocity thus being established, it remains to propose an explanation. For this, a model is made: it assumes that the dark formations visible in ultraviolet are constituted by an immense aggregation of living material: a sheet of molecules constituting a sort of Sargasso Sea. This hypothesis, formulated for the first time in 1967 by the author's friend Paul Malaval, has nothing improbable about it. At the level of this layer, at 60 kilometers above the surface of Venus, the climate is very similar to the terrestrial climate: temperature on the order of 20° Celsius, pressure close to one atmosphere. In addition, all the ingredients necessary to life are present: 0, C, H, N, S, and even more complex molecules: H_2O, SO_4H_2. The dark formations could thus be aggregates of molecules, perhaps cells floating in the upper atmosphere. In order to explain that they float at this altitude, two possible explanations arise: either they are very light and their density corresponds to the mean density of the environment, or else they are heavier but they are supported by the intense rising currents that must prevail in the atmosphere. In fact, in is necessary not to forget that the surface of Venus is at 475°C and the atmospheric layer that interests us at 20°C. It is necessary that there be a significant vertical circulation in order to take into account these heat exchanges.

Whatever the case, this layer floats at 60 km altitude. It can validly be assumed that its life is maintained by reactions analogous to photosynthesis, and with chlorophyll assimilation. The portion in sunlight thus reconstitutes its reserves, but the portion in the shade consumes them and the trip in the shade lasts 48 of our hours. At the end of the night, the layer is exhausted, it is hungry. When it approaches the sunlit zone, it is warned three or four hours in advance, either by a rudimentary nervous system, or more simply by the first glimmers of dawn. The zone thus alerted rushes toward the beckoning Sun, hence the enormous acceleration observed. But once the layer is in the sunlight, the acceleration ceases and the deceleration begins. This is assisted by a standard pumping effect. The layer, brought by its own inertia, decelerates much more if it is not necessary to then slowly reaccelerate. It is this last reacceleration that the author had observed with Sidi several years ago. The oscillation must complete is damping in the dark zone. /83

The major advantage of this hypothesis is that it allows an explanation of why the attraction toward the Sun which is manifested at dawn is no longer manifested at twilight. In fact if the phenomenon was purely physical, it would be produced at twilight as a braking of the same intensity as the acceleration of the dawn which would cancel the effect and finally the rotation would not be maintained. Although on the contrary, the evening finds the layer satisfied to glide without any reaction in the shade.

Thus, after having demonstrated the reality of the retrograde rotation in 4 days [1, 2, 3, 4, 5], the author hopes to have elucidated the mechanism of this rotation. But the author's explanation is still quite hypothetical and will have to be confirmed by the analyses and observations in situ which the next launchings toward Venus will allow.

REFERENCES

1. Boyer, Ann. Astrophysique 24, 531 and more (1961).

2. Boyer and Camichel, C.R. Ac. Sc. Paris 260 (1965).

3. Guinot, C.R. Ac. Sc. Paris 260, 431 (1965).

4. Guinot and Reissel, Journal des Observateurs 51, 13 and more.

5. Boyer and Guerin, Icarus 2, 338 and more (1969).

6. Boyer, Planet, Space Sc. 21, 1559 and more (1973).

7. Sidi, C., Icarus 28, 359 and more.

8. Boyer, Coupinot and Hecquet, C.R. Ac. Sc. Paris 287, 45 and more (1978).

9. Boyer, Coupinot and Hecquet, C.R. Ac. Sc. Paris 289, 107 and more (1979).

10. Boyer, Coupinot, Hecquet and Pieplu, C.R. Ac. Sc. Paris 294, 257 and more (1982).