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By L. V. Ksanfomality, A. S. Selivanov & Y . M. Gektin

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Possible Signs of Flora on the Planet Venus

L. V. Ksanfomality [α], A. S. Selivanov [σ] & Y. M. Gektin [ρ]

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I. Introduction

For thousands of years, humanity has wondered whether there is life outside the Earth. Recently, a series of studies was devoted to strange entities in images that were returned from the surface of the planet Venus by the VENERA landers, 39 (for VENERA-9, 10) and 32 years ago (for VENERA-13, 14). Experiments in television photography [1, 2] instrumented by the landers VENERA yielded many panoramas (or their fragments) of the Venus surface at the landing sites.Thus the method was the same that is used for a contemporary search of hypothetical martian life. The images were re-processed using modern processing techniques. There are entities that one can consider to be signs of hypothetical life on Venus, regardless of how crazy this assumption sounds. Along with unfamiliar forms, some of the found objects are closely reminiscent of the forms of some of Earth's living organisms. The similarity phenomenon is called terramorphism.

II. The Venera TV-Experiments

The VENERA experiments were of extreme technical complexity. Over the past 32 years, no similar missions have been sent to Venus. The thematic issue of "Kosmicheskiye Issledovaniya", V. XXI, No. 2-3, 1983, presented the main results of the VENERA-13 and -14 missions. The methodology of the television experiments on the surface of Venus and the date and list of the experimental data have been published in details [1-4]. The coordinates of the lander VENERA-13 (March 1, 1982) landing site were 7.5°S, 303.5°E, and its height above the level of radius 6051 km was 1.9 km. The temperature was 735 K (462°C) and the pressure was 8.87 MPa, which corresponds to the atmospheric density 59.5 kg/m^3, with the composition CO_2 (96.5%) and N_2 (3.5%). The VENERA-14 lander (March 5, 1982) sank at the equatorial zone at 13°S, 310°E, and the landing site's height was 1.3 km above the radius of 6051 km. The measured physical settings were as follows: The temperature was 738 K, pressure of 9.47 MPa and atmospheric density approximately 65 kg/m^3. Gas analyzers repeated that the atmosphere is composed almost entirely of CO_2 (96,5%) and N_2 (3.5%). At both landing sites local time was about 10 am, with a solar zenith angle of 37 and 36°. Illumination by the diffused sunlight was 3-3.5 kLux. (For more details see [2]). The scene illumination reached 3.5 klx [1,5]. In both cases, the transmission of images began with a one-minute delay after landing to prevent any dust from obscuring the optical view.

The first images of Venus' solid surface were transmitted to Earth by TV-cameras of the VENERA-9 and -10 landers, on 22 and 25 October 1975 [6]. Each of the landers returned one whole and one fragmented panorama. The landing site of the VENERA-9 lander was 32°N, 291°E and of the VENERA-10 lander was 16°N, 291°E, both near the extensive highlands Rhea and Theia Mons. The typical Venusian landscape is a waterless hot stones, or friable flat desert (Fig.1), sometimes with mountains or even volcanoes. An interesting feature of the hypothetical Venusian flora (as well as hypothetical fauna) should be their adaptation to the very long duration of day and night [7]. The annual period of Venus (224.7 terrestrial days), combined with the rotation period (243 days), taking into account the inverse rotation, results in a duration of a sunny day of $T_{sol} = (T^{-1}_{sid} + T^{-1}_{orb})^{-1} = 116.8$ days. Since the rotation axis is almost normal to the orbital plane, day and night are equal to each other and last 58.4 days each. Seasonal effects are absent.

Author α : Space Research Institute, Moscow.
e-mail: leksanf@gmail.com
Author σ ρ : OAO Russian Space Systems.

Figure 1 : Upper panel: a color image of the camera 2 of VENERA-13 constructed after the initial processing (1982). The lower panel presents the same image after the author's contemporary treatment.

On March 1 and 5, 1982, experiments in television photography were repeated by the landers VENERA-13 and 14 [1], yielding in 37 panoramas or their fragments of the Venus surface, with both groups suitable for processing. Their landing sites were 7.5°S, 303.5°E and 13°S, 310°E. Over the past 32 and 39 years, no similar missions have been sent to Venus, primarily because of their extreme engineering complexity. Cameras of VENERA-9 and -10 were less sophisticated than those of VENERA-13 and 14. It should be mentioned that besides VENERA-9, -10, -13, -14 there were VENERA-11 and -12 missions (landed December 21 and 25, 1978); each lander was equipped by two scanning cameras. Unfortunately, on both VENERA-9 and -10 only one camera opened, the lid of the second one was not released. The second camera worked fine, but the window remained closed. The problem worsened when after landing, at VENERA-11 and -12 all lids of the cameras remained closed, although the cameras continued to work.

The VENERA-13 and VENERA-14 scanning cameras were fitted with glass filter disc. Spectral intervals were 410 - 750 nm (no filter), 390 - 510 (blue, images are almost useless), 490 - 610 (green) and 590 - 720 nm (red filter). The transfer of the first black-and-white image was succeeded by transmission of a red, green and blue image, and then again a black-and-white image came. At that time CCD detectors still were at their laboratory stage. The scanning optical-mechanical cameras were equipped by the photomultiplier FEU-114 as the light detector. Its spectral sensitivity was characteristic for a multialkali photocathode (Fig.2).

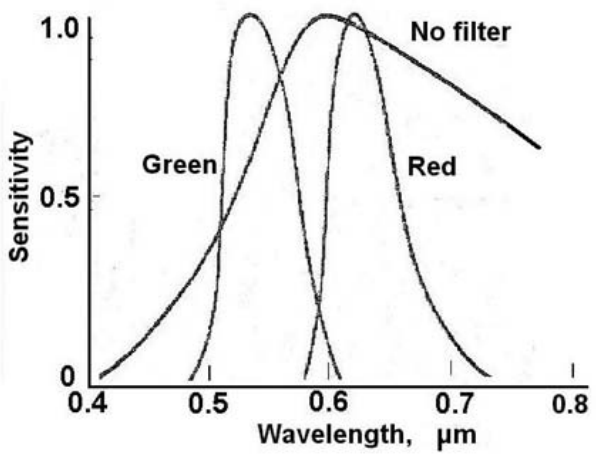

Figure 2 : Spectral sensitivity of the VENERA-13, -14 landers cameras.

The cameras optics entrance was located at a height of 90 cm above the surface, on both opposite sides of the lander. The inclination of the camera's axis (50°) allowed to discern millimeters-sized features of the surface in close proximity to the lander, and about 10 m at the mathematical horizon (at a distance of 3.3 km on a flat surface). The inclination of the camera's axis distorts the image. Pattern of the VENERA-13 panoramic image in initial processing is presented in upper panel of Fig.1. When treated by a contemporary means and corrected for the geometry distortion, the image appear much more detailed (Fig.1, the main panel).

As distinct from traditional television systems, the images produced by each VENERA cameras were panoramic (a horizontal field of about 180°), with lines oriented vertically having a resolution of 211 pixels on the active part and 252 pixels per line, including

housekeeping. The angular pixel size was 11 arc min. One line took 780 ms (3.1 ms/pixel). The images consisted of 1000 lines and were transmitted by a radio transmitter's omni-directional antenna to the satellite located in the elliptical orbit. The satellite relayed the data from the lander to terrestrial receiving stations in real time.

The VENERA-9 and -10 cameras (1975) were designed for only black-and-white TV-images. The camera design, the images, methods of their processing and interpretation were detailed in a special edition "The first panoramas of Venusian surface" [8]. A special feature of the experiments was the use of powerful lights for the field illumination as there was no certainty that surface will be in good lighting conditions. Two 100-Watt halogen lamps were used, but the precaution was not justified.

Due to high efficiency of thermal protection the rise of the landers' temperature was fairly slow, despite high ambient temperature [2]. On March 1, 1982 the camera 1 of the lander VENERA-13 was operating during record long time, 1 hour 40 minutes, as reported officially. If one considers all the data, including those with an increased noise the signals were being received by the orbiter for more than 2 hours (126 minutes; or may be even for 139 min, according to M.Yu.Gektin, one of authors of the TV-experiment). Anyway, it would have continued, and still worked, but approximately at this time, it is not clear who and why, sent a command from Earth, ordered to stop receiving data on orbiter, while the lander continued to send its signals.

The loss of radio communications between the lander and orbiter would ultimately caused by orbiter's dipping beyond the horizon. Nevertheless disturbance in the operation of the dangerously overheated radio system had been observed sporadically long before the connection was completely lost. Scanning of a single panorama made by VENERA-13 and its simultaneous transfer took 13 minutes. The ADC used 9 bit encoding (TIFF format, with bit #10 used for housekeeping).

After the first full series completed, in the second set, with a good signal level and with low noise, partly shortened versions of the red and green panoramas were transmitted; however, some of their parts still were lost due to the noise. When processed they were replaced by the same parts taken from other images. After completing the second series, the camera and the radio link, of course, did not shut down and continued to work. In the third series, black-and-white, red, green and blue images were transmitted, all with different types and level of noise. The images obtained in the blue spectral region were almost useless, because the blue rays are almost completely blocked by the Venus' atmosphere.

The published colorful panoramas are based on the data of the first and partly of the second series. For the synthesis of color images, that was enough.

III. Hypothetical Mushroom-Like Entity

As a result of the panoramas newly processed the quality of the images was noticeably improved. An interesting findings on the panorama Fig.1 may relate to hypothetic Venusian living form. These entities were investigated first in 2012-2013 [8, 9]. With the improved methods of image processing, contours of previously unclear details became sharper. In Fig.3 "a mushroom" belonging to hypothetical living forms is presented.

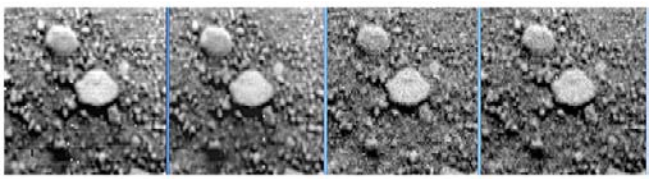

Figure 3 : Fragments of four VENERA-13 panoramas with the "mushroom" object.

Prior to the new image processing, these objects have not attracted any attention, although one of them has been located in the very foreground of the VENERA-13 panorama.

Four fragments of non-processed versions of panoramas of the landing site of the VENERA-13 are shown in Fig. 3, two black-and-white, red and green images were obtained during the first 87 min of the mission.

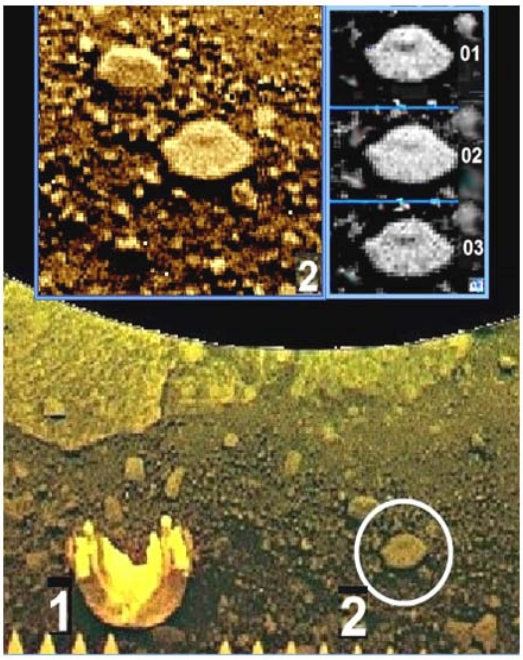

Figure 4 : Position of the tent-shaped object "mushroom" (2) on the VENERA-13 panorama. Three black-and-white figures 01-03 demonstrate a radially folded structure of the object resembling Earth' mushrooms. The white feature 1 is the camera's lid.

The object 2 whose shape resembles a mushroom is located in the foreground at a distance of

15 to 20 cm from the buffer of the lander (Fig. 4). It is elevated above the surface by about 3 cm; however, its support is not visible. The detached camera lid 1 sizes 20 cm. The diameter of the "mushroom" 2 attains, approximately, 8 cm. It is clearly seen on all sequential panoramas of VENERA-13. In Fig. 4, 2, the mushroom is the brightest object in the central part of the panorama. Comparing its brightness with the lighter periphery of the figure, one should keep in mind that the object resides in the shadow region made by the parachute panel of the landing module. The color image Fig. 4 is composed of black-and-white and color-divided red and green primary panoramas. Six sequential images were processed by the method of correlative stacking, including all available panoramas. Three of the resulting versions of black-and-white images are shown by the upper panel of Fig. 4. In each case, the radial tent-shaped folded structure of the object is seen. By virtue of the fortunate close position of the "mushroom", its structural details are clearly distinguishable.

For the 1.5-hour observation of the Venusian surface, no attributes that could testify to motion of the object were found. However the resolution is too poor for a confident conclusion. Apparently, one may relate these objects to Venusian flora (if "mushrooms" relate to flora). This allows associate its properties with the noticeable manifestations of terramorphism, which indicates certain unknown yet biological regularities [9]. By virtue of the small size of the mushroom, it is hard to observe other similar objects remote from the camera at a greater distance.

IV. Hypothetical Plants on Panoramas of Venera-13 and Venera-14

Due to the availability of up to eight duplicates of the images obtained and their low level of masking noise, the VENERA panoramas permit identifying and exploring many types of hypothetical life forms of Venus. Specifically, "plants" or "stems" are the most numerous group of samples of hypothetical flora. The first stem object was detected due to its being close to the entrance of the TV camera, and the remaining were detected by similarities in their shapes and positions to the first stem.

At the time of this writing, three years have elapsed since the submission of the first manuscript for publication that was devoted to hypothetical signs of life on the planet Venus [3]. These objects hypothetically have characteristics of living creatures - flora or fauna.

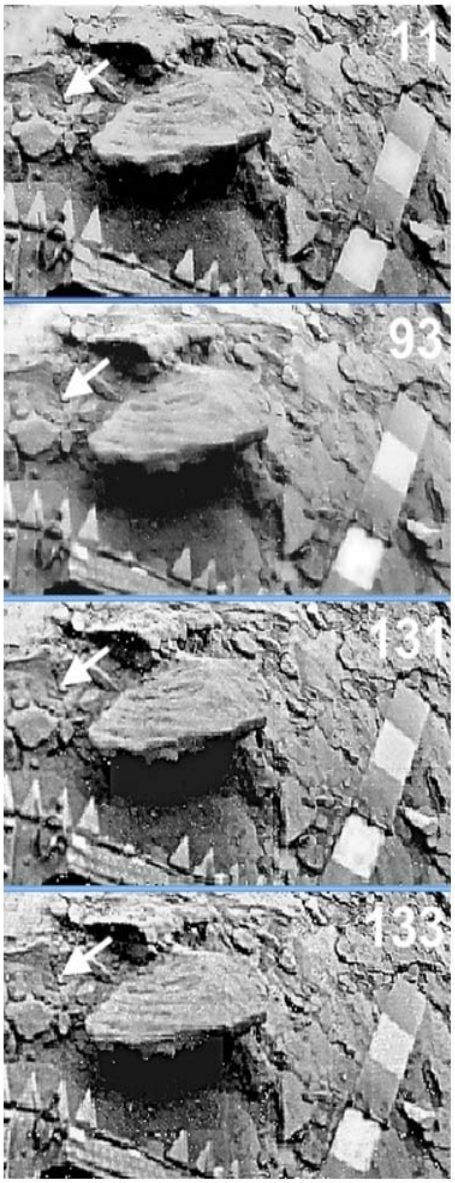

Figure 5 : Fragments of the image of the planet surface at the landing site of VENERA-14. A feature under consideration is shown by the arrow.

When experience using image processing was accumulated, the VENERA-14 panorama allowed an approach to the finer details. An important role was played by additional image processing, image geometric correction and the presence of up to eight duplicates of images that were obtained with good quality and low levels of noise. This arrangement enabled the selection and staking of their fragments. As a result, it managed to find and learn about a few new types of hypothetical living forms at the VENERA-14 landing site [10].

The interest in the searched autotrophic flora of the planet as a source of the existence of its fauna was noted in [4,8-10]. It is natural to assume that, like on the Earth, the Venusian hypothetical fauna is heterotrophic,

and the source of its existence is hypothetical autotrophic flora. Although the direct rays of the Sun, as a rule, do not reach the surface of the planet, there is enough light for photosynthesis of the Earth-like type there. A diffuse illumination of 0.5-5 kLux is sufficient for photosynthesis even in the depths of the dense forests of the Earth. The measured illuminance on Venus is of the same order, at the range of 0.4 to 9 kLux. Of course, photosynthesis at high temperatures and in a non-oxidizing environment should be based on a completely different, unknown biophysical mechanism.

The feature shown by the arrow in Fig.5 resembles only a thin scratch, but it is repeated at all panoramas and in the same place. When processed the "scratches" are vertically arranged thin knotty trunks, which are 0.3-2 cm thick and 0.2-0.5 m (and more) tall. On color panoramas, they look black. The first "stem" object that was detected (Fig.6, circled), has a large bulge at the top end, a "burgeon", with a lighter center. The "stem" is located close to the camera. At the "stem's" base, on the surface, there is a visible group of details that resembles a quatrefoil. Each of its "leaves" has a size of approximately 5-10 cm, and possibly, they have a radial structure. In the vicinity of VENERA-14, the number of stems at the panorama is approximately eight. All of the "stems" are placed vertically, with the exception of one of the largest, which bends to the surface.

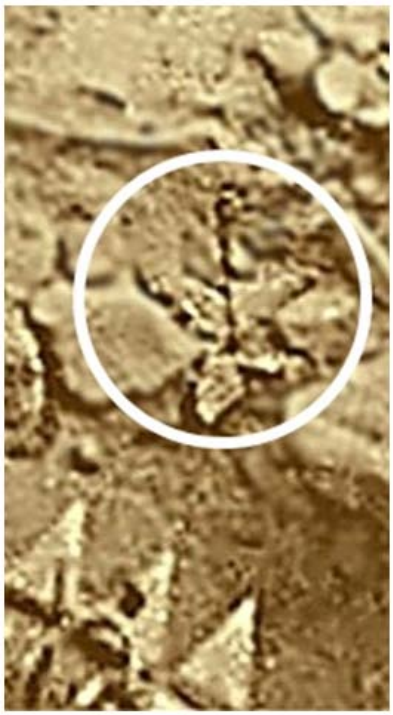

Figure 6 : The first found object of the "stem" type is a thin vertically arranged knotty trunk that has a height of approximately 42 cm and a thickening ("burgeon") on the top. The "stem" is located at a distance of approximately 40 cm from the landing buffer of the VENERA-14 lander and is seen from above.

The clarity of a picture element that has a fixed size depends on the distance. The line resolution was 211 pixels and 11' (arc min); thus, a pixel size of 0.5 cm (thickness of the stem) will correspond to the distance 0.005/(11/3438) = 1.56 m (3438 - the number of minutes in one radian). If the image of a specific object is not single, as in the case of stems, then batch processing and stacking can be used to study the details. Unfortunately, upon heating, the equipment's adjustment deteriorated, and the actual resolution became worse. In Fig. 6, the knots on the stem have a 2-3 pixel size (1-2 cm), and the "bud" has a 5-6 cm size. Based on the geometry of the resulting angles, we can assume that each point of the image of a stem that is at a distance of 3 m is eroded by four pixels, and its contrast is reduced by about half (due to the one-dimensional structure of the object). For more remote stems, the contrast is reduced; thus, their detection becomes impossible.

To find the height z of the stem in Figure 6, one should use geometric relations and a photoplan (because, on the original panoramas, the distances are significantly distorted). An exact photoplan of the landing site of VENERA-14 is currently being finalized and is not shown here. The input window of the TV camera is located at a height of h = 90 cm, the distance a from the projection point of the TV-camera lens onto the surface, to the base of the stem is approximately 40 cm, and the top of the stem is projected onto the surface details, roughly at the distance of b = 75 cm. If the stem is placed vertically, from the right triangle, then the angle α at its apex is found to be $\mathrm{tg}\,\alpha = b/h$, and the stem height is $z = (b\text{-}a)/\mathrm{tg}\,\alpha$ = 42 cm. A possible error can indicate that the ground surface is uneven.

All of the detected stems are thin and apparently knotted. However, perhaps there is one exception. In the peripheral part of the panorama of VENERA-9, there is an object that could be a thick stem. The image shows its light spotted top.

Its height is approximately half a meter, the thickness of the stem is approximately 5-8 cm, and the nodes are not visible. However, we should be reminded that the low resolution of the VENERA-9 images does not permit making firm conclusions. Other stems on the panorama of the VENERA-9 panorama were not found, perhaps for the same reason.

V. Stems with Flowers

To search for other stems, an additional processing of the VENERA-13 and -14 panoramas has been made to improve the clarity of the details. In some of the cases, the correction has been made of geometrically distorted panoramas. Black-and-white panoramas of VENERA-14 presented in series - groups 1, 6 and 9, 13 (of camera 1) and 3, 5 and 7 and 11 (of camera 2) - and the "red" panoramas of the same series

(except for defect series 7) were used obtained within 1.5 hours. "Green" panoramas are difficult to use because they are noisier. The synthetic color panorama was used to obtain some information about the colors of the objects.

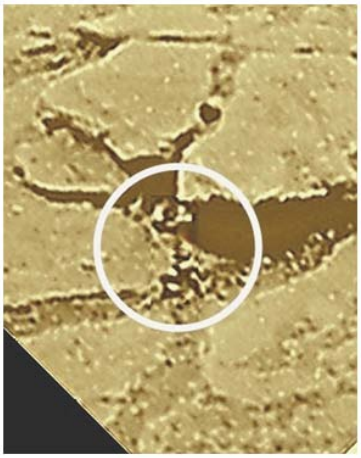

Figure 7 : Processed image: "stem", "quatrefoil" at its base and the opening "burgeon", crowning the top of the "stem" at the landing site of VENERA-13."Stem" is in the foreground.

The clarity of details is different in different panoramas. Large but distant stems, perhaps more than half a meter in height, appear to be found in the left-hand edge of the panorama VENERA-14 and several distant "stems" were found in the right part of the panorama VENERA-13. In all of the cases, the bases of the "stems" were located in crevices between stones. All of the stems that were found are solitary.

Unlike VENERA-14, at the VENERA-13 landing site, only one or two such objects were found, for which the base of the "stems", similar to in Fig.6, were in a crack between the stones. This circumstance can be important because the soil here is mainly fragmented, but the stems there were not found. This interesting object is shown in Figure 3, which presents a stacking of four consecutive images of a knotty stem that was found in the VENERA-13 panoramas. However, the "stem" in Figure 3 is lower than in Fig.6; it is more distant, and the stem itself is not easy to notice, although there are eight distinct images (duplicates), which allows for batch processing. The attention is drawn to the top of the stem, which appears in Fig.7 as a triad of bright dots that are visible on all of the original high-contrast images. The position of the triad is not identical in successive frames. It varies slightly with respect to the adjacent light-colored stone on top of it (Fig.7). This change could arise from the swinging of the triad by the wind.

A clearer picture of the "stem" with a flower is highlighted in Fig.8. It has been suggested that the complex structure of the top of the stem is an opened burgeon. When processing the image with a decreasing contrast, this assumption was confirmed and allowed us to see the whole "flower", of a regular shape (Fig.8), with a white spot (pestle?) in the center and the surrounding petals.The top of the "stem" is more complex than the triad (or bud in Fig.6). The object is visible from above, and its height, which is found by its position on the photoplan, is only approximately 20-30 cm at the base in the crack between the stones. At its base, there is a group of four bright details, similar to the "quatrefoil" leaves shown in Fig.6; that appears to be associated with the stem, also.

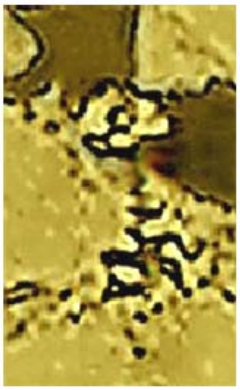

Figure 8 : "Flower" - the same object as in Fig. 6, with lowered contrast and detailed image of the "flower", its light central part and leaves at the base. The diameter of the flower and the "quatrefoil" at the base are 5-8 cm.

The flower is composed of six to eight light petals. Its right-hand bright part forms the triad that is repeated on all of the duplicates, as part of a disclosed flower. The "flower" size is approximately the same as a "quatrefoil" at the base of the stem. The VENERA-13 panorama has been organized in such a way that Fig. 7 represents only a fragment of the black-and-white image; thus, one can talk about only the bright colors of the petals, and their color in Figs.7 and 8 is unknown.

Another interesting but unobtrusive small bright quatrefoil was detected at the center of the VENERA-14 panoramas in a depression that is quite close to the landing buffer (Fig. 9, see frames 1 and 2). In contrast to Fig. 6, its "leaves" are very bright, only slightly darker than the white cap released from the TV camera. One of the quatrefoil elements is in the shadow of a stone. The dimensions of the "leaves" are not more than 2 cm. Despite its smaller size, the object similarity with Fig.6 is obvious. The "stem" itself on the source panoramas (frame 1) is difficult to see; it was isolated by using a gamma-correction and in such a form is shown in column 4 as consecutive original pictures (Fig.9, frame 3).

The height of the plant observed from above is approximately 10 cm. There is a "flower" seen on its top, also. When the image is processed, the "stem" gets viewed as in Fig. 9, frame 4. The dimensions of the "flower" are approximately 2 cm, also. To the right of it, another "flower" is visible, the stem of which apparently is placed behind the stone.

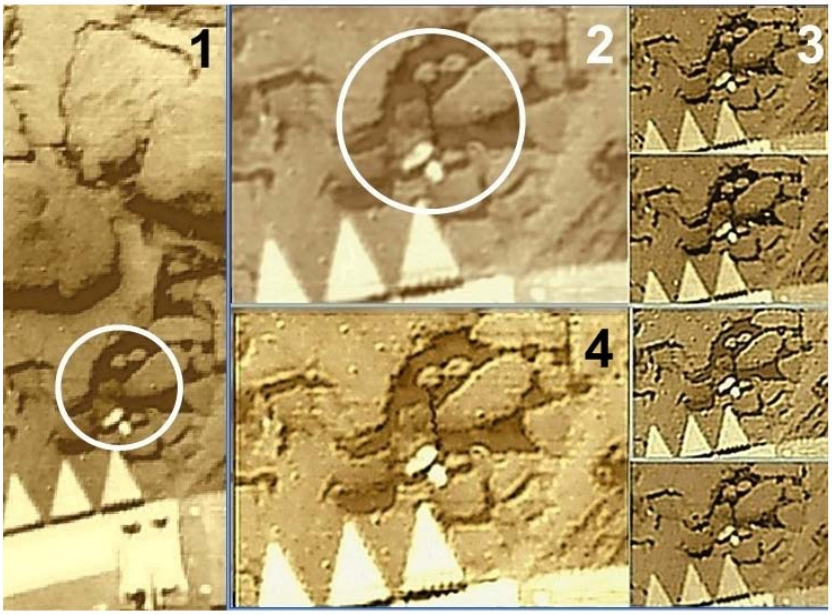

Figure 9 : "Stem" (1, 2) with a bright "quatrefoil" located directly at the landing buffer of VENERA-14; its recurring images are shown on four consecutive panoramas (column 3). The processed image is shown in frame (4). To the right of the feature there is another "flower" visible, the stem of which is apparently situated behind the stone.

In Fig. 9, "stem" and "flower" are seen against the background of high contrasting details and cracks in the stone slab recess. The stem rises from the recess. The object is relatively close to the camera (less than 1 m), but the "flower" is small, and compared with Fig.6, the resolution is low.

There is another fragment of the supposed stem refers to the VENERA-14 panorama, for which there is a full color version. Therefore, it is possible to obtain some information about the color of the object. As mentioned above, the useable VENERA-13, -14 color separation were 490 - 610 nm (green), 590 - 720 nm (red filter) and 410 - 800 nm (no filter). The solar energy distribution at the surface in the range of 410 to 800 nm has a maximum in the nearest infrared region (Fig.10).

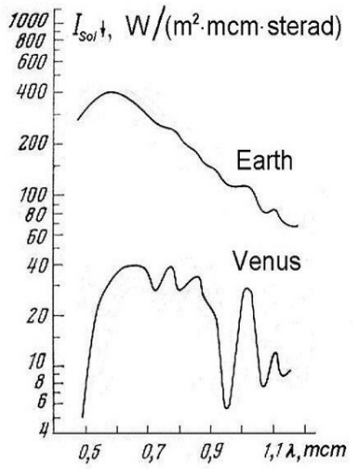

Figure 10 : The solar energy distribution at the surface of Venus close to the equator and midday, in the range of 500 -1200 nm.

Thus, colorful panoramas can be considered conditionally as tricolor. In this sense, the flower shown in it, when compared with the background, has a greenish tint. However, the identification of the object is made with the least confidence among the other figures. The spotty nature of the surface and numerous cracks complicate the identification of the object.

VI. On the Role of Burgeons and Flowers

The landing site around the landers VENERA-13 and VENERA-14 showed a significant number of vertically oriented objects that were similar to the stems of terrestrial plants. The stems are an important complement to the objects of a hypothetical Venusian flora discussed in [10]. If the tops of the stems really are burgeons and flowers, one should reflect their role. The flowers of terrestrial plants are intended for their pollination and reproduction. Pollination is conducted either by insects or by the wind. Wind-pollinated plants do not require blooms in principle, for example, the case of the poplar "fluff." Flowers attract insects. Do the tops of the stems in Fig. 6-9, at least indirectly, hint on the likely participants in the process of pollination?

Terramorphism of hypothetical objects of the flora and fauna of Venus was observed repeatedly in many entities [5, 8-9]. Flowers with their petals in Figures 8 and 9 are new objects that are surprising to find. It is surprising to find the occurrence of the same forms of living objects on different planets that have radically different physical settings. What are the laws of nature that determine the recurrence of terramorphism hidden in such markedly different environments?

The Earth's flora began the evolution of carbon dioxide in an oxygen-free atmosphere, for which the composition was similar to the current atmosphere of Venus. As noted, the illumination on the surface of the planet Venus energetically complies with photosynthesis. Therefore, apart from the very large difference in the physical conditions, the flora of Venus should not be less rich than the Earth's flora.

VII. Conclusion

For thousands of years, humanity has wondered whether there is life outside the Earth. Recently, a series of studies was devoted to strange entities in images that were returned from the hot surface of the planet Venus by the VENERA landers, 32 years ago. Thus the method is the same that is used nowadays for a search of hypothetical martian life. The images were re-processed using modern processing techniques. There are entities that one can consider to be signs of hypothetical life on Venus, regardless of how crazy this assumption sounds, keeping in mind physical setting on the planet. The pictures revealed a dozen previously undetected strange objects that can attest to the fact that Venus does possess life. Materials shown in this paper demonstrate experimental results that involve re-processing of the original panoramas, without any retouching or corrections. For the moment, it is impossible to prove that the objects are alive in fact because they cannot be touched. However, the opposite is true also, that nobody can place errors into the processing of the images. Instead, critical arguments boil down to the famous humorous statement of A.P. Chekhov, in his 'Letter to my neighbor-scientist': "this cannot be, because it never can be." Subconsciously, all positions of critics have been based on variations of the statement: only the Earth's conditions are suitable for life. "We are the best and all our physical conditions are the best too". Based on this idea, limited "habitable zones" are drawn in schemes of extrasolar planet systems and are under the study of theoreticians. One may conclude that other physical settings should be considered either.

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