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MARS CHANNEL OBSERVATIONS 1877-90, COMPARED WITH MODERN ORBITER DATA

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Abstract. The astronomic sensation of 1877, Schiaparelli's *Canali,* were a main research topic for 80years (in a way they are it now again). Up to Mariner 4 (1965) many institutes believed in melted ice and periodic vegetation along the gray or green linear structures. Mars mapping reached a 2^{nd} summit by *Antoniadi,* whose map 1936 was the basis of the US Mariner program. But ∼1915 the shift from linear to area drawing caused some quality losses in planetography. In the fifties the *Canali* were mostly interpreted as optical illusions or contrast effects.

The *rivers and tectonics* seen by Orbiters encouraged me to special studies: 60% of Schiaparelli Channels correlate with: Albedo patterns, terrace-shadow structures, broad valley systems (e.g. Valles Marineris) and rows of craters or clouds. Experienced observers know that linear structures can be "seen" even if their elements are below the resolution. Feedback of this fact to space-born Remote Sensing is recommended – for maximal use of the modern planet Orbiters and special studies of geology, dust storms and clouds.

1. VISUAL MARS OBSERVATIONS AND THE CANALI (CHANNELS)

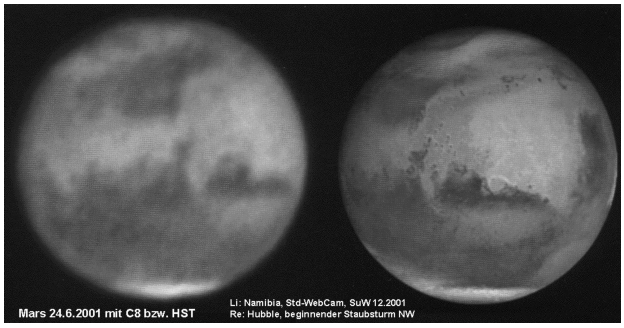
Visual terrestrial observations were the basis of Mars research up to 1965 (Mariner 4), and are still of some interest in the present, as I'll show below. After many space probes and in a year of new 'robotic earthlings' the situation is curious:

Our actual interest in the *Red Planet* was founded on telescope sightings of *"Canali"* 125 years ago – and on their misinterpretation by Science-fiction authors: the idea of *Martian Life.* Since 1965 the detection of craters and deserts undermined this idea, and "channels" were explained as optical illusions. Nevertheless –

Astronomy, Geology & SpaceTech are busy to find paleo-water, and many old Canali observations prove to have a real physical basis.

Seen through a large telescope or CCD, Mars is *earth-like* with its polar caps, seasons, and changing coloration. But Orbiters, altimeters and probes form another model: extreme heights and giant canyons, invisible huge volcanoes, strange sediments, ice floods and planetwide dust storms (Fig.1).

First Mars drawings were made by Huygens 1659; a periodic dark structure (Syrtis major) led him to a rotation $\sim 24^h$. Cassini detected the polar caps 1666. Precise rotation period and axis (24.0°) was derived by W. Herschel 1777-83; he also guessed a very thin atmosphere by a star occultation.



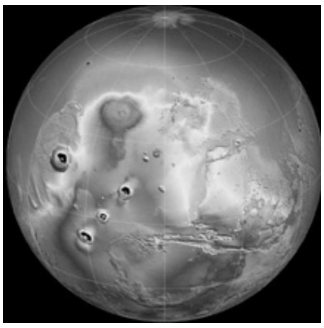


Figure 1: Mars from Earth, 24 June 2001 (21cm telescope, WebCam; Hubble HST), beginning sand storm in northwest. Right: MOLA Orbiting Laser Altimeter model.

Most of the early observers took the dark regions for oceans, and the orange colours for continents. But the astronomers understood that great oceans couldn't exist under a thin atmosphere. In 1860 D. Liais published the idea of dark ocean floors with primitive vegetation.

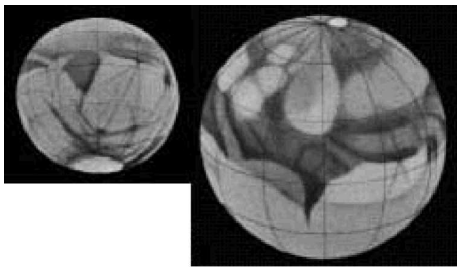


Figure 2: Syrtis mjr. at aphel opposition 1901 and perihel opp. 1909 (Graff. Univ. Vienna).

During the close opposition 1877 Giovanni **Schiaparelli** (1835-1910, Milano) observed thin gray or green lines; some of them joined in a complicated pattern. Calling them *'Canali'* (channels) he thought on natural lines or running waters, perhaps *with lateral vegetation*. However, the Italian word was mistranslated into 'canals'. That, combined with the lines' straightness, bespoke of artificial structures and created a furor. Speculations conc. the possibility of intelligent life on Mars sprang up in the popular press. Even astronomers felt the pull of that dramatic possibility.

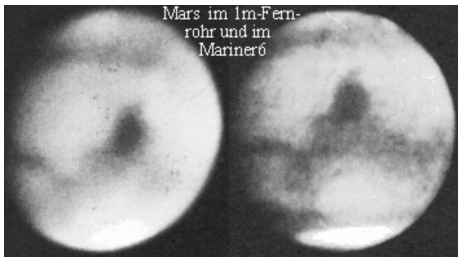


Figure 3: Syrtis mj. photo by 1m mirror resp. Mariner6. Caused by atmosph. ∼5 times less details than visually.

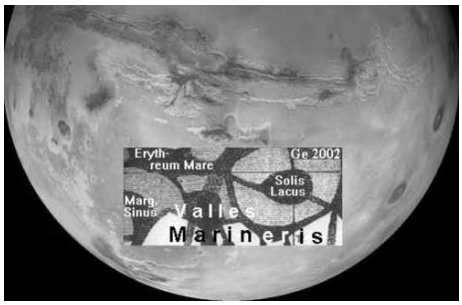


Figure 4: Valles Marineris, a 4000 × 600 km Graben system (10× greater than Gr.Canyon). Right: Tharsis volcanoes, heights 12-20 km [Aarhus 2002].

Inlay: 4 'Canali' (Nizza 1886, telescope 60cm) correspond to Val. Marineris [Gerstbach 2003].

Foremost among these was Percival **Lowell** (1855-1916), who carried matters far beyond Schiaparelli [GSFC 2003]. First an admirer of S. (a famous Mercury observer, too), the rich hobby astronomer then became a serious scientist. 1894 he founded the Lowell Observatory Arizona, where his studies of Mars led him to believe that the lines on the surface were "canals" and therefore intelligent beings may inhabit the planet. His successors researched galaxies, spectroscopy and discovered Pluto.

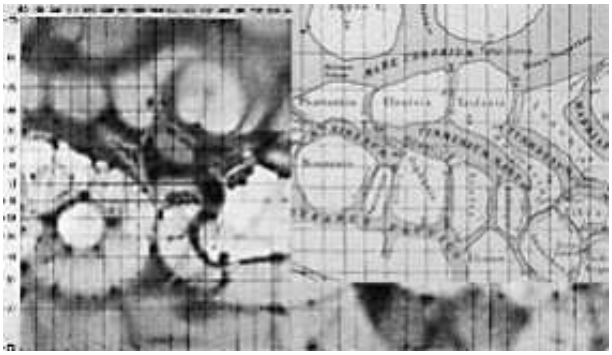


Figure 5: Area map vs line style. Antoniadi 1915 (left: Elysium, Mare Cimmerium) compared with Schiaparelli. Lost of details, espec. if 3 times greater telescope is considered.

The *Canali* sensation of 1877 was proved at the next opposition 1879 – and some of them were doubled within the 2 years. *Now* Schiaparelli also began to speak of possible martian civilisations, of trans-/ regressions (Fig.5) ... and the Channels became a main research topic for 80 years. Up to Explorer **Mariner 4 (1965)** many institutes believed in ice-water and periodic vegetation along the grey-green or brown linear structures [Bernhard 1962]: "observers now report that they have seen sections near the canals turn blue-green in one season and dark brown in another."

2. MARS MAPPING FROM ANTONIADI TO THE ORBITERS

Mars mapping reached a 2^{nd} summit by **E. Antoniadi,** whose map 1936 was basis of the US Mariner program [Blunck 1994]. But when A. and his 'Paris school' ∼1915 changed from *linear to area drawing,* this caused (to my opinion) in the first decades some quality losses in Mars Cartography. In the fifties the *Canali* were mostly interpreted as optical illusions or contrast effects – see Herrmann [1963]. Below and in Gerstbach [2003] I show that ca. 60 per cent of the Canali have a real physical basis.

Up to Mariner 4 (1965) there was *too little* prudence to Lowell, Sagan and other "Mars vegetation astronomers" [Raeburn 2000] – but now we *over-interprete* some spaceborn data: e.g. the fictive "Altimeter model colours" Fig. 1 [MOLA 2003, SUW 2001] – drawn with *no respect to albedo* or geology [Tanaka 2003]. Most of these models ignore well-known morphology, line patterns or crater genesis.

The rivers and tectonics detected by Mars orbiters encouraged me to special studies: ca. 60 % of Schiaparelli Channels correlate with: **Albedo** structures, **terrace-shadow** structures, edges of broad **valley systems** (Mare Sirenum, Valles Marineris etc.), or **rows of craters.** For examples see Figs. 4, 6a/b and 7.

Experienced observers know that linear structures can be "seen" even if all details are *far below the resolution* → Just remember when standing on a summit, seeing all narrow roads, trails and brooks – even if they are smaller than visual resolution of 1'. Feedback of this fact to space- born Remote Sensing and to some Astro software is recommended – for maximal use of the modern planet Orbiters...

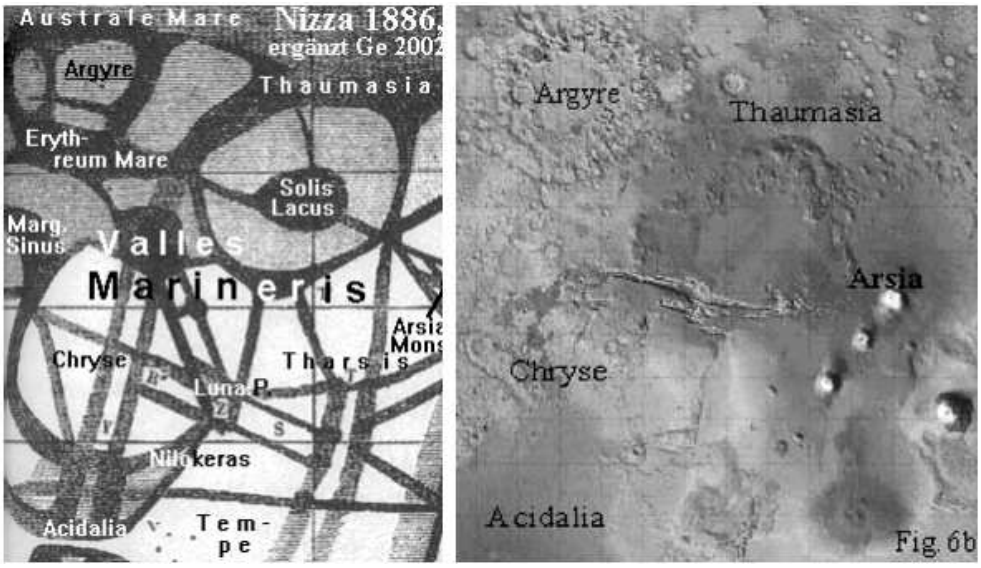


Figure 6: Canali (1886, telesc.60cm) and Altimetry model [Mola 2003], orig. colour. The Canali correspond 70% to: crater rows/ terrace shadows (Argyre, Thaumasia, Tharsis), valleys (V.Marineris), 'coast lines' (Chryse..), albedo (Marg., Solis Lacus).

3. THE DIFFERENT VIEW EARTH / ORBITER; SEEING AND STORMS

Up to 1960 visual telescoping was the only way to observe fine details of Mars' surface. From the earth, photo resolution (Fig.3) is limited by small planet disks (3-25") and atmospheric seeing, whereas the human eye cancels this effect and detects line or curve structures promptly. Therefore *Canali structures* could be seen by experienced observers even if its single elements are much smaller than the eye's resolution e.g. at a 10 inch telescope.

Nowadays digital image processing overcomes the drawbacks of photography [Gerstbach 2000]. Overlays of e.g. 500 CCD- or WebCam images give better resolution than visual observers under the same conditions. Nevertheless some *information is lost* as long as no software modules for line or pattern recognition are integrated.

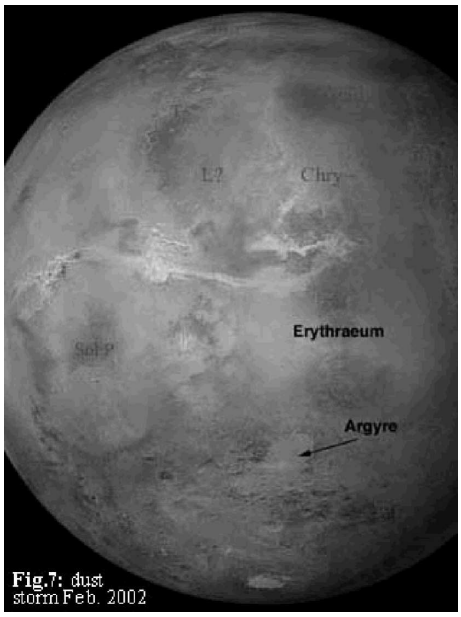


Figure 7:

In 1877 Schiaparelli used a 21cm refractor with a resolution of 0.6" [Lena 1998]. Under a magnification of 2-300 he was able to "scan" the planets surface to ca. 0.4", supported by line structures of shadow and albedo effects (Fig.6a). Most parts can be correlated to elevation pattern of Orbiter data – despite their very different data source.

One of Mars' mysteries is the changing of colours and dis/re-appearing of structures – which was earlier interpreted as vegetation. Figure 7 [Moc 2003] shows a global dust storm cycle which "continued unabated in the Chryse Trough, where storms lofted dust from Acidalia to Valles Marineris; on Feb.20 it spilled out of Eos Chasma into Northern Erythraeum (above left) where it persisted for several days, stimulating dust activity as far south as Argyre Basin." This dust activity changes the contrast (compared e.g. with Fig. 4) remarkably → Many additional structures can be observed as "Canali" and interpretated morpho- or geologically.

4. RECENT & ANCIENT "RIVERS", TERRACES AND SHADOWS – VISIBLE AS LINE STRUCTURES

Some Orbiter images can give an impression that also faint structures may be visible from Earth by a skilled observer – if they are almost straight lined or sun is low.

Blinking the eyes one can see 2-3 'lines': 1) vertical (left of the centre), 2) inclined (near the bottom); 3) evt. right, following the 'gullies lines'. (1) is a terrace-shadow effect and depends on sun altitude, (2,3) is mixed with 'alignement'.

Many Mars rivers are at least 10 times broader than the gullies above. Two giant valleys 10-40 km broad (∼700km long, **Fig.9b**) seem to be identical with 1-2 Canali.

Quite interesting: the straight line between the 3 huge volcanoes is *neither* seen in Schiaparellis structure maps 1877-79 *nor* in Nizza 1886-90. *Valles Marineris* (Graben system 700 × 4500 km; Moore 1990] can be seen at all maps – as a group of 4-5 almost parallel lines.

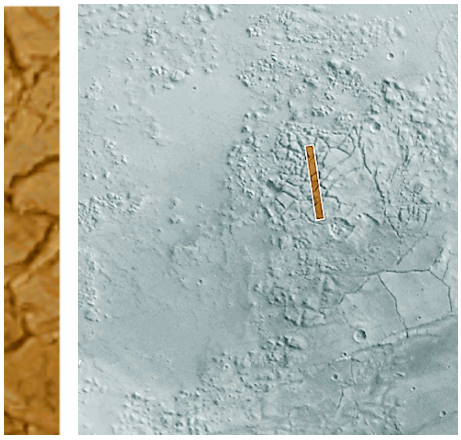


Figure 8: "Evidence for Recent Liquid Water on Mars: Gullies in Gorgonum Chaos" (-37° / -170°) formed by ground water...

seeping from a specific layer (aquifer) near the tops of trough walls, espec. on southern slopes. Long view 3x23 km. Sunlight from upper left. MOC picture of Jan 22, 2000, north is up.

B/w. image by Viking 1 orbiter in 1977, illuminated from upper right.

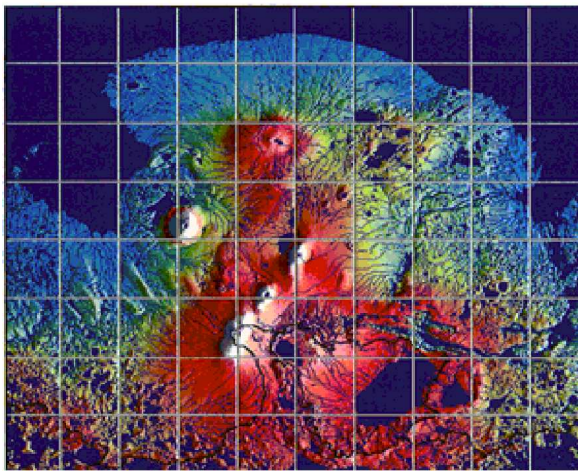


Figure 9a: The MOLA Laser altimeter model near 4 gr.volcanoes demonstrates 2 other "Canali types": the steep 'artificial coast line' left of Olympus Mons, and an almost north-south structure near the right edge.

Figure 9b:

Figure 10:

Different from Fig.8-9, *straight small valleys* are existing, too – detectable by HST with special software. The Mars Global Survey image (**Fig.10,** orbiter camera; NASA 2002) shows flat-topped mesas in Nilosyrtis, separated by valleys or troughs of similar depth and width. The valleys probably formed by faulting; origin of the mantling material is unknown (Image area ~20 km; May 2001, sunlight from upper left).

5. GEOPHYSICAL–GEOLOGICAL IMPLICATIONS

Recent studies of Global surveyor and other data [Tanaka et al 2003] revealed new insights into geologic processes of northern hemisphere. Four successive stages of lowland resurfacing in topographic levels of 2 km to -5 km has formed patterns which are visible from Earth at special sunlight or dust storms. Fig.11, interpreted by geologists, contains 3-4 "coast lines" and terraces (mapped by Schiaparelli and successors) not yet mentioned above.

Another recent implication of old "canali" observations is research on seasonal development of cloud systems and sun-glint phenomena at Mars' surface. Since 2001 astronomers of the Japan OAA Mars Section refer to observations ~1910 [Minami 2003] to study long period behaviour of atmosphere and storm sediments.

Fig.12 shows visual cloud observations of A.Dollfus 1956 in direct neighbourhood of stable "Canali" patterns.

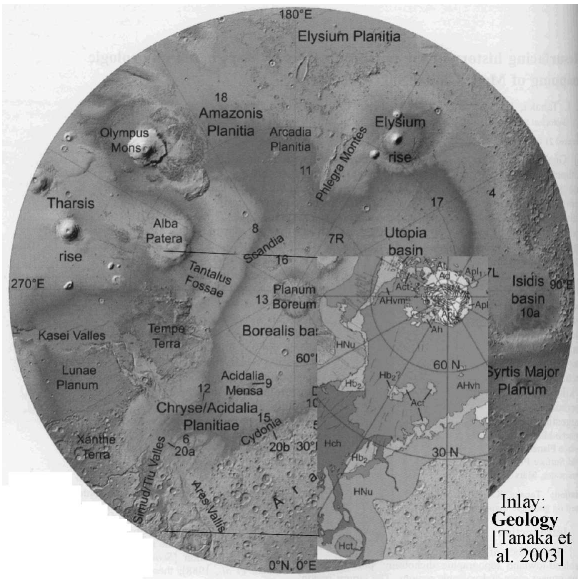


Figure 11: Topographic shaded relief + geology, nothern Mars hemisphere.

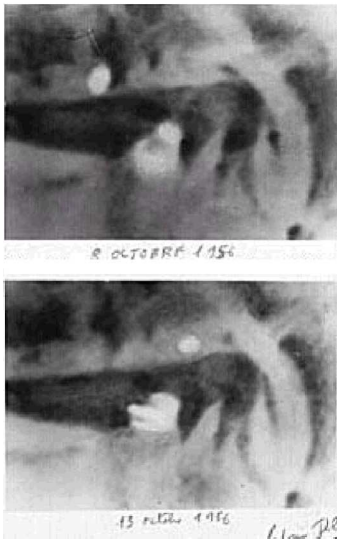


Figure 12: Persistent clouds Edom 1956 Oct. 8/13. (c) A. Dollfus, Meudon.

6. CONCLUSION

As discussed above – and as shown in my Lecture and the Symposiums *Poster Session*, – in my opinion 60% of "Mars Channels" are not an optical fiction. In the next future I'll publish these facts – together with a detailed map – in my Home Page and in an astronomical or geoscientific Journal.

Thanks to many of you for interesting talks with me – a geodesist who started his "astro career" as a hobby, but works in Astrometry for a long time – convinced that astro- and geoscientific disciplines can stimulate mutually, as it was usual in the centuries of Bessel or Struve – and now again in Space research.

I am convinced also that "linear structures" should play a better role in Planetography and planetary Image-processing software – even if Schiaparelli's *Canali* do not "really" exist.

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