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iMAGE PROCESSING

CAPTURE MANAGEMENT & ANALYSIS

INTELLIGENT FACES ON MARS?

Satellite images reveal mysterious formations

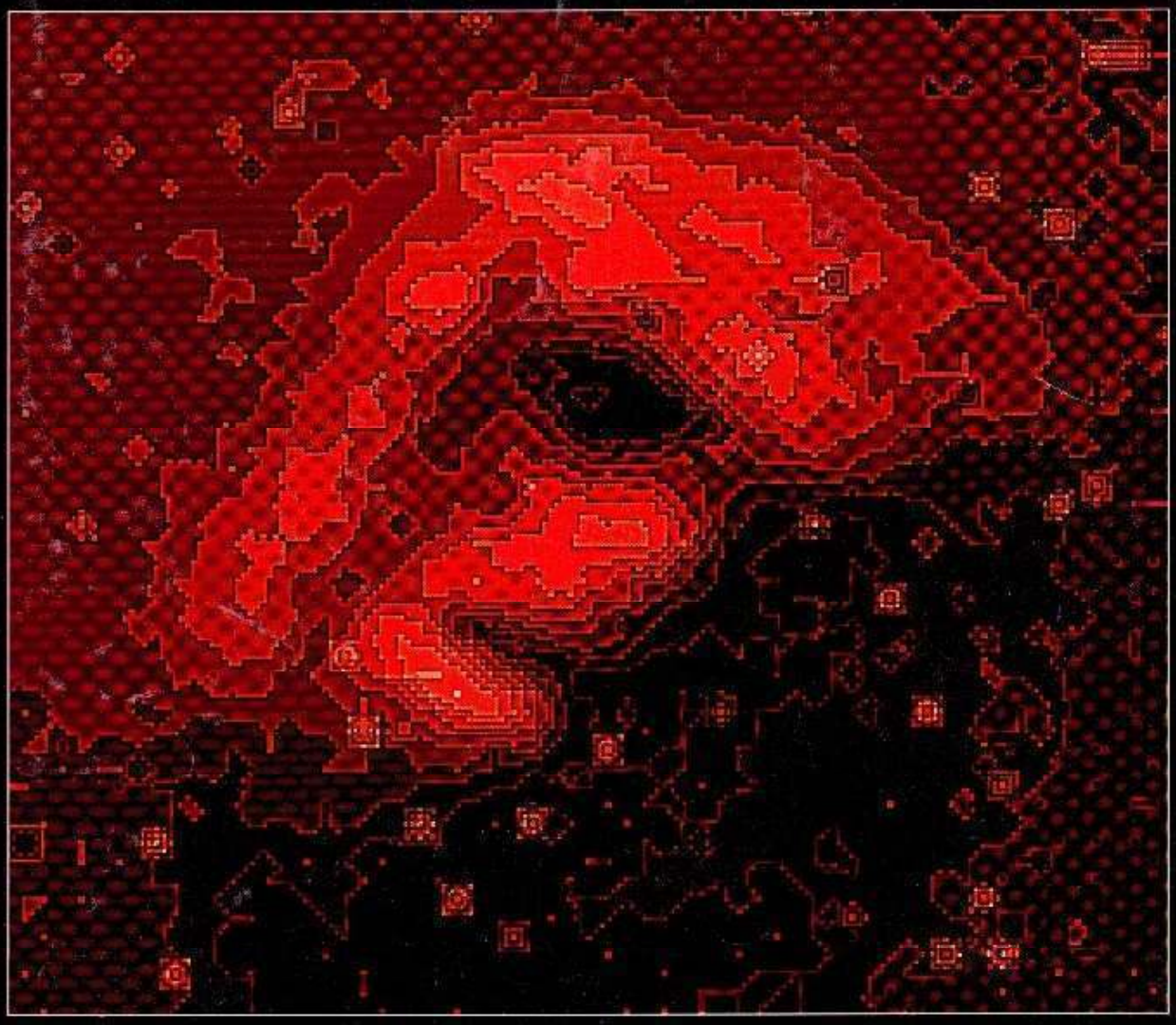

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iMAGE PROCESSING VOLUME 4 ISSUE 3

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The 'Primary Face' from frame 35A72 taken of Mars 10

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Exploring the past and future

What are the origins of the Martian landscape features which created the eerie and haunting images of our cover story - Intelligent Faces On Mars? (Page 10)

Ananda Sirisena, author of the feature, has used image processing techniques to examine the original photographic images taken by the Viking 1 spaceprobe. In doing so he has discovered a further face-like feature in addition to the main face and unexplained geometric landscape features discovered by US scientists.

It is hoped that the mystery will be solved when the Mars Observer mission, due to launch in September this year, gets in range to take a closer look at the enigmatic Cydonia area of Mars.

Image processing will be critical in interpreting the pictures the Mars Observer sends back to earth. The technology has a key role to play in the exploration of space and in discovering whether we do in fact share our universe with other intelligent life forms.

Meanwhile, image processing is also being used to help understand our past, as our feature A New Image For Archaeology describes on page 24.

As Paul Reilly makes clear, pursuing knowledge by picturing information on the computer screen leads to a natural overlap between image processing and the graphical techniques of data visualisation.

We are likely to see a continuing merger of these technologies which, as Paul Reilly also points out, leads inevitably to a consideration of virtual reality and the potential it holds for turning images into 3D worlds which we can 'climb inside' to explore their meaning.

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REED BUSINESS PUBLISHING GROUP

Report on emerging visual technologies

The emerging technologies of multimedia, data visualisation and virtual reality can be applied to solve business and industry problems now, acording to a new report.

The report, Multimedia and Beyond: The Business Applications, describes how these new technologies are already available for PCs and networks and are being applied in manufacturing, finance, sales and marketing, scientific research and many other applications.

The report, which is written by Image Processing's consultant editor Clive Davidson, describes the technologies and how they can be applied with substantial detail on the main suppliers and products. It provides a useful resource guide for any organisation wanting to investigate and implement the technologies.

The report, published by Computer Weekly Publications, is in three sections. Part I - Multimedia costs £145, Part II - Data Visualisation costs £125 and Part III - Virtual Reality also costs £125. All three parts are available together for £325.

For further information call John Riley on 081-652 3099.

Flexible framegrabber

Data Translation has launched a new series of flexible image processors which combine independent grab, display and overlay framestores with the powerful TMS43020 processor in a single monitor system.

The DT3851 Series overcomes the disadvantages of single-buffer image processors that have to scale incoming images before placing them into memory thus discarding potentially valuable data, says the company. The multiple buffer architecture of the frame grabbers allows a full-resolution image to be aquired in the grab buffer and a suitably scaled version to be placed wherever desired in the display buffer without affecting the grabbed image. Display resolution is programmable up to 1024 X 768 non-interlaced.

Data Translation has also released a modular open software architecture for Windows software development. The DT-Open layers libraries for Microsoft Windows allows users to integrate products from multiple vendors for data aquisition and image processing applications.

DT3851 prices start at £2995. DT-Open Layers is free to developers. For further information call Data Translation on 0734 793838.

Imaging user group

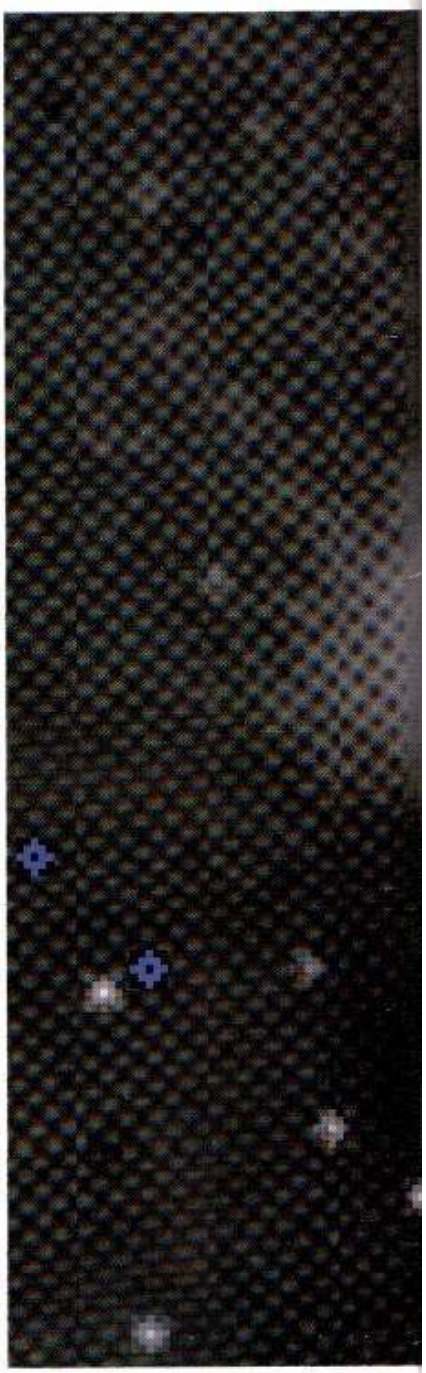
A user group has been set up to bring together organisations and individuals using and developing imaging technologies within business and government.

The Cranfield Imaging User Group has been established by the Cranfield Institute of Technology and was due to hold its first working session at the end of July. Its focus is on document imaging and its implementation in companies and public bodies.

The group offers independent advice and support and a series of seminars and a research programme is planned. Issues to be addressed include copyright and security, admissibility of electronic data, EDI and images as well as geographical information systems and engineering applications of imaging.

For further information contact Mrs Maureen Mahoney on 0234 752797.

INTELLIGENT FACES ON MARS?



WHEN SCIENTISTS STUDIED PHOTOGRAPHS THAT THE VIKING I SPACECRAFT SENT BACK FROM MARS THEY NOTICED A LANDSCAPE FEATURE THAT LOOKED REMARKABLY LIKE A HUMAN FACE. ANANDA SIRISENA APPLIED IMAGE PROCESSING TECHNIQUES TO THE PHOTOGRAPHS AND DISCOVERED A SECOND FACE-LIKE SHAPE. THEIR ORIGINS ARE A MYSTERY

The Harper & Row Mars Flight Atlas has a curious sentence in it:

'Just after Viking I arrived in orbit, an Italian writer claimed that it had discovered an ancient city but that the pictures had been censored. How he came by this information in Milan has never been explained.....'

The Viking I spacecraft to Mars was inserted into orbit of the red planet on 19 June 1976, after a journey of 304 terrestrial days, almost 10 months from launch date of 20 August 1975.

One of its first tasks was a reconnaisance mission to photograph the surface of the area chosen for its lander to descend. The close-up pictures showed the area, Chryse Planitia, to be much rockier than had first been thought. After a three-week search, a much safer site in the western part of the plains of Chryse was found. There appeared little danger there of the lander toppling over because of one of its triad of feet coming to rest on a rocky boulder. Thus it was that the historic soft-landing on Mars by the first Viking lander took place at 22.5 degrees North, 48 degrees West on 20 July 1976. (Many Americans were disappointed that it did not land on the 4th of July.)

Meanwhile, still in a highly elliptical path around Mars, the Viking I orbiter continued to photograph the surface in preparation for the Viking II orbiter-cum-lander which was rapidly approaching the planet. It was during this phase of photography that NASA (National Aeronautics and Space Administration) personnel discovered a striking feature in the region known as Cydonia.

There, amidst the rugged terrain was a rock which looked like a human face, serenely staring up into space.

The Viking II orbiter with its own lander package arrived at Mars on 7 August 1976. Cydonia, which had initially been selected for Viking II to land was also judged unsafe and nearly a month later, the second lander settled down without mishap hundreds of miles away. But Cydonia

Left-
Primary Face in Cydonia enhanced by Starburst Pixel Interleaving Technique. Low-sun angle excerpt from Frame 35A72, contrast stretched, brightness adjusted. Note that each black and white pixel caused by transmission bit-loss shows as a starburst (picture copyright Vincent Dipietro, Mars Research)

Below-
From Frame 35A72. Primary "face' in Cydonia enhanced with an edge filter and added colour

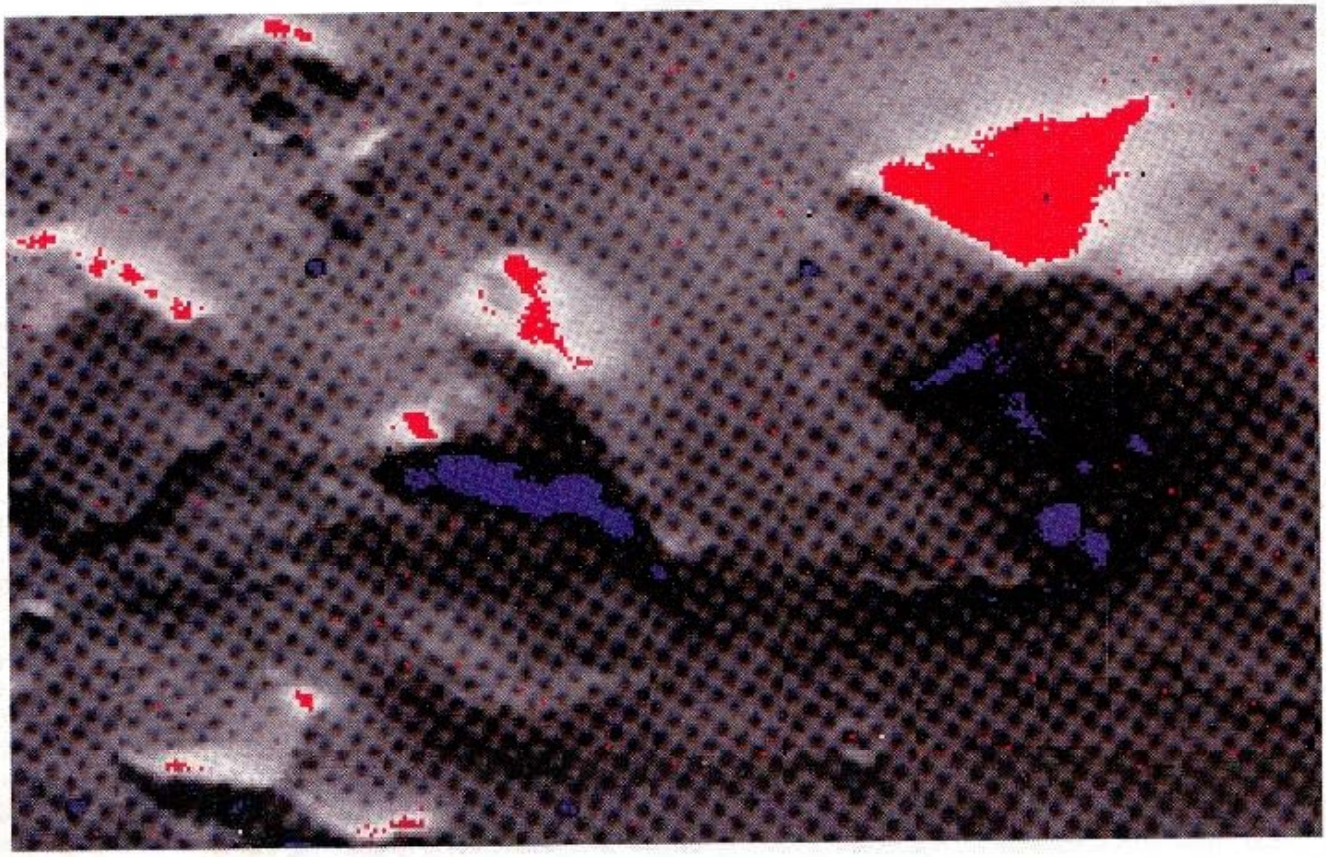
was to remain in the limelight. For it was in Cydonia, not far from the 'Primary Facial Feature', that other unusual landforms were discovered on the same photographic Frame, 35A72.

Shortly after the discovery of the mile-and-a-half facial feature, a Viking project scientist showed the image from Frame 35A72 to the press assembled for daily briefings at the Jet Propulsion Laboratory (JPL), stating:

"Isn't it peculiar what tricks of lighting and shadow can do....? When we took a picture a few hours later it all went away; it was just a trick, just the way the light fell on it."

The scientist had not considered one simple fact - Frame 35A72 which was shown to the press corps - was taken near dusk on Mars, at about 6.00 pm local time for Cydonia, while the Sun was about 10 degrees above the horizon. A few hours later, Cydonia would have been in total darkness, so his claim that it all went away was true in one sense but very misleading. Mars has a period of rotation of 24 hours 37 minutes, therefore its diurnal cycle is very similar to that of Earth. Cydonia would not have been in sunlight again for at least ten hours.

Some years later, an engineer working at NASA's Goddard Space Flight Centre by the name of Vincent DiPietro found that NASA had archived Frame 35A72 with the caption: HEAD. The designation for Frame 35A72 indicated that it had been taken on the 35th orbit of the A camera (i.e. Viking I's camera) and



The 'D & M Pyramid' from a high-sun angle frame. Red shows sparkle area due to brightness beyond program's acceptable display. Blue shows very black pixels, near to zero on scale.

that it was the 72nd image in the series. DiPietro also discovered that Cydonia had not been rephotographed for another thirty-five days.

By doing a further search, DiPietro came across another image of the face on Frame 70A13, taken by the same camera over a month later. On this frame, the afternoon sun was at a much higher angle, 27 degrees above the horizon. Thus the light falling across this rock was at a different slope but the facial feature had not gone away. Quite the contrary, Frame 70A13 showed much more detail on the side of the face that was previously in the shadow. It began to look as though the feature was a large-scale representation of a partly bisymmetrical, humanoid-type face.

Intrigued by this unexpected confirmation, DiPietro paired up with a colleague named Greg Molenaar and decided to apply image enhancement techniques to the raw images which they were able to obtain from the tape copies. In a pioneering effort, they developed their own technique of pixel interleaving called Starburst and were amazed with the results. When they added colour to their enhancements, they began to see an eyeball in the eye cavity and finer detail which convinced them that they were looking at a real rock.

DiPietro and Molenaar also discovered an immense structure, less than a dozen miles from the face, which can only be described as a gigantic pyramid, with sides at least 1 mile by 1.6 miles. This structure is now referred to as the D&M pyramid by researchers involved in an ongoing analysis of these peculiar and unexpected shapes.

If the Primary Face had been the only non-natural looking feature in this area in the northern hemisphere of Mars, it could easily have been swept under the rug as nothing more than an oddity of nature. However, the proximity of the other 'shapes' to the 'face' presents a more persuasive case for extended research.

Astronomer and former astronaut, Dr. Brian O'Leary has said:

'It might be argued that intelligent intervention should not create a humanoid face on Mars, as this

The author
Ananda Sirisena is technical instructor at Unisys Europe Training Centre

TECHNICAL NOTES

The Viking pictures were taken by two identical cameras mounted on a scan platform on each orbiter, such that they could be rotated about two axes. in order to target specific areas of Mars. Each slow-scan camera comprised a telescope, a vidicon light-sensitive faceplate a filter wheel and shutter assembly plus the control electronics. Each camera on each platform could take a picture every 8.96 seconds, thus one orbiter with two cameras could cover a designated area in a two-frame-wide sweep with exposures every 4.48 seconds.

The resulting scene. digitized by the modulation of an electron beam scanning the faceplate consisted of a frame 1182 samples by 1056 lines in size. The total of 1.2 million pixels constituting each frame was recorded onboard the spacecraft for later transmission to Earth. Upon receipt each image underwent a typical batch processing routine at the Jet Propulsion Laboratory prior to press release or academic study. Published photographs were either shading corrected or filtered depending upon requirements. What appears to be dark shadows in many pictures is an artifact of the batch processing and true sun shadows are normally only identifiable in the unprocessed raw data.

The raw digital data can be manipulated in many ways. For example, missing pixels can be

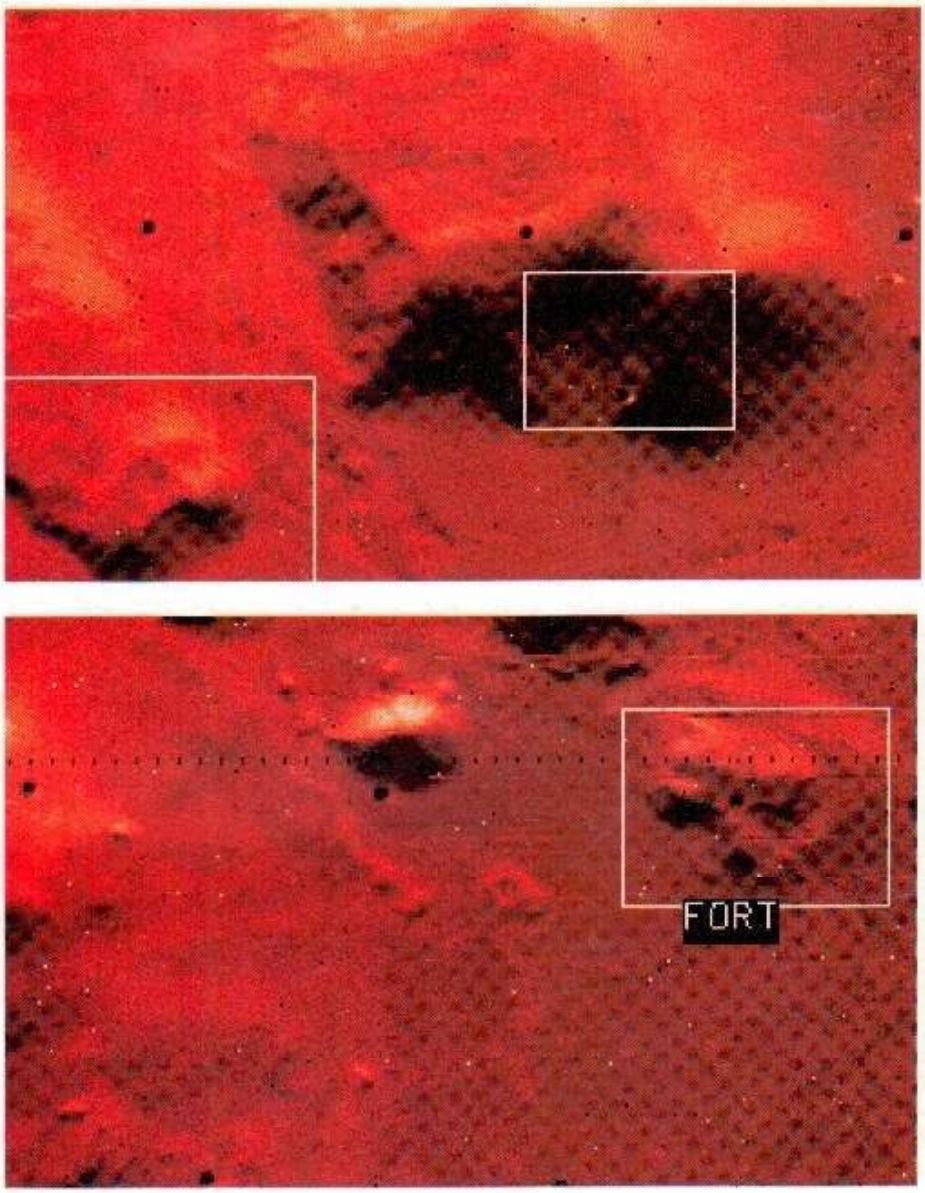
would violate our operating paradigms in SETI (Search for Extraterrestrial Intelligence). Such a view is overly narrow as all reasonable inquiries into possible manifestations of extraterrestrial intelligence are worth pursuing.....'

Dr. Brian O'Leary has advocated the re-imaging of Cydonia at high resolution by the Mars Observer mission, due to be launched in September 1992. Meanwhile, the existing imagery from the Viking orbiters lends itself to enhancement and detailed study.

It would appear that the D&M pyramid is a five-sided structure - there seem to be five buttresses - that has suffered extensive damage by the collapse of two walls. Authors such as popular science writer Richard Hoagland have postulated that the D&M pyramid may be a 'rosetta stone', containing in its internal angles, the key to a mathematical message encoded in the layout of the entire complex at Cydonia.

The D&M pyramid seen from above is uncannily reminiscent of Leonardo Da Vinci's drawing of a man in a squared circle. In such a configuration, its right hand points towards a collection of pyramidal objects that have come to be known as 'The City' and its left hand towards a tholus or mound which bears a resemblance to Europe's largest man-made mound, Silbury Hill in England.

The surprising morphologies found on the Viking Frames 35A72, 70A13 and 70A11 are evidence of either extremely unusual natural erosional forces at work on Mars, or the result of alien landscaping on a scale perceivable from a distance of 1000km from the surface. The dis-



Above-
Second face from frame 70AII indentified by the author
Below-
From frame 70AII: 'Fort' showing transmission losses but with brightness increased

replaced in a "cleaning" operation. The black or white pixels resulting from bit-loss during transmission can be substituted by an average of the adjacent pixels. Differing algorithms can be used depending on the technique applied. The cubic convolution method uses pixels in four directions. The subject pixel is discarded in favour of an average obtained by summing two pixels in each of the four directions of the compass.

Telemetry noise was removed by a despike programme that compared the grey value assigned to each pixel with adjacent pixels. If the difference was above a specified value then the pixel was replaced with the average of all the adjacent pixels. Corrections for geometric (squareness) distortion could also be made for any frame if necessary. Distortions in the amount of light transferred through the camera to the imaging plate (called radiometric distortion) could also be compensated for by using calibration files.

Contrast stretching is done in order to fill the full range of the 256 grey values assigned to pixels. From a histogram of an image it is possible to assign new upper and lower limits to the grey-scale, thus 'shifting' the entire content. A frame that contains a high contrast scene will have a wider range af grey values between 0 and 255 than will a scene with very low contrast but both can be stretched.

Various filters can be applied to any image. Edge filters will delineate sharp edges in a scene. Smoothing filters will apply a mean or median filter to the image. A Laplace transform applied to the image will sharpen the image as though it has been refocused.

Optimum illumination for studying topography of a planetary surface is with the Sun between 10 to 25 degrees above the horizon. Both frames shown here -35A72 and 70A11- are choice candidates for such analysis. Frame 35A72 is an evening shot taken from a distance of 1873 km with the Sun 10.07 degrees above the Martian horizon. Frame 70A11 is only slightly outside the criterion. It is an afternoon picture with the sun 28.07 degrees above the horizon but taken from a range of 1721 km from the surface.

covery of the secondary facial feature and the five-sided star formation on Frame 70A11 by this author, adds weight to the proposed intelligent action scenario, recently published.

It is hoped that data from the Mars Observer will shed further light on the enigmas of Cydonia. Its high resolution camera may well show much finer detail, opening up a new and exciting phase in the science of remote sensing as applied to planetary images.

The author wishes to acknowledge the cooperation of Dr. James L. Green, Acting Director at the WORLD DATA CENTRE-A based at NASA's Goddard Space Flight Centre in Maryland, and Vincent DiPietro of Mars Research

For further information contact Ananda Sirisena on

FURTHER READING

RACE TO MARS - THE HARPER & ROW MARS FLIGHT ATLAS
by Frank Miles and Nicholas Booth. Harper & Row. 1988

THE CYDONIAN HYPOTHESIS
by John Brandenburg, Vincent DiPietro and Gregory Molenaar. Journal of Scientific Exploration, Vol. 5, No.1. Stanford University. 1991

THE MONUMENTS OF MARS
by Richard C. Hoagland. North Atlantic Press. 1987

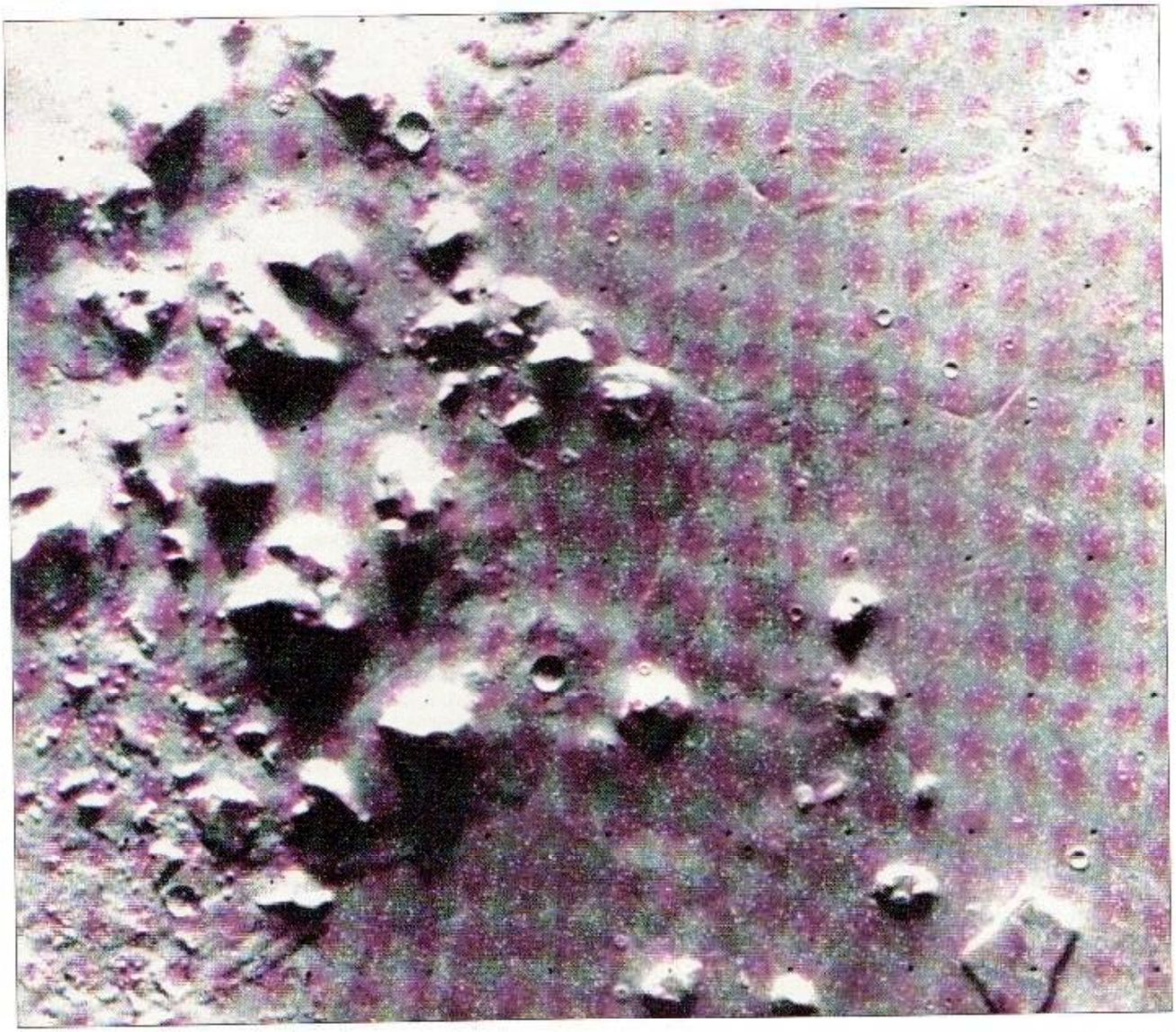
UNUSUAL MARS SURFACE FEATURES
by Vincent DiPietro, Greg Molenaar and Dr. John Brandenburg. Mars Research. 1980. Obtainable from Mars Research, P.O. Box 284, Glenn Dale, Maryland 20769, U.S.A.

THE MARTIAN ENIGMAS - A CLOSER LOOK
by Dr. Mark J. Carlotto. North Atlantic Press. 1991

ANALYSIS OF IMAGES OF THE FACE ON MARS AND POSSIBLE INTELLIGENT ORIGIN
by Dr. Brian O'Leary. Journal of the British Interplanetary Society: Volume 43, pp 203-208. 1990

THE NASA CYDONIA BRIEFINGS: COMMUNICATION OF AN ADVANCED SCIENCE FROM ANOTHER CIVILIZATION?
by Richard C. Hoagland. The Mars Mission, P.O. Box 123, Danville, CA 94526-0123,USA.

THE FACE ON MARS - EVIDENCE FOR A LOST CIVILISATION?
by Dr. Randolfo Pozos. Chicago Review Press.



Full frame 35A72. Area is approximately 34x51 miles (picture courtesy of NASA)