Development of a Local Toponym System at the Mars Desert Research Station

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Abstract

Place-naming processes for the features on other planetary bodies are controlled by the International Astronomical Union's (IAU) Working Group on Planetary Nomenclature. This article examines the development of the nomenclature of the surroundings of the Mars Society's Mars Desert Research Station (MDRS), located in Utah, USA, a simulation facility for future Mars stations. The development of this nomenclature system is also representative of the system of local place names in terrestrial remote research and military stations and may foreshow how names will be "born" in a future permanent Mars or Lunar Base.

Résumé

Le groupe de travail sur la nomenclature planétaire de l'Union internationale astronomique contrôle le processus de nom-de-place extra-terrestre. Cet article examine le développement de la nomenclature des environs de la station de simulation du désert martien (MDRS) de la Mars Society en Utah aux États-Unis. Le développement de ce système de nomenclature est typique de ce qui se déroule habituellement pour des bases de recherches ou militaires isolées et peut être considéré indicatif de ce qui pourrait se dérouler dans le cas d'une base lunaire ou martienne.

> And out of the ground the Lord God formed every beast of the field, and every fowl of the air; and brought them unto Adam to see what he would call them: and whatsoever Adam called every living creature, that was the name thereof.
> (Genesis 2:19)

The current planetary nomenclature system has three different, independent sources.

First, planetary surface features may be *officially named by committees* of planetary scientists (task groups of the IAU's Working Group on Planetary Nomenclature). Some of these names are recommended by the scientists who first undertake detailed research on the area (often members of a current or recent mission), with the help of people familiar with mythology, but names can be suggested by anyone. If the members of the task group agree that a name is appropriate, it can be retained for use when there is a request from a member of the scientific community that a specific feature be named. This is a well-controlled process (USGS 2006) – unlike the case of terrestrial names, which are generally "naturally born in the field."

Proper names are chosen from a well-defined group of names (a "theme"). Sometimes this theme is related to the real nature of the feature type: volcano gods (active eruptive centres on Io), Celtic stone circles (large ringed

features on Europa); sometimes, to the name of the planetary body (e.g., female first names for craters on Venus) or the discovery of the planetary body (deceased scientists who have contributed to the study of Mars for large craters on Mars). Others are not related; for example, smaller villages of the world are used to name small craters on Mars. These names are used for features that are most frequently discussed by current scientific papers, and therefore need to be named.

Descriptor terms are selected from a group of Latin words – used as *termini technici* – that are related to the appearance of the feature (i.e., not necessarily its geologic origin).

Second, toponyms, or place names, at both human and spacecraft landing sites are also given by astronauts and planetary scientists *working on the area* – in cases of human missions, mostly prior to landing, to enable faster and better communication and identification of features at landing sites. This latter group of names is less strictly controlled than official IAU names: these features are named freely, using the imagination of scientists, and the names may later be approved by the IAU (as the Apollo Landing Site names were). Some pre-selected commemorative proper names also appear in this group (e.g., places named in honour of astronauts who died in the *Columbia* explosion). Rocks and hills near landing sites on Mars are named so that they can be referenced easily in papers and discussions. Official (approved) names are listed in the *Gazetteer of Planetary Nomenclature* (USGS 2006).

A third grouping consists of the informal names not used on maps but used in popular literature. Some of these names are given by planetary scientists. They may refer to features that are already officially named or to newly discovered features that have no official name yet (e.g., "Tiger Stripes" on Enceladus). Some scientists vigorously oppose the use of these categories of names, while others use them in popular scientific texts. There are several unofficial names, especially for Mars, that are mainly used by people involved in "new age" culture (e.g., "Face on Mars").

Naming Analogs

An analog for naming unknown landscape features is the process that took place during the early voyages of discovery around the world. An example is James Cook's journal of 1768–1771, which preserves the ways he named features – using free association, for their shape, in honour of persons related to the feature or the captain, and so on:

> This Island I named New Island because it is not laid down in any Chart. [. . .] It [was found] to be an Island of about 2 Leagues in Circuit and of an Oval form, with a Lagoon in the Middle, for which I named it Lagoon Island. [. . .] The border of land and Reef surrounding this lake like a wall appeared to be of a Bow-like figure, for which reason I named it Bow Island. [. . .]I have named [the bay] Poverty Bay, because it afforded us no one thing we wanted. [. . .] At Noon the South-West point of Poverty Bay, which I have named Young Nicks head (after the Boy who first saw this land) [. . .] I have named [a point] Cape Pallisser in Honour of my worthy friend Capt. Pallisser. (Cook 1968)

Other analogs for this type of informal naming – apart from Lunar and Martian landing sites – are polar (Antarctic) bases and stations.

Early Lunar maps used nomenclature systems developed independently by the individual planetary cartographer-astronomers: Langrenus (1645) used names of contemporary rulers, saints' names, and his own name, as well as symbolic names for the terra regions; Johannes Hevelius (1647) used European geographic names placed relative to each other as on Earth; Riccioli (in Grimaldi's map) (1651) used personal names of ancient and recent thinkers and scientists, giving the "politically correct" basis for today's Lunar nomenclature. Martian albedo features (i.e., bright and dark spots) were named on early maps for explorers (Secchi 1859) and astronomers (Proctor 1873) or given mythological and biblical names (Schiaparelli 1877). These parallel systems have been standardized by IAU in several steps during the twentieth century (Hargitai 2006).

Place Names at MDRS

The Mars Society's Mars Desert Research Station (MDRS) is located in the US state of Utah, in a mainly vegetation-free biancane-type badlands area (Figure 1). Groups of scientists and people interested in a future Mars expedition carry out Mars-analog "simulations." These crews of four to six individuals live and work as if in a Martian environment; crews change every two weeks. The central element of MDRS is the habitat, or "Hab." MDRS crewmembers cannot leave the Hab unless wearing space suits (also simulated). The crewmembers perform geological, biological, and psychological research while maintaining the operation of the habitat and the connected greenhouse.

During its first four years of operation, more than 170 place names have been recorded. The first entries into the database were places where scientific observations had been made by the first crews. Most of the subsequent place names were assigned by MDRS Crews 5 and 37, of which one of the authors (Jan Osburg) was a member. Another author (Hugh Gregory) a member of MDRS Crew 35, added navigation waypoints from Salt Lake City to MDRS, published in a detailed set of driving instructions now issued to all incoming MDRS crews by Mars Society HQ. On two subsequent privately

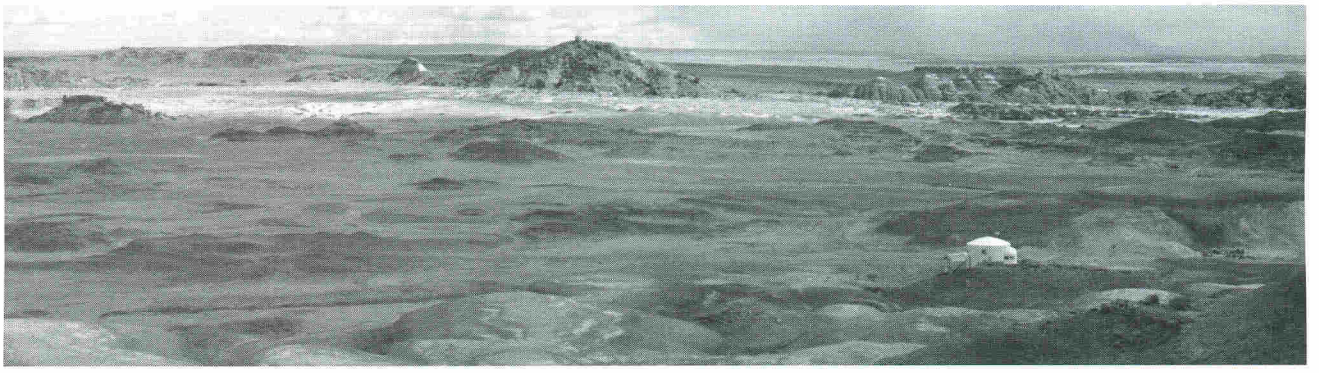

Figure 1. View of the Hab and its surroundings, looking east. The peak at the centre is Phobos Peak; the Hab is the white, circular building at the lower right. Photo: Henrik Hargitai.

funded MDRS crews in 2005 (FLAME and MAST), while making a 3,000-plus-image photographic record of the entire road network for a virtual-reality training simulator called Project MAST, Gregory recorded waypoints for all road junctions in the MDRS exploration area and waypoints for frequently used scenic viewpoints located along the main MDRS roads. These were added to the main database, as well as being published as a smaller MDRS Navigation Waypoints Only database. Members of MDRS crews can use this smaller database to load navigation data into their GPS units quickly, rather than having to dig though the much large main database to find the navigation information they need. Names given by Crew 42 were recorded by Henrik Hargitai.

These names can be considered originally as temporary or informal names for a particular crew's use. Changes in nomenclature may occur at MDRS because the high degree of erosion changes the landscape quickly; this is probably a minor factor on Mars or the Moon, where landscapes change in small orders of magnitude over millions of years.

This *ad hoc* naming process at MDRS may be analogous to place-naming practices at a future Martian or Lunar station. Its main rules follow "normal" terrestrial naming practices or the naming of features at Lunar landing sites and do not resemble the naming rules of IAU. Generics of place names are exclusively in English (even those given by a French crew) and employ a wide variety of descriptor terms, which are not used consistently in all cases and are sometimes interchangeable (e.g., Ridge/Hill/Range). Several feature names do not include any descriptor term. In real life, there seems to be a need for a rich vocabulary of geographic terms instead of one well-defined, scientifically correct terminological system. Alternatively, there may be a need to define a selected group of terms for "generic elements" that astronauts are allowed to use for naming features in the field. In the official IAU planetary nomenclature, 52 Latin descriptor terms are currently used. In the IAU system, the following have no descriptor elements: craters, eruptive centres, and albedo features (for a detailed description of the planetary nomenclature, see Hargitai 2006).

There are two major groups of place names at MDRS: road names and other names. Only road names have an officially assigned "theme": they are named for deceased astronomers (Brahe, Halley, Sagan, etc). All other names are given freely by crewmembers. The places named, in general, can be divided into three major classes: linear features (roads, valleys, canyons); area features (hills, ranges, canyons, areas, fields); and point-like features (rocks, intersections, points of special interest).

The Naming Process

Mapping in the field while wearing space suits and bulky gloves is difficult. To document names in the field, the members of Crew 42 used a permanent marker on a transparent plastic sheet that protected the map itself (Figure 2). While in the field, crewmembers discussed place names via the Extra-Vehicular Activity (EVA) radio system installed in the space suits.

Place naming can be improvised using pre-defined rules for both proper names and descriptor terms. Improvised names are given by resemblance, metaphor, events happening at the location, or unique features that can be found or have been seen there. Names improvised in the field may be changed by the time they are documented. During one of Crew 42's EVAs, one feature was named "Banded Dragon Hills" after a three-minute discussion via radio; but by the end of the EVA "Striped Dragon" was used instead. In another case a feature was named Dinosaur Footprint Canyon in the field but later became "T-Rex Canyon" on the map because the latter was easier to use. Pre-defined proper names used included names of crewmembers, their loved ones, persons participating in the mission or previous missions, and those who made the mission possible.

Figure 2. Recording names in the field. Photo: Henrik Hargitai.

All actual place naming by Crew 42 took place in the field, during EVAs. No names were given based on inspection of maps or photos at the Hab or prior to the mission.

In the case of MDRS Crew 42, during the first days of the mission crewmembers named features in the field and recorded their approximate coordinates. These features were named for their resemblance to animals, imaginary creatures, or objects (Turtle Hills, Baby Dragon, Fire Hydrant). In one case, features of a particular area were named after the nicknames, or "handles," that the crewmembers used for their radio conversations; in this way the crewmembers avoided naming features after themselves. Later, during one of the after-action discussions, crewmembers decided to name some features for their loved ones. They compiled a list, and, while in the field, they went along the list, picking one for each feature they passed by. These particular names are in the possessive case, strengthening the relationship between the person and the surface feature (e.g., Barbara's Hill).

There are a few locations where nearby place names are related: in "Area 42," all features are named for Crew 42 members' spouses and children (Figure 3); in another location, two hills named "Striped Dragon" and "Baby Dragon" are next to each other (Figure 4).

Some of these EVA radio discussions were recorded. These recordings provide, possibly for the first time, direct documentation of how names are "born." Here are two examples:

Example of naming from general discussion:

"A neat little plateau, huh?"

"It should be the name for it: Neat Little Plateau"

Example of conscious naming process:

"OK, what do we name it? There appears to be at least six prominent peaks and there are a bunch of others. Can you think anything with six?"

"Do we have anything named for Zubrin [Founder and president of the Mars Society]?"

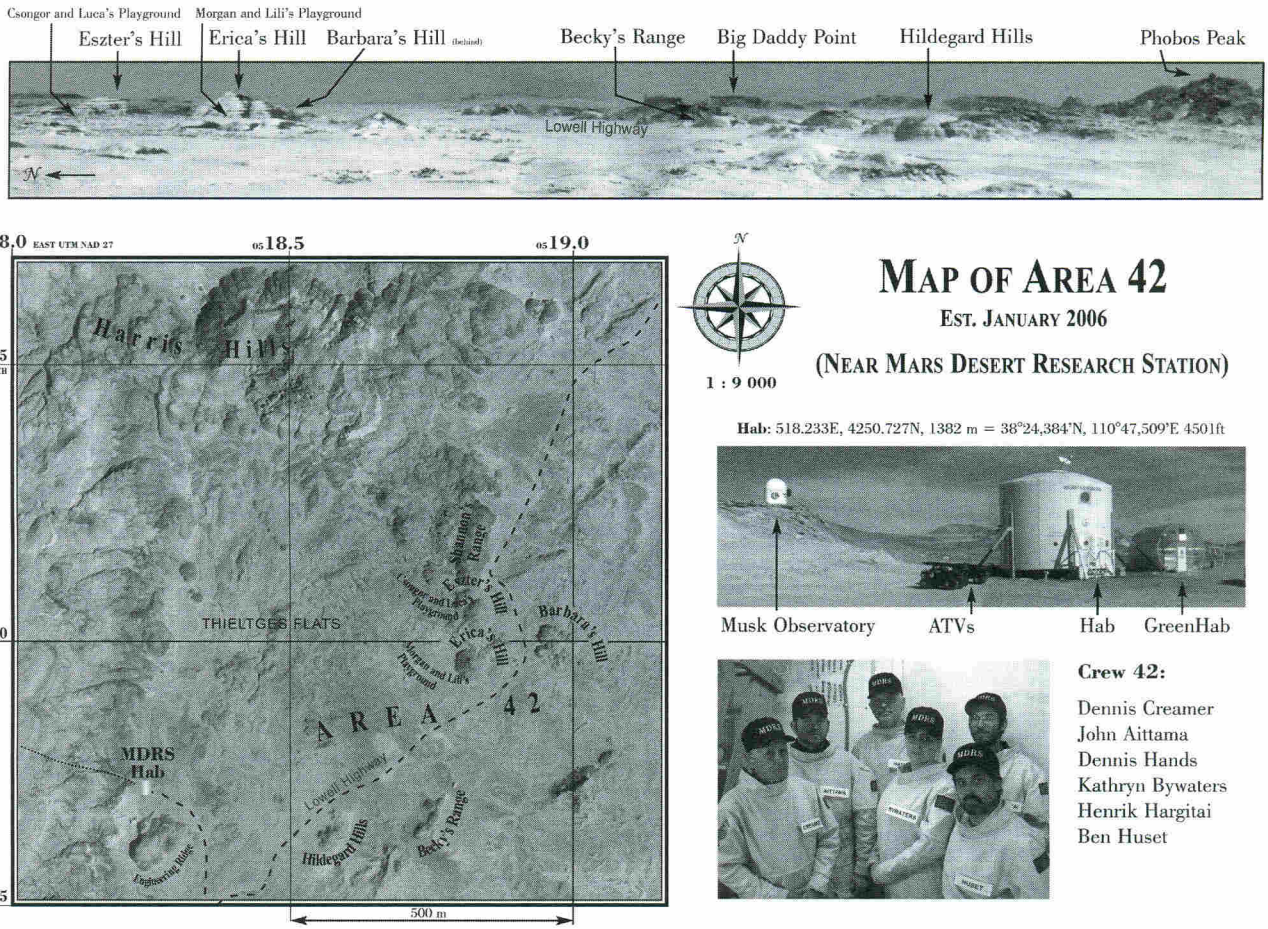

Figure 3. Map and overview of "Area 42"; photo of the Hab and the members of Crew 42. Map and photo: Henrik Hargitai.

"No" [in fact, there is already one rock formation called "Zubrin's Head."]

"That almost look like a . . . half-submerged hippopotamus or a turtle or something like a pile of turtle like half buried in water"

"Turtle Hills, what do you think?"

Two "off-season" crews, FLAME and MAST, used several four-character designators (acronyms or initials) instead of waypoint numbers when displaying maps on the GPS; these units could only handle four letters (e.g., BHLW for the junction of *B*rahe *H*wy and *Lo*W*e*ll Hwy). Such acronyms are also used for other terrestrial features, for example, WAIS for West Antarctic Ice Sheet.

History of the Nomenclature System at MDRS

The first place names and waypoints were recorded by Crew 1. Later, Crew 3 manually plotted waypoints on the paper copy of the USGS 1:24,000 topo map that was at the Hab at the time, noticing that the map and its grid were based on the NAD27 datum. Thereafter, crews were instructed to set their GPS to NAD27. Crew 4 switched the coordinate system from latitude/longitude to UTM, which Crew 5 and subsequent crews continued. One issue resulting from this iterative approach was the existence of multiple versions of maps and databases used and displayed at the Hab. This sometimes led to confusion.

A majority of the crews have not recorded their place names, if they actually assigned any. When Crew 42 arrived, several parallel versions of the waypoint database existed on the MDRS Web site and in other locations. Some places had multiple names originating from various crews recorded in various forms (Excel databases, actual maps, daily logs, etc.). Some place names had several spellings on the maps and textual resources. Photomaps were available that showed all road names but only a few other place names. The task of solving the problem of multiple names for a single place or given geographic area, and thus uncluttering the MDRS road map, was begun in January of 2006 by Hugh Gregory, aided by student volunteer Elizabeth Tang.

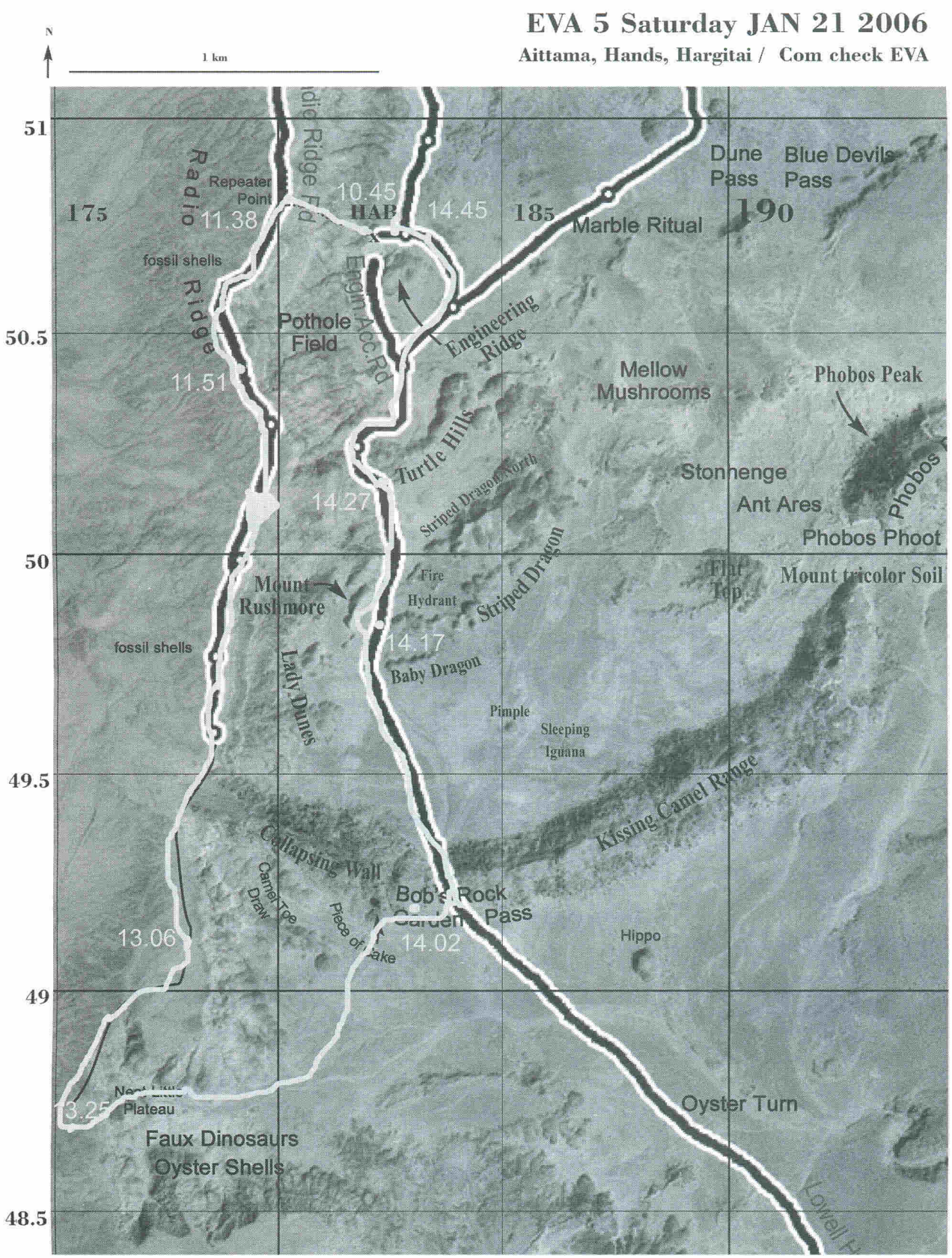

Figure 4. EVA photomap of the area south and east of the Hab, indicating the route of EVA 5 (grey line, with times). Black and white lines indicate roads. This map was actually used in the field during the EVA (the EVA route was added later, after the EVA). Created by Henrik Hargitai.

During this "clean-up" process, the oldest names had priority in cases of duplication. "Old" names also had to be documented, since older logs and papers used these. These data were then retired to an archive.

Documenting Names

Place names at MDRS are currently recorded in the latest version of the Waypoint Database spreadsheet mentioned above.

The format of the database for recording waypoints (which also serves as the nomenclature database) at MDRS contains the following information: Crew number, EVA number, four/six character designator, waypoint number (counting from 1 continuously), waypoint name (proper/descriptor), name origin (as comment), UTM Easting, UTM Northing, elevation (meters), date established, radio reception data, image filename, surrounding terrain type, surrounding terrain description, geological description, biological description, and remarks. In most cases coordinates refer to waypoints that can be located on the feature. In some cases, however, the feature named is visible from the waypoint but the coordinate and elevation given are not directly on the feature because of difficulties in getting there safely (e.g., steep terrain). Elevations of highest points of hills are mostly missing from the database, since most elevation data were gathered from GPS measurements during EVAs made near the elevated feature named. Thus, elevation data corresponding to a hill or range mostly refer to the waypoint elevations closest to the feature itself. Peak elevation could be retrieved from georeferenced DTMs and photomaps.

Data

PROPER NAMES

There were 170 named features in the 8 × 10 km MDRS area as of February 2006. The toponyms can be divided into the following categories and subcategories.

Commemorative names

These are mainly hills and intersections and are named after living *persons*, in the possessive case. The following categories were recorded: actual crewmembers (e.g., Heidi's Hill), crewmembers' spouses (e.g., Erica's Hill), crewmembers' girlfriends (e.g., Blecken's Boulder), crewmembers' children (e.g., Dimitri Corner), crewmembers' parents (e.g., Rolf's Ridge), members of previous crews (e.g., Shannon's Range), visitors (e.g., Hubert's Heaven), important people in realizing the project – mission support team members or founding members (e.g., Bob's Rock Garden), nicknames or handles of crewmembers (e.g., Big Daddy Point), TV/movie characters (e.g., Daisy and Duke), science fiction book characters (e.g., Barsoom Outcrops), important people in astronomy (e.g., Brahe Highway; this category is used only for roads). Only 5% of the above-mentioned categories used last (family) names (e.g., Colvin's Cove); 95% of the place names are first names (e.g., Clara's Canyon), indicating the informal character of the mapping process. Other categories of place names are pets (e.g., Fritz Field), spacecraft, rovers (e.g., Pathfinder Wash), trademarks (e.g., Mount Nutella), places in the surrounding area (e.g., Henry Street, named after Henry Mountain), existing planetary features or bodies (e.g., Phobos Peak), and artificial terrestrial features (e.g., Road 66).

Descriptive names

A large pool of names is connected to the *characteristics* of the named feature. These may use adjectives describing colour or shape, (e.g., White Rock Canyon); they may also describe the feature's resemblance to a non-living thing (e.g., Fire Hydrant), to animals or parts of animals (e.g., Turtle Hills, Camel Toe Draw, Toothy Ridge), to plants (e.g., Brussels Sprout), to imagined animals or beings (e.g., Striped Dragon, Scylla), or to human features (e.g., Wind Face); or may refer to art-like features (e.g., Marble Ritual). Several metaphorical names were also used (e.g., Mirrors, Widow's Peak, UFO Landing Site).

Names connected to the locality

Other names are *connected to the locality*: they describe what has been seen from that point once (e.g., Gecko Bay), what has happened there (e.g., Balloon Launch Pad), or what is there (e.g., Huge Fossil Field). A subgroup of this type is the "useful" names: warning names (e.g., Impassable Wash, Rope Rescue) or names indicating a waypoint, stop, or viewing point (e.g., Rest Stop, Habview). Some names are related to communication infrastructure (e.g., Repeater Point).

Many of these categories are also used by NASA geologists to name features of the Mars Exploration Rovers' environments. It is perhaps remarkable how many naming categories emerge from only 170 place names.

GENERIC ELEMENTS

Some generics have been taken from the official planetary nomenclature (Planitia, Chasma), but all the rest are in English. About one-quarter of the place names have no generic element; most of these are metaphorical names for small hills or fields (e.g., Baby Dragon). Generics recorded can be grouped to the following categories: *neutral terms* (Area, Point); *mesas* (Plateau, Butte); *vegetation related* (Meadow); *lookout points* (Lookout, View); *peaks* (Peak, Crest); *hills* (Hill, Hillock, Hills, Knolls, Mound, Mount, Mountain, Range, Ridge, Dunes); *roads* (Highway, Road, Route, Street, Trail); *points on roads* (Corner, Crossing, Exit, Gate, Junction, Stop, Turn, Turnaround, Turnoff,

End); *aerial features*, mostly rock debris fields; *metaphors* (Field, Garden, Park, Playground); *plains* (Highlands, Planitia, Flats); *resemblance to hydrographic features*, used as metaphors – these are false descriptors, as in Lunar nomenclature (Bay, Seas); *true hydrography* (River); *rock outcrop, mining, sampling* (Bed, Fall, Outcrop, Quarry); *steep slope* (Cliff, Flank, Wall); *boulders, rocks* (Boulder, Rock); *canyon, valley* (Canyon, Chasma, Gulch, Ravine, Valley, Wash); and *other* (Cave, Dam, Draw, Rim, Pass).

The Importance of Place Names in a Human Mission to Another Planetary Body

Several, sometimes surprising, conclusions can be drawn from personal observations made while participating in a crew that was busy naming surface features near the MDRS habitat during field trips (EVAs). Naming places during a human mission on the surface of an alien planetary body is more significant than can be inferred from theoretical research. The existence of place names is important for the astronaut's orientation. In the close vicinity of the habitat, even small features (a few metres in size) should have names; further away, larger features and uniquely shaped landmarks can help astronauts navigate. Because they can verbalize their environment, orientation is faster and safer: it is much easier and faster to refer to a place by name in radio communication than to read out its coordinates. Place names can be memorized and mentally organized much more easily than generic waypoint numbers. Verbalizing the space makes the otherwise harsh environment more familiar. Toponyms make for more immediate contact between the habitat surroundings and the researcher.

Place names enable easier description of the area; they are an important part of geological descriptions, daily reports, and so on. Personal observations show that named features appear more often in personal communication and science reports, even if they are of the same importance as, or even less than, other, unnamed features nearby.

Place names given by a particular crew are especially important for that crew. The most important places on the cognitive map of an astronaut (at MDRS, a simulated astronaut) are those that he or she has visited most often and those where something important has happened. As for names, most important places are those that have the name of another crewmember, a spouse, or a child. During the mission of Crew 42 at MDRS, crewmembers decided to name features for their spouses and children in an area close to and visible from the habitat. These hills became important for all crewmembers: they photographed them, including themselves in the pictures. For the author, it was a place for remembering family back home. In this way the lifeless hills gained a special, personal, cherished meaning. This could be an important part of any mission to an unknown, unexplored territory where crewmembers live in one specified place for a longer time. Neutral names, like those given by IAU commission, can never have such a personal impact. This means that place names for human exploration necessarily differ from those of automated spacecraft reconnaissance missions, for which, in most cases only the names of mythological characters or deceased persons are or can be used.

Coordinate Systems

MDRS Crew 42 used the UTM NAD 27 CONUS coordinate grid. For a mission that will have only one centre point (with, for example, a non-movable habitat), a polar coordinate grid might be better for orientation (with latitudes given in kilometres and longitudes in hours, north being 0 h), but for a "moving mission" in a pressurized rover-habitat, for example, it is not appropriate. However, people are more used to rectangular coordinate systems. The Moon and Mars have their coordinate systems of latitudes and longitudes (there are different topographic data surfaces, but all use a latitude/longitude system); they do not have any other coordinate system such as UTM. The coordinate system of Mars was changed in 2002 from planetographic with west longitude to planetocentric with east longitude (0deg–360deg) (Duxbury and others 2001).

Conclusions

A human or even automated lander's landing site on a planetary body cannot be imagined and explored without toponyms. Features on another planetary body where humans will live need to be named and displayed on maps. This helps orient the astronauts, gives a close link to surface features (especially if they are named after the astronauts' loved ones), and makes verbalization of the area easier in radio communication, reports, and scientific papers. Careful choice of place names is therefore an important aspect of any human mission to another planetary body.[1]

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Note

1. Updates to the nomenclature database at MDRS are available at http://engineering.marssociety.com/eng06.html

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