NASA/TM—2001-211300

"Real World" Connections Through Videoconferences

Joseph Kolecki
Glenn Research Center, Cleveland, Ohio

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November 2001

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Prepared for the
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Preface

During the week of July 23, 2001, a workshop called Japan 2001 Science, Creativity and the Young Mind took place at Bristol University in Bristol, England. Coordinated under the direction of Dr. Eric Albone, Clifton Scientific Trust, it brought together 60 British and Japanese students and provided them with a forum for learning and interacting. We at the NASA Glenn Research Center (GRC) in Cleveland, Ohio, had the good fortune to participate with six of those students and their team leaders in a Space Science Workshop. The Space Science Team was led by two Bristol University people from the Earth Sciences Department—Carsten Riedel and Stuart Stansfield—under the direction of Professor Steve Sparks, FRS. The Team was assisted by Lawrence Williams, Director of Studies, Holy Cross School, UK. Funding was provided by the Daiwa Anglo-Japanese Foundation, the Great Britain Sasakawa Foundation, and Japan 2001.

The following is a compilation of correspondence via e-mail that took place before, during, and immediately after the workshop. Corrections were made to overt spelling and grammar errors, but, otherwise, none of the text has been altered. A final report from the students on their findings is now in production and will be made available from the Clifton Scientific Trust website: www.clifton-scientific.org/j2001/indexN.htm.

Appendices have been added to provide:

- a sense of the overall context, including a list of students, schools, and supporters (Appendix A)
- the document sent to the Space Science Team in advance (Appendix B)
- impressions of the Space Science Team Workshop from Carsten Riedel (Appendix C)
- the plan for the information and communications technology (ICT) aspects of the Workshop, which were developed following our first successful videoconference with the Holy Cross School, UK, last summer (Appendix D).

Joseph C. Kolecki
Ruth Petersen
NASA/GRC/LTP
July 2001

The NASA/GRC/LTP TEAM (small picture-in-picture). Standing, left to right: Sam Deans and Andy Campbell, Center of Science and Industry, Toledo, Ohio; special guests, Robert Skupinski, Microgravity Science Division; Ruth Petersen, LTP; and Melissa Mongalier, IDAC; sitting, left to right: Dale Morris and Joe Kolecki (presenter), LTP.

Group photo from final presentation.

The SPACE SCIENCE (UK) TEAM (large picture). Back row, left to right: Kako Iwaki, Carsten Riedel, and Stu Stansfield. Front row, left to right: waving hand of Lee Parsons, Adriano Silva, Akiro Nakamura, Rania Kashi, Ryo Nakamura, and Toshiyuki Itai.

"Real World" Connections Through Videoconferences

The Learning Technologies Project (LTP) is a partner in NASA's educational technology program unit, an electronic community center that fosters interaction, collaboration, and sharing among educators, learners, and scientists. The John H. Glenn Research Center's LTP distance learning program, called NASA Virtual Visits, uses technology—videoconferencing and the Internet—and interactions with experts to motivate science students by providing "real world" experiences. Students gather resources from the Web, communicate with team members and experts through e-mail, and are introduced to the thought processes of experts in the research community through videoconferencing connections. Students admit that knowing that experts might see their work is a great motivator!

Glenn LTP is supported in this effort by the staff of the Integrated Design and Analysis Center (IDAC), a facility developed by the Systems and Analysis Branch to support collaborative engineering between NASA, industry, and academia. A special thanks is extended to the External Programs Directorate for providing a Mars backdrop for the Japan 2001 event.

1. COMMUNICATIONS PRIOR TO THE WORKSHOP

i.

[The following is a message with an attachment that contains two suggestions for team activities for the Japan 2001 Workshop. Eric Albone requested the suggestions at the conclusion of his visit to Cleveland, Ohio, on April 12, 2001. He then shared the suggestions with his colleagues at Bristol University for a decision on their inclusion in the Workshop. The first suggestion was the basis of the Space Science Team activity. RP]

From: Ruth A Petersen <Ruth.A.Petersen@grc.nasa.gov>
To: Eric Albone <albone@dial.pipex.com>
Subject: Proposals for Martian Volcanoes and Martian Dust Charging Projects
Date: 18 April 2001 16:06

Dear Eric,

Thank you for taking the time to visit us in Cleveland on April 12 to discuss the specifics of the Clifton Scientific Trust and Japan 2001. We agree with you that it was good to meet face-to-face and feel that we had a very worthwhile meeting.

Attached is a file that contains a rough draft of each of the projects we discussed. I believe they are in a format that can be quickly read and discussed. We look forward to your response. I trust that you had a safe, pleasant trip back to Washington and England. My family and I enjoyed a gorgeous Easter weekend in South Carolina!

Best regards,

Ruth

Attachment (written by Joe Kolecki and edited by Ruth Petersen):

Project 1-Draft 1
Martian Volcanoes

Objective: Draw conclusions on the structure, history, and origin of the Martian volcanoes in Tarsus by comparing NASA photographs of the Martian volcanoes with terrestrial volcanoes.

The group of six students may either break into teams of two or three people, each choosing specific aspects of Tarsus to study, or they may choose one topic and all six work as a team. Essential to the experience is:

- *Using NASA materials obtained via the www (e.g., Viking and MGS orbital photos, etc.);*
- *Engaging in group dialogue, including free discussion and brainstorming about ideas and possible theories;*
- *Collaborating with experts present at Bristol University and NASA;*
- *Drawing conclusions; and*
- *Making a final presentation.*

If opposing theories arise, the theories should each be developed and presented with supporting strengths and weaknesses. The students will thus get a taste of comparative planetology as practiced by NASA scientists in collaboration with professionals from different walks of life.

Project 2-Draft 1
Martian Dust Charging

Objective: *Using terrestrial analogs (e.g., thunderstorms), develop a research program for a future robotic flyer to Mars to study electrical phenomena in depth.*

There is evidence that:

- *Martian surface dust acquires an electrical charge by friction (e.g., compaction by an astronaut's boot or by a rover wheel) or by collision (as in a dust storm, wherein airborne dust grains collide with one another in atmospheric suspension).*
- *The dust acquires an electrical charge whose SIGN depends on particle size. ('Small' particles tend to charge positively; 'large' particles tend to charge negatively.)*

In order to answer the question regarding environmental electricity on Mars, scientists will study and discuss:

- *The kinds and varieties of electrical phenomena that might occur (with supporting arguments), and*
- *The means of detection of each (e.g., broadband radio to detect static noise from dust devils, etc.).*

Essential to the experience is:

- *Engaging in group dialogue, including free discussion and brainstorming about ideas and possible theories;*
- *Collaborating with experts present at Bristol University and NASA;*
- *Drawing conclusions; and*
- *Making a final presentation.*

If opposing theories arise, or alternative detection strategies are developed, they should each be presented with supporting strengths and weaknesses. The students will thus get a taste of comparative planetology and instrument design and selection as practiced by NASA scientists in collaboration with professionals from different walks of life.

ii. (a.)

At 09:02 AM 05/22/2001 +0100, you wrote:

Hello, Ruth and Joseph,

Eric told us about the exciting Japan 2001 project and showed us some of your suggestions on the Martian Volcanoes (Project 1) and Dust Charging (Project 2). Since I have no experience in that, I find the videoconferencing the most fascinating bit. But at the time of the project we will have support from someone who knows about those things. Coming back to the Project No.1:

a) Do you have suggestions about where it will be possible to find the Tarsus volcanoes in the large dataset? I once worked with the Viking Orbiter images and within the 3 and a half days it could come down to looking for pictures if we do not know where they are.

b) Since we are planning to compare them to earth's volcanoes, would it be possible to get the satellite pictures from similar volcanoes during these 3 and a half days of the project in July? Since I do not know the volcanoes we will be looking at, it will be very spontaneous to pick them out and usually it needs a lot of effort and money to get pictures.

c) Do you have a map of the Tarsus region that you could send to Bristol? Maybe you could also (suggest) some references for basic papers on the area? Otherwise it should be easy to find them in GeoRef.

Project No.2 sounds like an unsolved mystery and will more likely motivate the students I think. On the other hand it is also of a more complex scientific nature and we still have to think about its realization. Maybe some easy experiments could easily convey some basic ideas to the students...hm

On another, we will be trying to get a working video conferencing system.

Hope to hear from you,

Carsten Riedel
EU-RTN Volcano Hazard Mitigation
University of Bristol
Wills Memorial Building
Queen's Road
Bristol
England

ii. (b.)

Date: Wed, 23 May 2001 10:34:02
To: Carsten Riedel
From: Ruth.A.Petersen@grc.nasa.gov
Subject: Re: JAPAN 2001

Hi Carsten,

It was great to hear from you and to know that you are beginning to work on Project 1. Before I talk about that, we probably should talk about the videoconferencing technology. We should go ahead and decide on a ***day and time*** *to do our first session and our final session. If we work with you on both of these projects, we will need to schedule two hours each day instead of one hour. The time difference is 5 hours. In the past, we've scheduled videoconferences around 10 a.m. EDT, 3 p.m. UK time. If I understand correctly, the two dates you wish to hold videocons are July 23 and July 27. Is that correct?*

We need to schedule a test connection as soon as possible. Melissa Mongalier (Melissa.J.Mongalier@grc.nasa.gov) will schedule that for you. We need to know the rate at which you can connect and your video dialing number. We do ask that you call us to establish the video connection. Our video dialing number is 216-433-0075. The telephone number in the videocon room is 216-433-5438, and we furnish that just in case you have trouble connecting and need to call us.

Now on to Project 1 and your questions:
a) Here are suggested URLs for images of the Tarsus volcanoes on Mars. If these do not furnish what you need, let me know.

http://mars.jpl.nasa.gov/gallery/volcanoes/index.html

http://ltpwww.gsfc.nasa.gov/tharsis/global.map.html
http://ltpwww.gsfc.nasa.gov/tharsis/ngs.html
http://ltpwww.gsfc.nasa.gov/tharsis/S%26T.html
http://ltpwww.gsfc.nasa.gov/tharsis/map_lab.html
http://ltpwww.gsfc.nasa.gov/tharsis/volcano.html
http://mars.jpl.nasa.gov/mgs/sci/tes/tes-release.html
http://mars.jpl.nasa.gov/mgs/realtime/groundtrack.html
http://mars.jpl.nasa.gov/mgs/realtime/groundtrack.html
http://volcano.und.nodak.edu/vwdocs/planet_volcano/mars/Overview.html
http://antwrp.gsfc.nasa.gov/apod/ap980730.html

b) Here are URLs for Hawaiian volcanoes, which is what we would suggest you concentrate on. Will these work for you?

http://www.aqd.nps.gov/grd/parks/havo/index.htm
http://vulcan.wr.usgs.gov/Volcanoes/Hawaii/framework.html

c) I believe there is a map of the Tarsus region included in the URLs I sent. Another excellent site is: http://www.nationalgeographic.com/ngm/0102/feature2/index.html. Do you have a copy of the National Geographic Feb. 2001 issue? Joe says he has a copy of a paper comparing the Hawaiian volcanoes to Mars volcanoes and he will try to find that and get a copy to you.

One final note--we are working on having a 3D "show" of the volcanoes on Mars in an immersive cave environment and are hoping to be able to show it to you during our connection on the 23rd. We are investigating methods of making this work--red/blue 3D glasses or goggles. We can't guarantee we will have this ready by July 23, but we are hoping!

We look forward to hearing from you again soon.

Ruth

iii.

[The following is a correspondence with Carsten Riedel following a telephone conversation in which we exchanged a number of ideas on form and content of our session. JCK]

Date: Tue, 03 Jul 2001 21:19:02 –0400
To: Carsten Riedel
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: Volcanoes on Mars

Hi, again, Carsten,

An afterthought: I am more interested in the students thinking through issues that THEY see associated with the Tharsis volcanoes and FORMULATING THEIR OWN SETS OF QUESTIONS AND APPROACHES TO OBTAINING ANSWERS than I am in transferring information to them about why we think thus and so about the Tharsis features. Science--especially this type of science--works in a vast unknown, and the development of good questions is often the activity of paramount importance. Good questions usually contain the seeds of their own answers, or of the means of obtaining those answers.

For this activity, I consider answers as being strictly secondary. I consider the process of thinking things through and using available resources (*i.e., a good comparative knowledge of Earth*) *as the single most important activity for the three days that they will be with us. I am most interested in the process and approach that THEY develop to thinking through the fact that these enormous and striking features exist on a sister world that travels in tandem with us around the sun.*

Joe

iv. (a.)

Ruth,

Here is more material for Bristol. If you think it appropriate, please send it on ahead. Thanks!!!

Joe

iv. (b.)

Date: Mon, 16 Jul 2001 08:52:40 –0400
To: albone@dial.pipex.com, LAWRENCEHX@aol.com
From: Ruth A Petersen <Ruth.A.Petersen@grc.nasa.gov>
Subject: Fwd: Hellas Basin Impactor

Carsten, Eric, and Lawrence,

The text shown below contains suggested paths of research on the origin of the volcanoes on Mars. The text was written by Joe Kolecki, who asked me to pass the information on to you to be used with your Space Science Team during the Japan 2001 Workshop. Feel free to contact Joe if you have any questions. He may be reached at 216-433-2296. We are all looking forward to next week!

Ruth

[*The following is a set of remarks offered to help establish some initial ground for our week together. JCK*]

Science is the business of observing natural phenomena and developing questions which are then answered by further consultation with nature via experiments, and so on, and so on, and so on…. The road followed is fascinating and, apparently, without end.

The process of formulating a 'good' question is by no means trivial, as I will try to show in the paragraphs below. A good question is a question grounded in the best knowledge we have in any given area. The open questions of Philosophy are usually not admissible by this criterion.

I hope to demonstrate further by example. I am going to pursue a chain of thought that fascinates me. Along the way, I will draw on what I know and allow new questions to emerge. Embedded in this process are potential seeds for future missions to Mars…provided, of course, that my ideas hold up under the strict scrutiny of my peers.

OK. Here goes: I've always been fascinated by the idea that the Hellas Basin, the Tharsis volcanoes, and the Mariner's Valley are connected by a single impact event that occurred in Mars' distant past. Does this idea have any real merit?

Let's begin by considering the fact that Tharsis and Hellas are not exactly antipodal (*i.e., diametrically opposite*). *This relationship is interesting from the standpoint of earthquake wave propagation. Earthquakes, as you know, produce waves that propagate outward from a highly localized area called an epicenter. Some waves travel along the surface* (*P and S waves*), *dissipating their energy in various kinds of surface shakes and shimmies; others travel through earth's deep interior, eventually emerging on the other side of the planet. The various arrivals and re-arrivals of these waves due to reflections, etc., are responsible for the aftershocks we hear about so often in the news.*

Anyway, the interior waves are DIFFRACTED by the earth's complex semi-molten core. Diametrically opposite any given epicenter, therefore, there exists a "*shadow zone*" (*quiescent zone*) *throughout which no interior waves arrive.* (*On Earth, this zone is actually quite extensive*

in terms of geographical area covered.) *The occurrence and character of the shadow zone provide geologists with important information on the structure of Earth's deep interior.*

Hellas' and Tharsis' "*almost, but not quite, diametrically opposite*" *relationship becomes very suggestive here. Let us, therefore, ASSUME that a massive impactor struck Mars at the Hellas site* (*essentially providing an epicenter for an absolutely immense quake event*). *Let us also ASSUME a molten core on Mars at the time of this event. What might we expect to have ensued?*

MOLTEN CORE…

Well, Mars-quake waves would be almost a certainty. Let's ignore the surface waves for the moment and focus on the deep interior waves. These waves would have been diffracted in a manner completely analogous with interior waves on Earth. If these waves were, somehow, responsible for the Tharsis and Mariner's features, then core diffraction would account for geometry. [*The students should try to learn more about interior wave propagation at this point.*]

In order for these waves to have been responsible for Tharsis, et al., they would have to have carried enough energy from Hellas to Tharsis through Mars to produce the bulge, the volcanoes, and the Mariner's Valley.

[*Let's digress for a moment. For visualization: The Mariner's Valley is over 2,000 miles long and 3 miles deep at its greatest depth. It is very much like the split in the skin of a baseball that has been overstressed.* (*What would happen to a baseball that was hit sharply with a heavy object?*) *The crust of a terrestrial planet is very like the skin of a baseball, in scale, when compared to the overall bulk of the planet. Thus, the Mariner's Valley may be viewed as a titanic rift or split in the Martian crust.*]

IMPACTOR…

OK. Let's think some more about energy. I have included a calculation that estimates the energy, mass, etc., of the Hellas impactor. Please note that the calculation shows that, in order to produce an impact feature the size of Hellas, the impactor would have to have had a mass one trillion times larger than the largest impactor known today on Earth. The energy would be correspondingly larger also! We will return to this point later….

BACK TO THE MOLTEN CORE…

First, though, let's return to the idea of a molten core. Although it is pretty well established that today Mars has a solid metallic core, our ideas on planetary formation lead us to believe that, almost certainly, Mars had a molten core at some point in its history. This notion will help us to establish a time frame for our hypothetical Hellas event.

Now, because Mars is 1/2 the [*linear*] *size of Earth, we might guess* (*just for the purposes of roughing out ideas*) *that it had 1/8 the initial interior heat of Earth and that it cooled at roughly twice the rate.*

> [*N.B.: This is a thumbnail-type calculation: 1/2 the size -> 1/4 the area and 1/8 the volume. Heat is stored in the volume and lost through the surface. ASSUMING equal initial thermal energy densities for Mars and Earth leads to the idea of 1/8 the initial thermal energy. And, since the surface-to-volume ratio of Mars is twice what it is for Earth, Mars would have cooled – initially, at least – at roughly twice the rate.*]

Mars would have grown cold much more quickly than Earth. This idea tallies nicely with conditions observed on Mars today. We observe that the planet is now in a protracted ice age. That Mars was warmer in its past, and possibly more earthlike, is evidenced by numerous arroyos and alluvial features seen from orbit. It is probable that Mars had a more extensive

atmosphere in its past than it does now and that much of this atmosphere was lost due to Mars' lower escape velocity (*Mars has 1/3 the surface gravity of Earth*). *This loss, combined with the other factors we have been discussing, would have lead to an overall cooling down of the planet during its early epochs.*

So…IF Hellas and Tharsis are connected, then these features MUST be very ancient; in fact, the forming event must have occurred during the earliest initial epochs of Mars' existence. Does THIS idea make sense?

Well, we know that Hellas' overall features are softened by erosion due to tenuous Martian winds, and that the entire region is pockmarked with more recent impact features. We also know that the Tharsis volcanoes have impact features, though not as many as Hellas (*as would be expected if these volcanoes were active for long periods of time*)…

And so on. The students might want to pursue these ideas further…

NOW, BACK TO THE IMPACTOR…

Returning to the enclosed calculation: The Hellas impactor is estimated to have been immense by any standard of comparison known today on Earth. Could such an impactor really have existed in the early solar system?

We know (*from the occurrence of craters throughout the solar system*) *that solid debris were ubiquitous and that, in fact, there WERE some pretty big objects moving in orbit about the sun during the late phases of the early solar system* (*when Mars was still warmer and more earth like*). *Additionally, Mars has, as one of its neighbors, the asteroid belt* (*which was also likely formed or forming during this early period*). *The asteroid belt is thought to consist of the remains of a terrestrial type planet broken apart by tidal stresses induced by Jupiter's gravitational field. So not only were large objects available, but if the pre-asteroidal planet* (*planetoid?*) *really had a structure similar to the inner planets, iron or iron-nickel fragments would* [*should*] *have been available from the core…*

ETC. …

And so on. Again, the students might want to pursue these ideas further, or develop new chains of thought of their own. They must remember that speculation must be bracketed as much as possible by our present (*though admittedly incomplete*) *knowledge of reality. We draw on what we know to try to push forward into new realms.*

Looking forward to a great week together!

Ciao!!!

Joe Kolecki

Attachment: The Hellas Basin Impactor

Density of impactors:

Irons: 7,500 – 8,000 kg/m^3

Stony-irons: 5,500 – 6,000 kg/m^3

Stones: 3,000 – 3,500 kg/m^3

Meteor energy to produce a crater of diameter d:

$E = 4 \times 10^{13}\ d^3$ erg $= 4 \times 10^6\ d^3$ j (d in meters)

Also: (Crater Mass Displaced)/(Mass Impactor) ~ 60,000

Nominal Density of Mars:

$\rho = 3.9$ ($H_2O = 1$)

Hellas Basin:

$d = 2{,}300$ km $= 2.3 \times 10^6$ m

Calculations:

1. *Energy of the impactor:*

$E = 4.9 \times 10^{25}$ j

2. *Mass of Impactor:*

Assume entry speed v = escape velocity from sun @ Mars orbit radius

$v = 4.1 \times 10^4$ m/s

Set E = K.E. and determine mass

4.9×10^{25} j $= \frac{1}{2}\ mv^2$

$\therefore\ m = 5.8 \times 10^{16}$ kg

[*Compare: Mass of greatest known impactor on Earth: 8×10^4 kg*]

3. *Mass* M *of ejecta:*

$M = 60{,}000 \times (5.8 \times 10^{16}\ \text{kg}) = 3.5 \times 10^{21}$ kg

3a.) *Speculate about crater depth* h*:*

Assume a cylindrical crater. Then:

Crater Volume $= \pi r^2 h = (3.5 \times 10^{21}\ \text{kg})/(3{,}900\ \text{kg/m}^3) = 9.0 \times 10^{17}\ \text{m}^3$

And, with $r = 1.2 \times 10^6$ m, we find that $h = 2.0 \times 10^5$ m or about 200 km.

[*Actually, this depth is close to 10% of the crater diameter, which matches measured results for terrestrial and lunar craters fairly nicely.*]

4. *Size of impactor:*

Assume spherical impactor and find its radius s

$5.8 \times 10^{16}\ \text{kg} = (4/3)\ \pi s^3\ (8{,}000\ \text{kg/m}^3)$

$\therefore\ s = 12$ km

Reference:

C. W. Allen, ***Astrophysical Quantities****, 2nd Edition, U. of London, 1963, pg. 139-140.*

J. R. Percy (*ed.*)*,* ***Observer's Handbook****, 1977, Royal Astronomical Society of Canada, pg. 6, 8.*

v.

From: LAWRENCEHX@AOL.com
Lawrence Williams
Director of Studies / Assistant Head Teacher
The Holy Cross School
65 Westbury Road
New Malden
Surrey
KT3 5AN
United Kingdom
Date: Mon, 16 Jul 2001 09:23:46 EDT
Subject: Looks interesting!
To: Joseph.C.Kolecki@grc.nasa.gov
CC: Ruth.A.Petersen@grc.nasa.gov

Dear Joe,

Ohio gozaimas, sensei!

(*Roughly = Hi, teacher!*)

Many thanks for the information, which we will pass on to the students. It all looks really fascinating.

My role in the week is to facilitate the links (*e-mail and video-conferencing*) *between Bristol and Cleveland, and support the kids in any way they need. I have been to Japan twice to lecture, so know a bit of Japanese – to speak, NOT to read. The Kanji are impenetrable!*

I have also been involved in a number of leading edge educational projects over the last few years, but I confess that this one has all the others well beaten! I am really excited about what we can all achieve through this creative week.

Many thanks for your careful preparation for the event, and willing involvement.

Looking forward to next week.

Best wishes,

Lawrence

vi.

Date: Mon, 16 Jul 2001 15:49:46 –0400
To: LAWRENCEHX@AOL.com
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: Re: Looks interesting!

Hi, Lawrence,

My only familiarity with Japanese is through a colleague here at GRC many years ago (*when we were still LeRC, in fact!*). *I used to admire his note taking – in Japanese – during meetings and lectures. Of course, the mathematics were all in familiar Roman and Greek characters!*

Thank you for your compliment. I consider it high praise to be called a teacher. The skills required and the responsibility invested in teachers is truly immense. (*That's why I went into physics, not teaching: I am, at heart, a bit of a coward…*)

I am looking forward to the upcoming week with you and the students. There is SO much to tell them, and SO little time! I hope to convey to them the tentative nature of modern science (*all science!*) *and to convince them of the importance of carefully investigating and developing good questions. I once read a commentary that a well formed question contained within itself the seeds*

of its own answer. Over my 32 years at NASA, I have come to embrace this idea as foundational in my work. After all, we build our spacecraft, wind tunnels, etc., all based on the logic invested in the questions we wish to answer!

Along the same lines: I spoke, a couple of years ago, with a group of exo-biologists who were developing life sciences experiments for Mars. I asked them what sorts of "things" they were looking for on Mars. They answered that they had not the slightest idea. "All we understand is terrestrial biology," one of them explained. "So, we are using terrestrial biology as our starting point. We do not necessarily expect to find terrestrial forms, but we hope to garner enough clues from this initial step to formulate more accurate second generation life-sciences experiments."

This experience is one of the most telling cases in point I have ever come across regarding the type of philosophy I hope to share with your students. If they learn some new ways of thinking about their world in the few days that we are together, then they will have achieved more than all the "right answers" in the world put together!

And, who knows…someone may just uncover a line of reasoning that is genuinely new. Then…just think of the possibilities!!!

Hope springs eternal!!

With best regards,

Joe Kolecki

vii.

Carsten Riedel
EU-RTN Volcano Hazard Mitigation
University of Bristol
Wills Memorial Building
Queen's Road
Bristol
England
At 11:38 AM 07/17/2001 +0100, you (Carsten Riedel) wrote:

Hello, Ruth and Joe,

I am quite fascinated by the ideas in "Hellas Impactor" mail. However, I would propose to launch the project by a more superficial approach, before we actually get to those points in the actual Wednesday session, which is the longest. My idea is still to start off by looking at the Tharsis volcanoes, slopes, flows and cones and get them starting to worry about what volcanoes these may be. And then we slowly work our way from surface to interior by thinking of the differences between Tharsis volcanoes and Hawaiian volcanoes, what restricts the size of the Hawaiian volcanoes?

The answers could be very diverse such as:

- ➔ *gravitational sliding--why could there be more gravitational sliding on Earth than on Mars?*
- ➔ *crustal thickness and so on…*
- ➔ *the composition of lavas*
- ➔ *Hawaiian volcanoes get more and more silicic, i.e. explosive, so what they built up is destroyed again. Could that happen on Mars as well? Why or why not?*
- ➔ *the effect of the moving plate, all is built on one spot, i.e., monogenetic volcanoes on Mars.*

That will get them thinking about the deeper origin of things. We are also going to show them how basic features on the photos – like flows or cinder cones – can be modeled in the lab very easily. So that they get an understanding of what static photos can actually tell about the dynamics of a process…

As far as I understand there is not much time before the first videoconferencing session, so until then they will get a basic introduction to volcanoes by Steve Sparks and we will try to inspire a discussion which will tell us how much they already know by showing them some of the Mars pictures and comparing them to Japanese volcanoes first and Hawaiian volcanoes afterwards…

So that is the plan. The first videoconferencing session is thus more or less an introduction of our group – i.e., Stuart and me – and you at NASA and the students to each other, I suppose…

So, many greetings from Bristol,

Carsten

viii.

To: Carsten Riedel
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: Re: Fwd: Hellas Basin Impactor

Hi, Carsten,

Your approach makes complete sense. I would add to it the building of scale models. For example, Mt. Olympus is, nominally, 180 km in base diameter and 10 km vertically from base to summit. This set of numbers, taken alone, could be compared with dimensions of the largest mountains on Earth. I enjoy using Mt. Everest, 3.3 km from base to summit.

Further: The calderas of Mt. Olympus have scale sizes of around 30-50 km or so. And the vertical escarpments around the base measure something like a 1.5+ km (variable with location). By simply drawing a cross section of the mountain, one gets an immediate impression of flatness (which is surprising at first glance!). A similar exercise could [should] be done with Hellas (2300 km diameter by nominally 200 km depth).

Going on, again: The nominal vertical extent of the Martian "lower" atmosphere is 0 – 45 km, and of the "middle" atmosphere, 45 km – 110 km (ref., Kieffer, et. al., "Mars," pg., 810, 811). Thus, the summit of Mt. Olympus is, essentially, in outer space. This fact should strongly influence how the students think about Mars. There is no direct analogy to such a system on Earth.

Finally, if a scale drawing of Mt. Olympus were turned upside down and placed into the scale drawing of Hellas (assume a cone-shaped basin here for simplicity), the immense Mt. Olympus would suddenly become a dwarf compared to the even more colossal H. Basin. One might ask how such a "small" planet could acquire such enormous features.

Anyway, these are all just suggestions. When we video conference, I hope not so much to lecture as to elicit questions. By doing so, I hope to attempt to address those concerns which are closest to the students hearts and minds without throwing a lot of extra confusing detail. I will rely on you and your colleagues to guide things along on that end, and to jump in at any point during my comments as you see fit.

Best Regards,

Joe

ix.

At 05:41 PM 07/19/2001 –0400, you (LAWRENCEHX@aol.com) wrote:

Dear Joe,

Here is a quotation by the patron of the Workshop:

"*The more we can build international links among young people, particularly in the field of science which is itself entirely international in its impact, the better it will be for the future of the human race and the world we inhabit.*"

(*Rt Hon the Lord Jenkin of Roding, Workshop Patron, welcoming the students to the Japan 2001 Workshop.*)

I thought this might strike a chord with you, bearing in mind your earlier comments. It also accords well with my own hopes for the use of the new technology tools. I have some papers up on the web under London University's MirandaNet project:

www.mirandanet.ac.uk.pubs/williams.htm

The one on "*Connecting schools*" *might be of interest.*

Looking forward to seeing you "*virtually*" *next week!*

Best wishes,

Lawrence

x.

To: LAWRENCEHX@aol.com
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: Re: A quotation

Dear Lawrence,

Thank you. Yes, I agree with the enclosed quotation.

I am currently reading Jules Verne's "*Master of the World,*" *which depicts a period in history when the lone scientist/inventor was a believable and viable entity. With the advent of 20th century science, this lone figure recedes, to be replaced by teams of specialists, each an expert in some part of a field or project whose full content is too large for any one individual to master. The launch of Apollo and the subsequent development of the Space Program bring into existence even larger groups. A successful launch requires the intricate cooperation of several hundred or more people, each with a specific set of tasks that must integrate with precision.*

The further exploration of our Earth, and the extension of that activity into the solar system (*and beyond*), *will be/become a global undertaking. We now know that the earth is not to be studied as a set of separate systems or subsystems operating semi-independently together. The earth is a single, tightly integrated system, a network, if you please, whose connecting links represent*

complex information pathways, and whose nodes represent individual states which are, themselves, complex sub-networks connected to the whole. The same must apply to the solar system as a whole, and to its individual planets, moons, etc., as well.

International cooperation brings into play resources – people and systems – whose whole is certainly greater than the sum of its parts. Such cooperation is the most viable path into the future, if it can be achieved and maintained peacefully and with a strong bond of mutual trust.

Joe

xi.

At 07:00 AM 07/21/2001 –0400, you (LAWRENCEHX@aol.com) wrote:

Dear Joe,

The team assembled here by Eric is an impressive one, and we at Holy Cross are both humbled and exhilarated by our involvement.

I think, perhaps, that you have actually missed your true vocation. Your e-mail suggests to me that you might have become a philosopher rather than (*or is that* "*as well as*") *a scientist….*

Best wishes,

Lawrence

xii.

To: LAWRENCEHX@aol.com
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>

Lawrence,

You are most kind. Thank you.

Joe

2. COMMUNICATION DURING THE WORKSHOP

- Day 1 -

i.

Handsome US scientist on TV

ii.

[The following was sent just after our first video connection. Some pauses were required to allow for translation of my remarks into Japanese and German. This posed no real problem, however. I think that the teams on both sides of the Atlantic were extremely impressed with one another. JCK]

At 11:45 AM 07/23/2001 -0400, LAWRENCEHX@aol.com wrote:

Dear Joe,

I have just "found" a computer, minutes after your inspirational final remarks. Many thanks for this. The group is sitting behind me as I am writing, working hard on many aspects of the project.

Carsten is a gem. We also have Stu, his friend, so the team is growing. As we mentioned, Professor Steve Sparks gave them a short introduction to terrestrial vulcanology, so that they all started at roughly the same point.

I shall e-mail you some of the JPEGS as soon as we get back to the Porter's Lodge, so that I can download the pics into my laptop.

Many thanks for your patience while we translated for the Japanese students. I was aware that this is not your usual format for a conference, but we are learning together.

More when I have caught my breath.

Warmest regards to you all,

Lawrence

iii.

Date: Mon, 23 Jul 2001 15:39:58 -0400
To: LAWRENCEHX@aol.com
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: Re: From the Physics Department at Bristol

Hi, Lawrence,

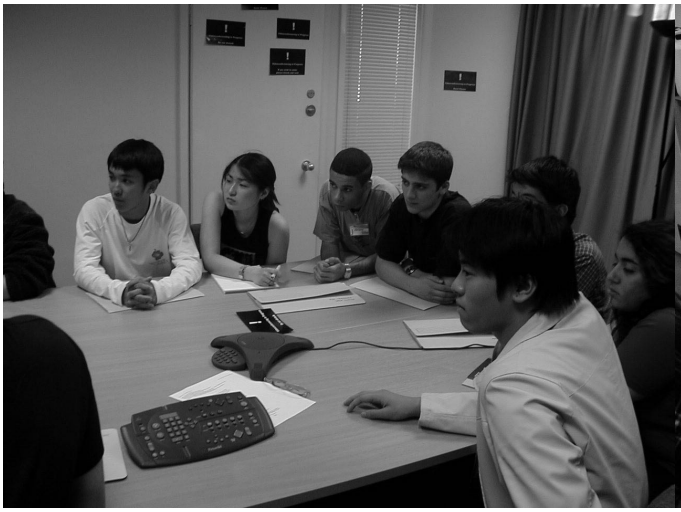
I am glad that this morning [*10:00 – 10:45 a.m. EDT, 3:00 – 3:45 p.m. Bristol time. JCK*] *worked out for everybody. I thought that the translations were very interesting--especially the ones from English to Japanese: I cannot imagine two more different languages!*

We were delighted to meet with all of you, and we look forward very much to seeing the students become involved with their questions and comments. You certainly have a great deal on your hands, but you/we are accomplishing something new and unique! Again, our best hopes and wishes go with you!! See you tomorrow.

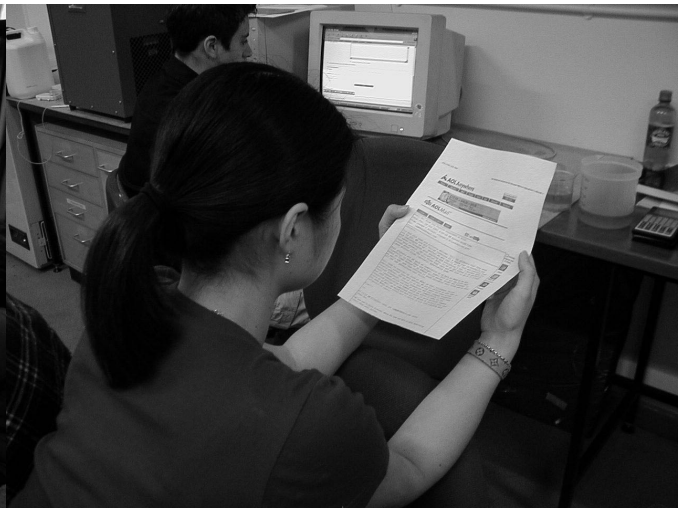
Joe

(*P.S. I am available for e-mails should the need arise.*)

Day 1: A SHORT PHOTO-STORY!!!



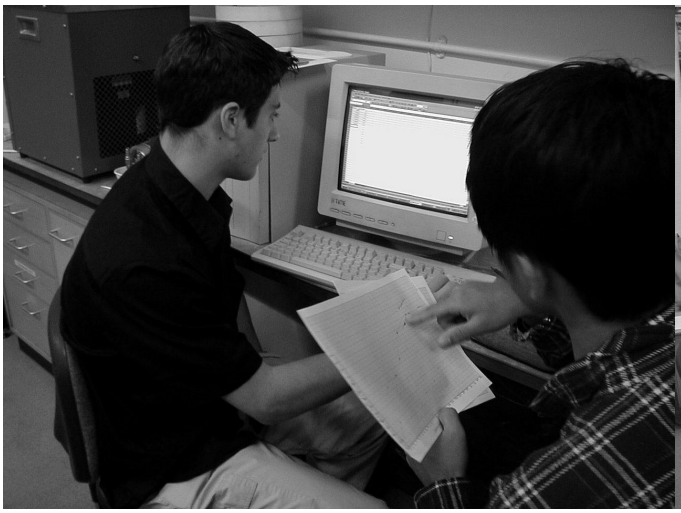
The Conference...



Translating Joe's E-Mail to Us!

Working on the material after the conference.

NASA Photos are VERY useful!!!



Working on Calculations!

Stu At Work!

- Day 2 -

i.

At 11:15 AM 07/24/2001 -0400, you (LAWRENCEHX@aol.com) wrote:

Dear Joe,

We are now in Earth Sciences, where the team members are back at work developing their ideas still further.

Thank you for your full and clear explanations. You are firing up the team's enthusiasm very effectively indeed.

We will try to tutor the Japanese students in English a bit, so that you can understand their questions, but they are SHY as well as new to English...Their research skills are good.

We plan to use the document camera more tomorrow to discuss actual Martian features, so that the students can develop different skills.

I am delighted with the way the project is developing. Thank you for your inspirational support and a kindness that we feel, even through the technology.

Lawrence

ii.

Date: Tue, 24 Jul 2001 18:56:59 -0400
To: LAWRENCEHX@aol.com
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: Re: From the Physics Department at Bristol

Lawrence,

You and your team are entirely welcome. Tell the students that they need not be shy. WE are all fellow travelers in a world that is eternally new and challenging to us - whether we are age 15 or 50. They are entirely free to agree or disagree with anything and everything I say. I neither have nor know many answers. (No scientist does, if he or she wishes to be perfectly honest about it!) The only thing that they are NOT free to do is to accept ideas without first [severely] questioning them.

Your students are as much an inspiration to us here at NASA as we are (hopefully) to them. They are bright, eager, full of all the stuff that makes an Isaac Newton or an Edmund Halley emerge, bright and luminous, at an early age, and then continue to shine throughout their lives and on into all the new generations that follow.

Tell them to consider us [here at NASA] as their colleagues, fellow explorers, rather than mere mentors. We are all tackling an area that is largely unknown. The fun of it is that we can share our ideas across national boundaries, cultural boundaries, and even language boundaries. Their language skills are FINE as they are. Communication is never easy, but GOOD communication is ALWAYS worth the effort it takes for the respective parties to understand each other. If world political leaders could do as well, we would not have all the messes we currently have, and the News Media would either have to retire, or else find something more optimistic to report!

Ciao!!!

Joe

iii. (a.)

Date: Tue, 24 Jul 2001 12:21:56 -0400
To: LAWRENCEHX@aol.com
From: Ruth A Petersen <Ruth.A.Petersen@grc.nasa.gov>
Subject: Fwd: Today's videocon
Cc: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Status: U

Carsten

Here are Joe's responses to the questions he wanted to investigate further. Hope this helps! See you tomorrow.
Ruth

iii. (b.)

[The following is a set of responses to questions asked by the students during our first video connection. The actual questions may be obtained from the videotapes. JCK]

Hi!

The question of Martian magma chemistries is still largely unanswered. So is the question of formation of such Provinces on Mars as Tharsis. I have before me a reference that argues a relatively young age for Tharsis. No numbers are given, and the idea is based upon the physical conditions in and around Tharsis.

Again, the students must examine ALL possibilities. The best way to test any theory is to try to tear it apart, not to try to prove it. If the theory withstands repeated attacks and counterarguments, then it is more likely to hold some truth. The impact theory is only one of many, connecting various features on Mars. Remember: We still do not know whether or how these features might really be connected. In their further thinking, the students should try to find as many counter-examples and alternative ideas as they are able.

As to the question regarding subduction zone formation: I do not believe that Tharsis is or was a subduction zone. The overall elevation of the region would seem to argue against this idea. But...making a comparison between Tharsis and known terrestrial subduction zone characteristics might prove to be very enlightening!

Now, here are some additional web sites that have good information--including animated sequences!

http://ltpwww.gsfc.nasa.gov/tharsis/mola.html
http://ltpwww.gsfc.nasa.gov/tharsis/volcano.html
http://cmex.arc.nasa.gov/MarsEssy/intro.htm
http://planetscapes.com/solar/eng/Marsvolc.htm
http://cass.jsc.nasa.gov/publications/MSR/Bogard/BogardAV.html

The last reference is a sample-return workshop held at NASA/JSC in 1996. It has a lot of compositional information derived from various sources, including meteorites that originated on Mars.

Best regards,

Joe Kolecki

iv.

From: Carsten Riedel
Date: Tue, 24 Jul 2001 17:14:10 +0100
To: Ruth A Petersen <Ruth.A.Petersen@grc.nasa.gov>
Subject: Projectiles and fax numbers...
Cc: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>, LAWRENCEHX@aol.com
Status: U

Hello, Ruth and Joe,

Good to hear that there is a positive echo from your side. I forgot about the calculation with the projectile, because I was not thinking the students were at it so fast. But since they are following two lines of research, the question came up in a brainstorming session and we will pursue this line later on. We have not yet looked at anything on Mars but Olympus Mons, and further features will only turn up from tomorrow on when they have a look at some more pictures. And probably we should assign names to the volcano types. Till now I tried to avoid geological terms and they rather know the outlook than the names of shield, strata, and other cones. But we'll get there. So, we are okay, and now the fax number:

+44 (0) 117 9253385

Hoping for more sessions like the one today and even better ones,

Carsten

v.

Date: Tue, 24 Jul 2001 19:13:09 -0400
To: LAWRENCEHX@aol.com
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: Re: From the Physics Department at Bristol

Hi, again, Lawrence,

I have an idea: Carsten wrote, earlier today, that the students have not yet learned geological terms to classify the volcanoes by type, etc. So.....Why not have them INVENT terms of their own--descriptive terms, terms based on their observations of structure, size, location, etc., and develop their own volcano taxonomy? (Just think of what the astronomers have done: "Terrestrial Planets," "Gas Giants," and so on. These young people ought to be able to do at least as well with the Martian volcanoes!!!) By making such an attempt, they will become more naturally open to both the possibilities AND the difficulties of taxonomy. Afterward, Carsten can show them how the geologists and volcanologists have actually solved the problem.

Just a thought....

Joe

- Day 3 -

i.

Date: Wed, 25 Jul 2001 09:28:31 -0400
To: LAWRENCEHX@aol.com
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Cc: Ruth A Petersen <Ruth.A.Petersen@grc.nasa.gov>

Hi, Lawrence,

Here are some more useful URL's.

http://www.solarviews.com/eng/tervolc.htm
http://www.star.le.ac.uk/edu/solar/tervolc.html
http://cass.jsc.nasa.gov/publications/slidesets/hawaii.html
http://Marswatch.tn.cornell.edu/rsm.html

Joe

ii.

Date: Wed, 25 Jul 2001 11:42:15 -0400
To: LAWRENCEHX@aol.com
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: One more URL...
Cc: Ruth A Petersen <Ruth.A.Petersen@grc.nasa.gov>

Hi, again!

Here is one more URL-- it features the book by Greeley and other resources.

http://volcano.und.nodak.edu/vwdocs/vwstore/books/c.html

Joe

iii.

[The following correspondence occurred after the students' first presentation to us. They took many of my comments to heart, and the response was absolutely outstanding! In fact, one of our videographers was amazed to learn that these young people were not college but high school students ranging in age from 15-16 years! JCK]

Date: Wed, 25 Jul 2001 11:04:25 -0400
To: LAWRENCEHX@aol.com
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: WOW!

Hello to all of you at Bristol,

Congratulations! We're all smiling from ear to ear on this side of the pond! I think that we've caught a glimpse of the future of space exploration this morning!!!

Joe

iv.

At 11:24 AM 07/25/2001 -0400, you (LAWRENCEHX@aol.com) wrote:

Dear Joe,

We are now working on a summary of what we have collectively gained ready for a final presentation to you tomorrow. We will add ideas from the URLs and books that you have kindly suggested.

I confirm that we will see you at 3.45 UK time, and that we plan to dial in at ISDN 6. The students say that they think you will look even more distinguished at this speed! But this is only a hypothesis and will need to be tested.....

Thank you for your very kind words of encouragement. I do not know if I have mentioned this, but all of the students have been chosen because they come from areas of social deprivation, where university education is not seen as a natural progression for them. Their families have no history of higher education, so we hope that this workshop, together with your warm encouragement and inspiration, will set them off on a journey that is entirely new to them.

So the workshop is particularly important socially as well as educationally. The confidence that the students are visibly gaining is worth all the effort in the world.

Thank you.

Lawrence

v.

Date: Wed, 25 Jul 2001 11:43:20 -0400
To: LAWRENCEHX@aol.com
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: Re: WOW!
Cc: Ruth A Petersen <Ruth.A.Petersen@grc.nasa.gov>

Thanks for the advance warning: I might just have to apply some makeup to hide the truth!!!!!!!!!

Joe

vi.

Date: Wed, 25 Jul 2001 11:49:32 -0400
To: LAWRENCEHX@aol.com
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: Re: WOW!

[The following was written after re-reading the previous message from Lawrence. JCK]

Lawrence,

I also started out with some very serious social and family disadvantages. My kind is usually assumed slated to make the skids or worse. But...I had a dream, and the dream was Mars. Please tell your students that, with perseverance and faith, they can climb above their respective situations--they can even touch the sky! It isn't easy, but it is certainly within the compass of human reach. Tell them that they are interacting with one whose life has become living proof of that statement!

Joe

vii.

[Lee was one of the students in our group. In the following letter, I have placed my remarks between paragraphs in Lee's letter. This is how I originally responded to him. My remarks are shown here indented and in a different font. JCK]

> Date: Wed, 25 Jul 2001 16:53:38 -0400
> To: LAWRENCEHX@aol.com
> From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
> Subject: Re: From Lee

Hello Joe,

This is Lee here. I have studied Mars along with the rest of the group, but have somewhat drifted away from the group's focus in my own spare time. I have spent a lot of time thinking about the theory that you suggested. Though I did agree with it in some way when I heard it, I felt that there had to be something wrong with it. So I began looking for faults. I decided to look for some evidence of plate tectonic activity, but could not find any, of recent date at least. What I did find was some evidence of some planetary movement much like that of the mid-Atlantic ridge here on Earth, but it looks dormant at the moment.

> Hi, Lee,
>
> The best use of a "Naive" theory (properly so-called) of the type that I suggested to you at the beginning of the week is as a seed crystal or catalyst for stimulating new ideas. Scientists advance them all the time in a process called brainstorming, then pan through their results to see whether they can find any gold nuggets. Sometimes the nuggets are there, and sometimes not. Einstein developed much of his thinking in this manner. He is reputed to have, "Toppled [his] house of cards," on more than one occasion. You are carrying your thinking forward in a similar manner. Bravo, Lee! You have the spirit of a true scientist!
>
> Plate tectonic activity on Mars was not known to have taken place until very recently. The Global Surveyor (currently in orbit around Mars) has revealed a wealth of new data in this regard. I like the fact that you are combining impacts, moving plates, hot spots, and so on. This kind of conjunctive thinking lies at the very heart of hypothesis building and leads to eventual experimental work. Ours is a world of connections. You are making valuable connections in your present thinking.

I have seen some magnetic patterns along the planet, and have concluded that they are aligned with the Marineras Valley. Thus I have concluded that this does in fact support your theory, and does not argue against it, as these movements would have occurred a long time ago. So the impact shock waves would have caused the formations as seen today, but not necessarily caused them by themselves.

> What kinds of patterns have you seen? Magnetic signatures do not always leave visible evidence, but, rather, evidence that must be gained through the magnetic field using a magnetometer, or related instrument. How does the magnetic signature support an impact theory? Your logic seems a little incomplete here.
>
> Also remember: There is a difference between "Supporting" a theory and "Not arguing against it." It is possible to have a situation in which an idea is NEITHER supported nor argued against. Logic, here, must cut through these matters with a keen edge--no stone left unturned, no statement left unqualified.

The theory that you believe in suggests that the shock waves travelled through Mars and caused the bulge upon the Tharsis Montes. However, I have noticed that the three volcanoes along Tharsis Montes are in line, just like those of the Hawaiian chain. I believe that these are in fact older than the bulge itself, and that Olympus Mons is younger than the impact crater. Following this, I have taken care in formulating a theoretical idea.

> Your observation of placement is excellent. Here, you grasp something that might seem so obvious as to not merit a second look. The fact that you DO give it a second look is much to your credit!
>
> Why are the three volcanoes necessarily "older?" I believe that you are arguing for independence between the three line volcanoes, the bulge, and O. Mons. Independence might imply differences in age, differences in processes of generation, and/or many other things. Be careful, here, not to overstate your case.
>
> Several investigators have suggested that O. Mons is a recent feature whereas Hellas is more ancient. Provided that you cite your references here, you are on solid ground.
>
> Additional comment: In formulating your theory, you may make conjectures about relative ages, if you feel that there is substance added. Just be sure to remember where the conjectures lie. Here, permit me a brief excursion into scientific logic: The more conjectures (X, Y and Z) you place in series (i.e., "If X, and if Y, and if Z, then W.") the more you reduce the probability that your conclusion (W) is correct. In logic, statements connected with "AND" have their probabilities multiplied. Since these probabilities are less than or equal to one, odds are that their product is very, VERY much less than one. Always bear this idea in mind when doing conjectural thinking. Quite often, verifying a conjecture becomes the essence of an experimental investigation!

I have noticed that Olympus Mons is not upon a bulge, but that the three volcanoes are. Also, there is a crack in the planet surface near the bulge. Before I explain my idea, I think it is important for a little background knowledge to be explained.

> Background info is ALWAYS necessary in a scientific argument. Good work!

The hot spot volcanoes on earth are all in a chain, (the Hawaiian islands) and so are the three volcanoes on planet Mars.

> You have just taken a leap into "Comparative Planetology." Nice step!!!

So I am suggesting that these volcanoes are in fact hot spot volcanoes. However, the plate that they would have been on would have been moving very slowly. This would explain why they would have grown so huge.

> Nice connection. Why do you think that the plate was moving slowly? Be careful of circular logic here: i.e., "The volcanoes are so huge because the plate was moving slowly, and the plate must have been moving slowly because the volcanoes on it are so huge." I am not accusing you of circular logic here. Please do not misunderstand; but I have seen many a professional fall into just such a trap! This is just another piece of 'pontification' on my part!!! **:-)**

Also, when they would have erupted, the lava would have cooled extra quickly due to Mars' harsh cold atmosphere.

> ...assuming a harsh cold atmosphere at the time of eruption. Probably not a bad assumption...

But what has this got to do with Olympus Mons? If we look at Olympus Mons, it is not entirely 180 degrees from the impact sight, and was caused by the reasons explained by you. But I have tried to think of reasons why along side the reason said to be the impact energy travelling outwards. One reason is that, if plate tectonic activity were evident on Mars at an earlier date, then a weak point in the planet interior would have aided the construction of today's features.

> Excellent! I like the progression of your thinking here. If there were a major fault system in and around Tharsis, some sounding experiments with a lander rover mission might just be able to detect them. If successful, a major contribution would have been made to our knowledge of this important region of Mars.

I am suggesting that shock waves sent out from the impact would have caused ~~sudden~~ movements in the Martian interior near Olympus Mons, causing some magma from the core to raise up to the surface, causing a bulge.

> [N.B.: Words like "sudden" are usually avoided since they cannot be easily quantified. Remember that everything you say much eventually be turned into numbers--either the results of a calculation, a measurement, or most likely both.]
>
> Greeley suggests a similar set of phenomena. He speculates about there being either a hot spot under Tharsis, or increasing gas pressure because of the accumulation of thermal energy [from deeper interior sources]. Do you remember the other day when someone asked whether water would affect the volcanoes? Well, steam might very well be a component of a deep subsurface gas pocket!

However, it is evident that the bulge has appeared near the three volcanoes mentioned above. So why was Olympus Mons formed? I have thought that it was formed because the magma from the hot spot down below has found a new way to the surface from the past happenings. In other words, a weak spot was formed from the past plate tectonic activity. When the activity became dormant, these weak points were left undisturbed until the impact happened. After this, the magma from the hot spot area was caused to rise. Then it found its way up to the surface, causing Olympus Mons to form.

> OK, Lee, you raise a plethora of good questions here. Your whole argument needs to be carefully thought out and expanded. What kinds of evidence would be required from the Tharsis region to establish the relationships you are suggesting? I would suggest that you consider both landers, rovers, AND orbiters. Several instrument suites might be required to completely determine whether or to what extent these complex relationships are real on Mars. You've turned up some interesting possibilities to pursue here!

But why is it so big? I have also put thought towards this area as well. My suggestion is that this is also due to the fact that the plates are no longer moving. Comparing Olympus and Hawaii, we can see that their characteristics are the same, and their profiles are especially similar.

> Good! You've made some more excellent connections here. Now, ask yourself this question: Is there a maximum height to which a volcano can grow depending on the surface gravity of the planet on which it occurs? Mars has 1/3 the surface gravity of Earth. Are the Hawaiian volcanoes at some limit of growth? (I do not know the answer, but one of your colleagues at Bristol probably does...). Is O. Mons at some limit of growth? (Here I can say that Greeley believes it is!)

So Olympus Mons is concluded to be also a form of a hot spot volcano. However, the planetary movements have stopped for some reason, (*WHY?*) *so the plate that Olympus is on is currently stationary. So the magma is* (*IS or WAS???*) *building up and up under the mount, as is the same*

case for the bulge under the three other older volcanoes. So we see a bulge form because the volcanoes are just sitting there and not moving away from the stationary hot spot. Part of the bulge, especially under the three hot spot volcanoes, was caused by the impact shock wave causing the rock to move, as seen in the Newton cradle effect.

> Now you sound like the geologists that I met when I was at the Pathfinder Mission Control. (Whew! Nice scenario!) I might throw in some additional info here: There is some disagreement today as to whether Mars is STILL volcanically active. If it is (the minority opinion), how might your ideas be affected?

I believe that Olympus Mons may have in fact grown bigger because the shock waves caused the magma to find a different way up through to the surface by means of a weak point in the interior of the Martian planet. And (I believe) that it builds because the plates are not moving. Also brought to notice was the formation of the trench. There is evidence of magnetic striations in line with the trench (known as Marineras Valley). (*Same question here as earlier on this point...*) *I know that I have mentioned this before, so this will be brief. I just want to bring to mind that this could have been formed in the early age of the planet's life, and then left, once again when the tectonic activity ceased. Nevertheless, it once again widened with shock waves from the impact, causing it to widen and deepen. So what was once before a simple ocean-like ridge is now a deep chasm that is very narrow.*

> You are suggesting that the Mariners Valley was originally a ridge that either collapsed or spread apart. WOW! I'm afraid that I cannot help much on this one pro or con. I have never studied the Mariner's Valley. But, your point IS very interesting. If you study photos of the M. Valley, you will see that it is punctuated by immense regions of crustal collapse. I do not know what the significance of these regions is. Please ask one of your mentors at Bristol. I would enjoy being copied on anything you might learn in this regard.

As a conclusion, I am saying that the formations on Mars, apart from the bulge and Olympus Mons were there before the impact, but had risen due to the impact causing magma to rise. Maybe the magma rose through weak points in the interior that had become excited by the impact shock waves, or maybe the magma rose in some other way.

> Lee, you have come a long way in your thinking over the past few days. Congratulations on a job well done. Whatever you do, KEEP THINKING, make notes, begin a series of correspondences with your friends at Bristol, with me, and with anyone else in research if you are able. Do some reading on mathematical and scientific logic. I believe that you've got the mind to pick up the intricacies easily. You're going to make a dynamite scientist if you keep at it ... so... PLEASE KEEP AT IT!!!!!!!!!

I would like to take this opportunity to thank all those who take their time out of important work, thank you very much. I would especially like to thank Joe at NASA for his time in working with us here, and I would like to thank Eric for running this course and Lawrence for helping the course. May special thanks go to Stu and Carsten here at Bristol University, for they have helped me and inspired me a lot. Please forgive me as I do not (know) or have forgotten people's surnames.

> This whole experience has also been one of the great highlights for me!!!

Thank you once again.

Lee Parsons

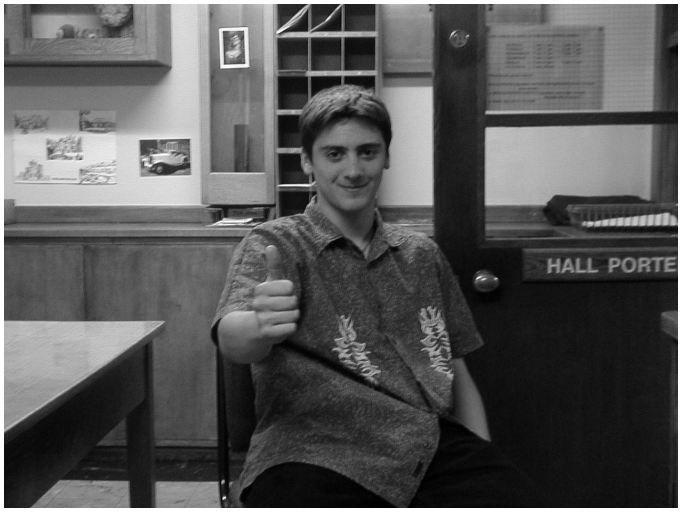
> Best regards --- and Godspeed! Joe

viii.

[I was extremely delighted to receive this photograph of Lee!!! JCK]

At 04:13 PM 07/25/2001 -0400, you (LAWRENCEHX@aol.com) wrote:

Mugshot attached.



ix.

Date: Wed, 25 Jul 2001 16:58:47 -0400
To: LAWRENCEHX@aol.com
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: Re: A picture of Lee

I'm going to save this picture and watch for Lee's face to reappear in some future publication on Martian volcanology. Note to Lee: You had better follow through on this, Lee, because you've got a friend waiting and watching "*just the other side of the pond!!!*" (*A little* "*Americanism*" *there...* **:-)**)

Joe

x. (a.)

Date: Wed, 25 Jul 2001 15:42:41 -0400
To: Joseph.C.Kolecki@lerc.nasa.gov
From: Ruth A Petersen <Ruth.A.Petersen@grc.nasa.gov>
Subject: Ask a Geologist Web Site

Joe

Do you think this would be a worthwhile URL to send to Lawrence and his students since we couldn't find a "live" geologist?

http://walrus.wr.usgs.gov/docs/ask-a-ge.html/

Ruth

x. (b.)

Date: Wed, 25 Jul 2001 17:10:12 -0400
To: LAWRENCEHX@aol.com
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: Fwd: Ask a Geologist Web Site

Hi, Lawrence,

Ruth found this site. It comes from the U.S. Geological Service. Your students might like to check it out!!

Joe

- Day 4 -

i.

[The following exchanges were made after a stunning presentation from the Bristol students. Everybody - on both sides - was on a high when it was over! JCK]

At 04:48 AM 07/26/2001 -0400, Lee wrote through Lawrence (LAWRENCEHX@aol.com):

Thank you very much, Joe!

I do intend on pursuing a career in science, but not one in planetary content. I love cosmology, and follow Stephen Hawkings' work closely. I wish to make a top cosmologist someday, or just a scientific reporter on all things scientific.

Nevertheless, I have really enjoyed studying Mars over the past few days, and would definitely like to keep in touch with everyone here at Bristol, and especially with you and any one else I can. I would like to study Mars in my spare time after today, I feel as though I have taken a real interest to it.

I really appreciate your response to my e-mail. I found it most helpful, and I want to discuss the points made by you with the people here at the university in Bristol. Thank you once again, Joe. Also, could I please have your e-mail, as I would like to keep in contact with you in the not too distant future.

And Godspeed to all of you on the other side of the pond too...from Lee.

:)

ii.

Date: Thu, 26 Jul 2001 09:08:32 -0400
To: Lee through Lawrence (LAWRENCEHX@aol.com)
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: Re: A picture of Lee

Lee,

Go for it! I once met a Shuttle astronaut whose favorite saying was, "Reach for the stars!" If you reach out, Lee, you will certainly touch them!!!

My e-mail is:

joseph.c.kolecki@grc.nasa.gov

PLEASE feel free to write whenever the spirit moves you!!!

Joe

iii.

At 12:18 PM 07/26/2001 -0400, Lawrence (LAWRENCEHX@aol.com), Rania, and Adriano wrote:

Dear Joe and all the people in the room there!

Many thanks for your kind support and encouragement. I have really enjoyed what was a very busy and demanding week.

I am now working on a new idea that will incorporate the Science through Drama workshop that has also taken place here. Watch this space!.....

Lawrence

Hi Joe,

Rania here, I'd like to tell you how immensely grateful I am to you and your team. You have been truly inspirational in your motivation and encouragement. This workshop has given me an idea of what higher education and a career in science would be like, and I will go back to school full of anticipation of such a path. I am now very excited about what the future holds and what I, and my new friends in Bristol, can go on to achieve.

I hope to keep in touch with you and will most definitely research further into this field.

Many thanks once again.

Rania Kashi

Dr. Joe,

I'm absolutely delighted to tell you that I'm glad to have taken part in this project. I guess we have showed to the world that it is possible and beneficial to share new information and work together. An unforgettable experience, a successful mission itself. Please send my acknowledgements to all our colleagues that took part at NASA. Thanks again and hopefully we will continue to keep in touch. GODSPEED

ADRIANO SILVA

This (is) Lawrence again, signing off for the moment. The students now have to prepare a PUBLIC presentation of their work....

iv.

Date: Thu, 26 Jul 2001 13:18:39 -0400
To: LAWRENCEHX@aol.com
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: Re: Thanks from us all

Dear Lawrence, and all our friends in Bristol,

It was our pleasure to have shared your week with you. Best wishes from all of us at NASA. Keep those lights burning! Each of you has something unique to give to the world.

Godspeed!!!

Joe Kolecki

v.

From: Lee Parsons
To: Joseph.C.Kolecki@grc.nasa.gov
Date: Thu, 26 Jul 2001 20:39:03 BST
Subject: Thank you

Hello Joe,

It is Lee here again. I would just like to say a big thanks to all those at NASA who helped make this experience helpful. I have truly enjoyed the study that we have done together, and I hope that we can stay in contact.

I feel as though my eyes have been opened up to a whole new world that is the world of Mars, and would like to study it further...but I would need to ask of some help from you and whoever else can provide help. I would like to be especially kept up to date with the discoveries about Mars, if that would be possible with you folks over there at NASA.

I feel as though I have fallen in love with the Planet; it has so many wondrous features, and I know that we here have really only touched the tip of the iceberg.

I would also like to thank you personally, Joe, for the things that you said about a career in science. I felt that it was very inspiring, and I will definitely pursue a career in the field of science, even if it means that I have to take it up as a hobby as a result of me being rejected from university.

Well, thank you for such a great time, may I take this opportunity to wish you Godspeed with the project on Mars, and I hope to hear from you soon.

Lee Parsons.

– Day 5 –

i.

Date: Fri, 27 Jul 2001 13:45:41 –0400
To: Lee Parsons
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: Re: Thank you

Hello, Lee,

Nice to hear from you. I assume that, by the time you receive this letter, you will have already made a successful presentation to your peers at Bristol.

Judging from what we saw of you and your group here, you had an experience very much like that of any group of scientists working through a real-life problem. I was reminded, at several points during our sessions, of my 18 days at the Jet Propulsion Laboratory, after we had successfully landed the Pathfinder Mission on Mars. We worked around the clock, had all sorts of little meetings and conclaves, made presentations, and tried our best to use our existing knowledge to interpret the new data that was coming down daily from the Ares Valles on Mars. It was both a heady and an exhausting experience. When I returned home, I went through a period of time in which I received calls from all over the country at almost all hours of the day and night. I had demonstrated an important point, you see, and, suddenly, I was regarded as some kind of an expert!

You and your group have experienced something similar this week, Lee. I hope that those of you who want to will go on into professional science. We need people of your caliber, especially in the world of exploration that is opening up throughout the solar system and beyond. And the best part of all of it is that you get to meet some of the neatest people anywhere and everywhere across the globe!

Best wishes, Lee. Keep in touch.

Your friend and colleague in America,

Joe

ii.

At 02:40 AM 07/27/2001 -0400, you (LAWRENCEHX@aol.com) wrote:

Dear Joe,

One of the aims of the Workshops, here at Bristol University, was to give a combined group of sixty young people, from across Japan and from the United Kingdom, a new view of themselves as potential scientists, and an ambition to succeed at the highest level. I am struggling to find words to express our gratitude to you and your team for your help in this venture.

Our particular group, in Space Science, at the Department of Earth Sciences, has had the most wonderful week, and I truly believe that the students' lives have been transformed by it. You have some evidence of this already in the e-mail that we sent just after the final presentation session.

The support you have given, the personal words of encouragement, and that rare combination of warmth and professional rigor which we now see as the hallmark of you and your team, have given these youngsters a new sense of confidence and pride, both in themselves and in their achievements. You will have felt this as the conferences unfolded. I am grateful to you for

lending us the legendary NASA name, proud of what we have achieved together, and joyful at the success of the students. "Thank you" does not even come close to it.

Today, Friday, our group has a public presentation to give, to the other nine groups and to many visitors, using PowerPoint, and will later word-process a full written Report, which of course we will send you.

Eric and I have only recently joined forces, and would both be delighted to work with you on future projects: we are hoping that this is just the beginning of many exciting ways of using the new technologies to advance the cause of science education, and to inspire young people.

I believe that during this week we have together taken another useful step.

With our warmest regards and thanks,

Lawrence

iii.

Date: Fri, 27 Jul 2001 12:06:21 -0400
To: LAWRENCEHX@aol.com
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: Re: Thanks from us all

Dear Lawrence,

Your kind words and the transformation we all saw in the members of our group say everything! We are proud to have been asked to join forces with you. All of you at Bristol have achieved a landmark in education! May its effects be felt everywhere!!

Yes to further involvement with you - by all means, YES!!!

Joe

3. COMMUNICATIONS IMMEDIATELY AFTER THE WORKSHOP

i.

From: "Eric Albone" <albone@dial.pipex.com>
To: <LAWRENCEHX@aol.com>, "Joseph C Kolecki" <Joseph.C.Kolecki@grc.nasa.gov>
Subject: Re: Thanks from us all
Date: Sun, 29 Jul 2001 02:30:18 +0100

Revisiting Lawrence's email (above) the one word I really do question is "potential" in the context of viewing themselves as potential scientists... they are scientists, nothing potential about it. It is I think an extremely important point.

Could I also add here what a tremendous benefit it was to us to have Lawrence in our team, and publicly thank and congratulate him for all he did and achieved. We are immensely grateful to him. It would have been a really good team anyway, but with him as part of it, it went beyond all our expectations.

Eric

ii.

From: "Eric Albone" <albone@dial.pipex.com>
Subject: Re: Thanks from us all
Date: Sun, 29 Jul 2001 02:23:46 +0100

Joe,

The outcome from the Japan 2001 Workshop will reverberate very widely. The event has just finished and everyone is absolutely thrilled. It is a tremendous exercise in teamwork, which is building so many new bridges. I am very closely aware of the remarkable work that was achieved by the Space Science team, but in addition to that virtually every one of the other nine teams (save one) has achieved absolutely outstanding success at all levels. It is a real vindication of faith.

I would very much like to discuss with you where we might go from here. I will be in touch in the very near future.

Eric

iii.

At 05:24 PM 07/29/2001 -0400, you (LAWRENCEHX@aol.com) wrote:

Dear Joe,

Tim, at Bath, has started work on the web site, this end. LOTS more to come.

You may NOT recognise one of the team. (*NO Lone Ranger Mask!....*)

However, it's at:

http://www.clifton-scientific.org/j2001/spacecomment.htm

Please circulate as you will.

The students will be contributing their Report asap.

Do you, or others, wish to make a comment or two for the web site by way of evaluation? We would be delighted to post it--though you have sent us some inspiring stuff already, which might, subject to your approval, be edited for the web?

If any of the planning notes, e-mails, etc. are useful for your own site, please use them as you will: we have complete confidence in your expertise and integrity.

Many thanks again for what has been the realization of a personal dream about using the web, e-mail and video-conferencing as a suite of interactive ICT tools for learning. I am still "on a high". The problem is creating still better projects for the future. But I am working on this already.

Am packing for Bulgaria now, to talk about the Lone Ranger.....

(And DON'T think that I am joking!)

Our love and thanks, once again, to you all,

Lawrence

iv.

At 10:31 AM 07/30/2001 +0100, you (Carsten Riedel) wrote:

Hello Joe, Ruth, Lawrence and Eric,

I think last week was a brilliant week, the Japanese and English kids were really enthusiastic and I am surprised which results we got in the end. It was a really dynamic process going on there and so it was no wonder we did not obtain the results we wanted (expected). It was unforeseeable like research should be. Especially breaking the language barriers between German-English-Japanese and scientist-not scientist was really worth an experience. And it was funny. So I want to say:

Thanks, Eric, for organizing such a thing. I think it is brilliant idea to do such summer schools...

Thanks, Ruth, for organizing the video-link and sending the valuable e-mail information. Without them it would have been much harder to start off...

Thanks, Joe, for the impact volcano model. Is that actually the Cattermole model? I enjoyed the discussions via videonet. In the end I had the impression, we were heading towards the edge of science and there were questions to raise that have not been addressed before. Once upon a time when there is a slot in my timetable I will think about it again. The truth is out there even though we will never find it...

And thanks Lawrence for the sparkling liquids, the video conferencing and the support especially in conveying theatrical presentation ideas and English language to the Japanese. By the way, where are the photos???

Carsten

v. (a.)

Date: Mon, 30 Jul 2001 10:59:05 -0400
To: Carsten Riedel
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: Re: THANK YOU !

Hi, Carsten,

We could not agree with you more! The week was wonderful, and the students exceeded our expectations by leaps and bounds! We saw some very talented and aggressive scientists emerge from an initial group of fairly shy young people. And, yes, we came very close to the edge of our current knowledge.

I'm curious: What were the expectations you referred to which were not met? We could learn a great deal by better understanding what your "theory predicted," and how reality diverged! **:-)**

Finally, the Cattermole model: No, the impact theory is not specifically part of the Cattermole model as far as I can ascertain. (Please correct me if I am mistaken here--I have only a cursory acquaintance with Cattermole's work at present!)

Cattermole speaks of closely linked geological events shaping the northern planes of Mars. In the sense of closely linked events, our thesis DOES parallel his thinking. I originally picked up the impact idea from some folks at the Pathfinder Mission Center in Pasadena, CA, while spending the first 18 days after the landing there, working around the clock and barely even realizing how tired I (we) were. I forget who mentioned it. I liked the idea because I enjoy connections. The impact idea connects a lot of major features on Mars, and, whether it is eventually borne out as true or not, it is VERY useful for students to "cut their teeth" in terms of seeing connections and deeper underlying realities rather than just collections of disparate events. I think that every serious student of science needs to learn this style of thinking. The universe, after all, is a system of interconnected relationships (especially if we truly believe in our quantum mechanics), and the scientist must, ultimately, learn to think in terms of such relationships...

YIKES!!! More pontification...SORRY!!!

Anyway, we are deeply honored to have been part of your week with Japan 2001. And we expect that our personal highs will last quite a while yet!!! I know that I speak for all of us on this end!

Best regards,

Joe

v. (b.)

Date: Mon, 30 Jul 2001 10:59:05 -0400
To: Carsten Riedel
From: Ruth A Petersen Ruth.A.Petersen@grc.nasa.gov
Subject: Re: THANK YOU !

Carsten and Stu

What a truly remarkable experience! I watched the videotapes at home again this weekend. As a non-scientist, I was awestruck. Joe is still on "Cloud 9"!

I was so interested to learn that you were surprised with the end results--that they were not what you expected. Kids can amaze and astound when given a "real world" challenge of this type with the support they need to "take it and run with it"! It was obvious how much they respected you and Stu and your knowledge of the subject because they kept saying they would take what Joe threw at them and discuss things with their Bristol friends.

And thank you for taking what we "threw" at you and weaving it into an investigation on the cutting edge of science. You are to be congratulated! Can't wait to see the final report!

Ruth

vi.

Date: Mon, 30 Jul 2001 10:24:30 -0400
To: LAWRENCEHX@aol.com
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: Re: Aftermath
Cc: Ruth A Petersen <Ruth.A.Petersen@grc.nasa.gov>

Dear Lawrence,

First of all, our congratulations on a magnificent piece of work! You and your team have certainly made history. Our hopes are extremely high for future successes as well. Next, Yes you may edit and post any and/or all of the material in my correspondence with you. And finally, we are extremely enthusiastic about joining forces with you again in the future.

Best wishes, and Godspeed!

Joe

vii.

At 02:33 PM 07/30/2001 -0400, you (Ruth A Petersen) wrote:

Joe,

Thought you'd like to see this postscript to a message I got from Lawrence:

"*PS The Space Science group all went off with the salutation "Godspeed" burned into their psyche. There was even talk of putting this on a group T-shirt.....*"

Ruth

viii.

Date: Mon, 30 Jul 2001 15:25:22 -0400
To: Ruth A Petersen <Ruth.A.Petersen@grc.nasa.gov>
From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
Subject: Re: Godspeed

Heyyyyyyyyy!!! OK!!!!!!!!!!

Joe

ix. (a.)

[The following comments (from Ruth Petersen and me) were written after a telephone conversation with Eric Albone and an e-mail message from Lawrence Williams. They requested comments on our perception of the workshop. So much happened during the previous week that it was difficult to

summarize it all. The following is an attempt to find some sort of perspective. I believe that Ruth Petersen and I will use this initial piece and, with some additions on her part, produce a journal article. JCK]

At 03:39 PM 07/31/2001 -0400, you wrote:

Eric,

I've forwarded everything to you. Please forgive the duplicates--they are just a naturally occurring part of the e-mail process! I have yet to cull through it all and to put it into a little book for myself. I hope to do this over the next couple of weeks.

OK...Here are some additional thoughts on our week together:

Science is the process of studying the world at large and forming valid questions. Facts are the natural endpoints of this process, and are always subject to modification as scientific questioning (a.k.a., scientific inquiry) proceeds. Taken by themselves, facts are relatively dull little objects, usually required to be memorized at school and regurgitated on exams, then promptly, and with more than a modicum of relief, forgotten. They ARE important--let there be NO doubt whatever; but they are hardly a proper end for science or philosophy or, perhaps, modern education...

A valid question is a question with sufficient definition that the means to obtaining its answer are implicit in its own structure. A valid question can lead to an experimental investigation, or a brilliant new inroad in theoretical understanding. One of the classic theoretical questions of the 20th century was asked by Albert Einstein: "What happens if I run abreast a light pulse?" Relativity and all of its ramifications (still being worked out even to this day!) followed.

Facts enter into the process of scientific/philosophical inquiry as data, which clear up certain ambiguous issues and raise others that, likely, had not been apparent previously. As such, facts are essential to inquiry, much as a pole is to a pole-vaulter; and knowledge of basic facts in any given discipline is essential to carrying on useful work in that discipline. But the formation of valid questions is the real heart of investigative thinking--the key word, here, being, "Thinking."

It is not easy to teach thinking in school, let alone to measure the progress students are making in it via tests and examinations. A knowledge of facts and associated problem solving skills is much more amenable to present day education/educational metrics. Perhaps for this reason, education is badly in need of reform today. The information age has provided so many new facts, that time barely allows for their proper assimilation, let alone the luxury of sitting down and thinking about them. I believe that this is the very point on which the Japan 2001 workshop departed, and why it was such a great success.

Permit me, now, to reflect on our group--the Space Science Team. We set our group the goal of developing questions that might lead to future spacecraft/lander instrument suites for investigating the great volcanoes on Mars. The students realized, from the very outset, that answers to their questions were probably NOT going to be readily in hand. THEY would have to draw up the pertinent questions AND the means of identifying and obtaining the necessary information to acquire the answers to those questions. As such, the students were immediately placed into a real-life situation in which original thinking was paramount, and in which the necessary known facts, required to accomplish that thinking, were readily available from the experts in the U.K. and the U.S. (Scientists typically use a combination of library and person-to-person communication to acquire the facts they need. The telephone and the card catalog may be the most essential research tools of all!)

The students had to sift through what was important in their thinking and what was not. It is easy to over-specify a problem if the thinking is not sufficiently carried through. The result is usually a dead-end path in research... They also had to deal with and communicate across the boundaries of language, culture, and discipline (scientist vs. non-scientist; planetologist vs. volcanologist, etc.), all of which are and will remain a real part of science both now and in the future.

Thus, their overall scientific experience was wonderfully enriched by a diverse "people contact," providing opportunities for a lively exchange of ideas, the development of new social skills, and the making of new friends and liaisons. From all of this, they have learned, I hope, that science is NOT merely a sterile enterprise carried out in a jar: it is a very human activity, full of joy and sorrow, success and failure, open roads and dead ends, and, most of all, PEOPLE, PEOPLE, PEOPLE, with all of the nuances that people bring.

Our students developed rapidly in their time at Bristol. We were very taken with this development--I daresay, almost to the point of tears at times--tears of happiness! Thomas Edison once said that genius is one percent inspiration and ninety-nine percent perspiration. Our young people were certainly inspired--thanks to the wonderful experiences provided for them at Bristol! They were also hard workers, as is evidenced by the quality of their work. As a planetary physicist at NASA, I would be proud to have any or all of them working at my side. They help to prove, as much as anybody can prove, that genius is not so rare a commodity as we might sometimes believe. Genius exists wherever people exist, and wherever an environment is present in which they are at liberty to think and to relate.

And so, in closing: Bravo to the students and to our colleagues in the U.K. We are proud to have been part of the Japan 2001 Workshop!!!

Godspeed!!!

Joe Kolecki, NASA/GRC/LTP

ix. (b.)

Space Science Team: Final Comments

During four videoconferencing connections between Joe Kolecki and the Space Science team, we witnessed real world science education at its finest. Progressing from an introduction to volcanoes through three videoconferences and hours of studying images and maps with their Bristol University team leaders, the six young scientists developed a final presentation to Joe on what they learned, their still unanswered questions, and suggestions for further investigations. Special guests from NASA and the Center of Science and Industry (COSI) in Toledo, Ohio, all felt the excitement of the real life scientific investigation and were amazed at the students' initiative and hard work. The model demonstrates effective collaboration among diverse cultures, as well as the effective use of technology (ISDN videoconferencing, e-mail, data sharing, and the Internet) in the educational setting. More importantly, it demonstrates that, given an exciting challenge and necessary resources, young people will far exceed everyone's expectations!

Ruth Petersen, Educational Coordinator, Learning Technologies Project

x.

At 05:03 PM 08/02/2001 +0100, you Adriano Silva wrote:

This is Adriano from the space science team and it's just to tell you that my form is on its way. I also heard that you wanted our contribution to your website? I would love to be involved but how could we do it?

Do you have any other developments on those theories?

Is there any mission on its way to Mars right now? Thanks.

xi.

From: Joseph C Kolecki <Joseph.C.Kolecki@grc.nasa.gov>
To: Adriano Silva
Subject: Re: hi
Date: Thu, 02 Aug 2001 12:35:45 -0400

Hello, Adriano,

It is good to hear from you! Anything you wish to contribute to our website will be most welcome! Please e-mail me or Ruth (Ruth.A.Petersen@grc.nasa.gov).

We are putting together all of our notes and e-mails from before, during, and immediately after our week with you. I have 31 pages of e-mail correspondence with Lawrence, Carsten, Eric, and the rest of you - and that is only on the science and philosophy we shared!!! Ruth Petersen is going to compile a similar collection on all of the Learning Technology that we used in making the video and audio links. WOW!!! What a week!!!

You ask about the impact theory. Theories may take the better part of a lifetime to advance and establish. The impact theory is only one of several competing theories about Mars that will be gone over and torn apart and reassembled over the years to come. There is a lot of spacecraft data still required to write a consistent "aerology" ["geology," only "Geos" = Earth, "Areos" = Mars] of Mars. But it will come. The most exciting part is that you and your associates from Bristol may all become part of the experience. There are plenty of opportunities for young scientists such as you to "hop aboard" and invest your careers in studying Mars, or any other parts of the solar system or the cosmos for that matter. There is also a crying need for teachers to guide other young people along the way to such careers.

What do YOU want to do with your experience and your future, Adriano? I think that this is one of the most important questions for you to be considering right now. There is another question that is similar: Perhaps people have already asked you, "What do you want to be when you grow up?" This question is most unfair because it implies that you are less than you could be right now. I prefer the question: "WHO ARE YOU?" Think about this one for a while, Adriano. It is the most difficult question that any of us has to answer. It is also the most important. It is difficult because the answer grows and changes with you as YOU grow and change. It is important because, like a diamond in the rough, you are all that you are ever going to be RIGHT NOW. The diamond can be polished...so can you. But, by the wrong moves, the diamond can also be ruined...and so can you.

I always begin to think about this question by going outside, alone, and saying to myself, "I'm here, right now. And here are all these trees [or buildings, or people, or what have you]. What am I feeling? What am I thinking? If I could have whatever I wanted right now, what would it be?" And I go on to realize that I have both the freedom and the God-given power to be all that I

can be--all that I can dream or imagine--provided that I am willing to take the risk of stepping out and TRYING.

It takes work to accomplish dreams, Adriano; and it takes perseverance. But work and perseverance are what separate true genius from dull mediocrity. Each person you have ever met and ever will meet has the potential to excel--the genius to excel--if he or she wishes. I have even met mentally challenged people who have developed a wonderful skill for social interaction. They are some of the most endearing people I will ever hope to meet! Theirs is the genius for overcoming an immense handicap and reaching out to other people for all they're worth.

We saw genius at your Bristol workshop, too. We were quite taken by what your group was able to accomplish in four or five days! Like diamonds in the rough, each of you requires time and polishing. But that is true of any of us, at any age. The next step is entirely yours. What will it be?

We have high hopes and expectations for all of you!!!

Now for Mars: At present, the Odyssey 2001 is en-route to Mars. Here is a www-site where you can read about it:

http://mars.jpl.nasa.gov/odyssey/

Please keep writing. I would like very much to hear from you again, soon!

In the meantime, best wishes,

Joe

Appendix A

JAPAN 2001 SCIENCE, CREATIVITY & THE YOUNG MIND WORKSHOP
UK-Japan Young Scientists Working Together
by
Dr. Eric Albone

Patron: The Rt. Hon the Lord Jenkin of Roding
A Japan 2001 Festival Event devised and organized by Clifton Scientific Trust
Bristol, UK, July 22-30, 2001

The more we can build international links among young people, particularly in the field of science which is itself entirely international in its impact, the better it will be for the future of the human race and the world we inhabit.
Rt Hon the Lord Jenkin of Roding, Workshop Patron, welcoming the students to the Japan 2001 Workshop

Most of all, I welcome the young people from our two countries whose energy and enthusiasm will pioneer such an exciting and important new venture.
Lord Sainsbury of Turville, Minister for Science and Innovation

I learned a lot about different fields of science this afternoon. But what has struck me deeply is how much you all have learned, not just about subjects that you have been working on, but also about each other's cultures, each other's life styles, and even language.
Professor Marie Conte-Helm, Director-General, Daiwa Anglo-Japanese Foundation

- Post-16 students from schools across Britain and Japan came together in Bristol to work for a week in small UK-Japan teams on a wide range of genuine open-ended science-related explorations that challenged their ingenuity and creativity.
- The student teams, led by top scientists, engineers, and social scientists, worked in the fields of Aeronautics, Archaeology, Chemistry, Earthquake Engineering, Environment, Ethics in Medicine, Space Science, Science through Theatre, Vulcanology and Wildlife Conservation. At the end of the week each Team made a public presentation of its achievements.
- In the process the students not only put their school knowledge to use and discovered something of the "scientist in themselves." Also, by living and working together, they came to share and value each other's ways of thinking and working.

This is the first time any such enterprise bringing young people from Britain and Japan together in a science context has been attempted.

The Workshop was rapidly and heavily over-subscribed by UK students with the minimum of advertising and was also over-subscribed in Japan. In both countries, two-thirds of the applications came from young women. The membership of the Teams was as follows:

Aeronautics Team

Mr.	Christopher POWELL	Downend School, Bristol
Ms.	Alexandria HOWE	County Upper School, Bury St Edmunds, Suffolk
Mr.	Michael DUFFY	Aquinas Diocesan Grammar School, Belfast
Ms.	Mariko KIMURA	Miyagi-kenritsu Daiichi Joshi Kotogakko
Ms.	Misa SEIZA	Osaka-furitsu Imamiya Kotogakk
Mr.	Shuhei MAEDA	Hyogo-kenritsu Himeji-Nishi Kotogakko

Team Specialists: Ms. Clare Dimyon, Connexions, and Mr. Alasdair Jamieson, Airbus UK, in association with the University of the West of England
Team Facilitators: Ms. Keiko Iizuka and Ms. Zoe Short

Archaeology Team

Ms.	Anoushka KHAN	Holy Cross School, New Malden, Surrey
Mr.	Daniel SEYMOUR-BLACKBURN	Heysham High School, Morcambe
Mr.	John KATEGE	St Thomas More School, Wood Green, London
Ms.	Chiemi KAJINO	Osaka-furitsu Imamiya Kotogakko
Mr.	Shinji AMANUMA	Rikkyo Niiza High School
Mr.	Oguri ATSUHIRO	Tsukuba Daigaku Fuzoku Komaba Kotogakko

Team Specialists: Dr. Ticca Ogilvie, Conservator, Bristol City Museum, and Dr. Katharine Robson-Brown, University of Bristol, Archaeology
Team Facilitator: Ms. Miho Takahashi

Chemistry Team

Ms.	Charlotte RAMPTON	Ralph Allen School, Bath
Ms.	Qian XU	Speedwell School, Bristol
Mr.	Paul FIELDING	St.Margaret's High School, Liverpool
Ms.	Chieko SAKAI	Miyazaki-kenritsu Kobayashi Kotogakko
Ms.	Noriko YAMAICHI	Tochigi-kenritsu Tochigi Joshi Kotogakko
Ms.	Maki MATSUI	Hyogo-kenritsu Himeji-Nishi Kotogakko

Team Specialists: Professor Brian Vincent, Dr. Patricia Marr, and Mr. Robin Mogford, University of Bristol, School of Chemistry
Team Facilitator: Mr. Manabu Imada

Earthquake Engineering Team

Ms.	Siobhain DALES	The High School, Gloucester
Ms.	Sheona MASTERTON	Manshead School, Luton
Mr.	William LUTON	City of Bristol College
Mr.	Junya YOSHIDA	Gifu-kenritsu Kani Kotogakko
Ms.	Asuka HATANO	Saitama-kenritsu Urawa Daiichi Joshi Kotogakko
Ms.	Maiko HIRAMOTO	Tokyo Jogakukan Kotogakko

Team Specialists: Dr. Wendy Daniell and Dr. Adam Crewe, University of Bristol, Civil Engineering
Team Facilitator: Ms.Akiko Yabuno

Environment Team

Ms.	Jo MATTINGLEY-NUNN -	King Edward VII School, Sheffield
Ms.	Hayley WEAVING	Ribston Hall High School, Gloucester
Ms.	Meryem KAYA	Leyton Sixth Form College, Leyton, London
Ms.	Manami NISHIKAGI	Osaka-furitsu Imamiya Kotogakko
Ms.	Junko YABE	Tsukuba Daigaku fuzoku Kotogakko
Ms.	Ayumi TAKAHASHI	Meikei Gakuen Kotogakko

Team Specialists: Ms. Kim Thomas and Ms. Lorraine Taylor, Environment Agency
Team Facilitator: Ms. Minako Teramoto

Ethics in Medicine Team

Ms.	Ozlem TURAN	Leyton Sixth Form College, Leyton, London
Ms.	Sofia AHMAD	Colston Girls' School, Bristol
Ms.	Laura BASER	Fairfield Grammar School, Bristol
Ms.	Machiko KUMATA	Saitama-kenritsu Urawa Daiichi Joshi Kotogakko
Ms.	Nozomi YASHIMA	Miyagi-kenritsu Daini Joshi Kotogakko
Ms.	Sayaka KANEYASU	Tokyo Jogakukan Kotogakko

Team Specialists: Ms. Sarah Edwards and colleagues, University of Bristol, Centre for Ethics in Medicine
Team Facilitator: Mr. Tadahiro Ishiwata

Science through Theatre Team

Ms.	Kirsty HORNER	Brighouse High School, Brighouse, W. Yorks
Ms.	Safia QURESHI	Holy Cross School, New Malden, Surrey
Ms.	Jane UBABUKO	St Thomas More School, Wood Green, London
Ms.	Masami FUJITA	Tochigi-kenritsu Tochigi Joshi Kotogakko
Ms.	Yoko OKAMOTO	Hyogo-kenritsu Himeji-Nishi Kotogakko
Ms.	Aruha TAKAHASHI	Tokyo Gakugei Daigaku fuzoku Kotogakko

Team Specialists: Ms. Helen Renwick; Y Touring Theatre Company, and Mr. Jonathan Hall; playwright
Team Facilitator: Ms. Junko Kawaguchi

Space Science Team

Mr.	Lee PARSONS	Hengrove School, Bristol
Mr.	Adriano SILVA	Sir George Monoux Sixth Form College, WalthaMs.tow
Ms.	Rania KASHI	Cardinal Vaughan School, London
Mr.	Akiro NAKAMURA	Kaisei Gakuen
Mr.	Toshiyuki ITAI	Tsukuba Daigaku fuzoku Kotogakko
Mr.	Ryo NAKAMURA	Rikkyo Niiza High School

Team Specialists: Dr. Carsten Riedel and Mr. Stuart Stansfield, with Professor Steve Sparks FRS, University of Bristol, Earth Sciences; Mr. Lawrence Williams, Holy Cross School, New Malden; and by video link Mr. Joseph Kolecki, Ms. Ruth Petersen, and colleagues, National Aeronautics and Space Administration (NASA) Glenn Learning Technologies Project, Cleveland, Ohio, US

Team Facilitator: Ms. Kako Iwaki

Volcano Science Team

Ms.	Helen FORSTER	County Upper School, Bury St Edmunds, Suffolk
Ms.	Jennifer HOWES	Manshead School, Luton
Ms.	Susan CHUNG	Audenshaw School, Manchester
Ms.	Chiharu OHSUGI	Meikei Gakuen Kotogakko
Ms.	Akiko SASAKI	Miyagi-kenritsu Daini Joshi Kotogakko
Mr.	Kotaro TONUMA	Rikkyo Niiza High School

Team Specialists: Dr. Jeremy Phillips, Mr. Tim Barass, and Professor Steve Sparks, FRS, University of Bristol, Earth Sciences
Team Facilitator: Ms. Makiko Kinoshita

Wildlife Conservation Team

Ms.	Sarah BAULCH	Prendergast School, Brockley, London
Ms.	Kathleen O'HARA	Cardinal Vaughan School, London
Ms.	Jennifer JONES	Hengrove School, Bristol
Mr.	Daichi SAITO	Komaba Toho Kotogakko
Ms.	Eiko OZONO	Saitama-kenritsu Urawa Daiichi Joshi Kotogakko
Ms.	Noriko ABE	Meikei Gakuen Kotogakko

Team Specialists: Dr. Sue Dow, Bristol Zoo Gardens; Dr. Tessa Smith, Queens' University of Belfast
Team Facilitator: Mr. Go Kurosu

The Workshop was devised and organized by Clifton Scientific Trust and hosted at the University of Bristol. It was supported financially by the Daiwa Anglo-Japanese Foundation, the Great Britain Sasakawa Foundation, and Japan 2001. Recruitment of British students was undertaken following widening participation criteria in association with the University of Bristol Widening Participation Office. The recruitment of Japanese students was undertaken and funded by the Chemical Society of Japan; Council of Chemistry Education in association with the Society of Biological Sciences Education of Japan, the Physics Education Society of Japan, and the Japan Society of Earth Sciences Education.

The Workshop was undertaken in partnership with:

- *The University of Bristol Widening Participation Office*
- *The University of Bristol Students' Union and Japanese Society*
- *Airbus UK*
- *Bristol Zoo Gardens*
- *Bristol City Museum*
- *Connexions, West of England*
- *The Chemical Society of Japan-The Council of Chemistry Education*
- *The Society of Biological Sciences Education of Japan*
- *Physics Education Society of Japan*
- *Japan Society of Earth Science Education*
- *The Environment Agency*
- *National Aeronautics and Space Administration (NASA) Glenn Learning Technologies Project, Cleveland, Ohio, US*
- *The Y Touring Theatre Company*
- *The University of the West of England*
- *Colleagues from Holy Cross School, New Malden & The Rikkyo School, Horsham*

The Workshop was endorsed by Dr. Peter Briggs, Chief Executive, British Association for the Advancement of Science; Mr. Stephen Cox, Executive Secretary, Royal Society; and Mr. Kunio Sato, Director, Japan Society for the Promotion of Science, London Liaison Office.

Further information is available from:
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Appendix B

Japan 2001 - Science, Creativity and the Young Mind Workshop
Space Science Team

Welcome to our Team

Welcome to our Team. We are looking forward to meeting you and working with you in Bristol. You will be working with two Bristol people during the week - Stuart Stansfield and Carsten Riedel - both of us work at the Centre for Environmental and Geophysical Flows of the University of Bristol Earth Sciences Department. You will also meet Professor Steve Sparks, FRS, our Centre Director, who is taking a close interest in your time with us. People working in our Centre in Bristol try to understand the behaviour of flow systems inside and outside volcanoes. Some people deal with the formation of glaciers.

Here is some information to give you a bit of idea what we're going to be doing, and **how your investigations can make a real contribution to science**.

The Space Science dimension comes because we will be studying volcanoes on the planet Mars. In this work we will be guided by videolink with Dr. Joseph Kolecki at the NASA (National Aeronautics and Space Administration) Glenn Research Centre in the USA who will also be very much part of our team. I must also mention Lawrence Williams, who will be working with us in Bristol and has a lot of experience in using videoconferencing between schools in Britain and Japan and has close personal links with NASA.

What will the Team be doing at Bristol?

During the week we are going to look at volcanoes on the surface of Mars and explore new ideas about the formation and structure of these volcanoes, by comparing them to equivalent volcanoes on planet earth. As indicated, during this week you will have the unique opportunity to speak to experts of NASA by using modern videoconferencing equipment, i.e. talking real-time to people from NASA in the USA.

What is so important about Mars?

There have been a lot of people already who have worked on photos from the surface of Mars. The study of the red planet dates back to early times, and in the last hundred years it has evoked speculations on bizarre lifeforms and advanced civilizations.

Although this is now discredited, by looking at meteorites in the last few years the idea that some form of simple life may have existed on Mars cannot be ruled out entirely. So by comparing today's empty planet with Earth it might be possible to find out how life survived on Earth but not on Mars. One essential feature for life is the presence of water. Mars is a very dry planet. Today water ice occurs in the polar ice caps of Mars, but liquid water cannot exist because the planet is very cold. If there was once liquid water, and there is evidence for this, there must have been another heat source adding to the heat coming from the sun.

Remnants of this heat source are the big volcanoes on Mars' surface. One of these volcanoes, Olympus Mons in the so-called Tharsis area of Mars, is huge (26 km high) and is so big that the whole island of Hawaii, and even the underwater volcanoes around Hawaii, could easily fit into it. And Mauna Loa on Hawaii is already the biggest volcano on earth.

How and why could Olympus Mons grow so high and what could have led to its formation? How are the other volcanoes on Earth and on Mars related to Olympus Mons? How can we find out more about these

Martian volcanoes? Mars can only be explored from satellites so far, by a technique we call **remote sensing**. And by finding out something about Mars' volcanoes we also learn something about how remote sensing can help us to understand volcanoes on Earth.

When you arrive

Once you have arrived in our department we will give you some background information and show you how to access photos from the Martian volcanoes on the Internet from NASA. We will show you how to compare volcanoes on other planets with those volcanoes on Earth that we investigate in our Centre. You can check out all the new photos from the new Mars Global Surveyor and discuss what you want to do further - with us and with Joe Kolecki at NASA.

Since the data are relatively new you could well discover something that other people have not noticed before or come up with an explanation that nobody has thought of. This would be a really important contribution you could make to the study of our "red planet" and to the possibility of life at some stage on all terrestrial (earth-like) planets (Earth, Mars, Mercury and Venus).

Preparation

Before you arrive, you may want to look at a few websites that we will be studying in detail once you are here. Maybe you know something of the volcanoes of Hawaii or Japan, especially the big ones to compare with those on Mars. Any book, TV documentation, or video about earth science will supply some relevant information. Refresh your knowledge and bring this information with you to Bristol or try to think how the volcanoes in the books or TV documentaries compare to pictures at:

http://ltpwww.gsfc.nasa.gov/tharsis/volcano.html
http://ltpwww.gsfc.nasa.gov/tharsis/ngs.html
http://ltpwww.gsfc.nasa.gov/tharsis/map_lab.html

There is an interesting book ***The New Solar System*** edited by J Kelly Beatty, Carolyn Collins Petersen, and Andrew Chaikin (Sky Publishing Corporation and Cambridge University Press) 1999, 4th Edition (ISBN Number 0933346867) with a good chapter on Mars. It is a bit technical and do not go to a lot of trouble to get it; but if there is a library with it, it is worth a read.

We (Carsten or Stuart) will be very happy to hear from any of you beforehand if you have any questions or comments. Our email addresses are:

stu.stansfield@bris.ac.uk (Stuart)
cr1613@bris.ac.uk (Carsten)

We look forward to welcoming you to the Japan 2001 Workshop in the very near future.

Appendix C

My impressions of the Japan 2001 Science, Creativity and the Young Mind Workshop Space Science Teaml

by
Carsten Riedel

criedel@geophysik.uni-kiel.de

The workshop developed very well during its short period of existence. Although their understanding of science was already on a high level, the students could not follow our train of thought at a high speed in the beginning. For the Japanese students there was also a language barrier, which had to be broken, and which was best depicted in our first videoconferencing session when Kako, our Japanese facilitator, had to translate word for word into Japanese. Since Kako was not into science as much as the students, I had to translate everything from Joe Kolecki's descriptions into more generally understandable English, which was then conveyed to the Japanese students by Kako. This language barrier from scientist to nonscientist and from English to Japanese is clearly a barrier to scientific discussions because it prevents the formation of an open discussion. In circumstances like these, there is rather one best way of information transport and that is from the teacher to the student directly.

To break this vicious circle, we gave the students the same information over and over again, until they could explain things in their own words. We showed them many pictures from the Internet to depict the situations on Mars and Earth, which clearly enabled us, as well, to think through the situation. After all students had something to talk about, we encouraged the students, of their own freewill, to prepare a question for the next videoconferencing session. So the second conference was more about asking. The students clearly were fascinated by the way NASA presented their theories. And though I sometimes thought, "Now this is getting too simplistic...," it appeared to be a good way to present the ideas. The spirit alone, that there was somebody who is in contact with "higher forces," i.e. people who built the Space Shuttle etc., drove the students to understand what was behind all of it.

In the last two or even three days, every one of the group took something home from the workshop. While some would only scratch the surface of what we or Joe presented, others were developing the ideas further and further, ranging from those who developed hypothesis after hypothesis, to those who followed a single line of inquiry to the bitter end. While I suspect the last one to be more scientific, the intuitive capacity delivered by the other approach was as important, because it could be developed further and further through their social evenings and nights. Taking the experiences of these evenings and nights into the workshop and getting into contact with Japanese culture was clearly a decisive motivation factor, especially for the Japanese students who were feeling more and more accepted.

Space Science offers many different perspectives. In the field of space physics or geophysics we spanned a much bigger range during the five days than I expected or was prepared for. Some of the ideas they wanted to follow had to be taken out of up-to-date scientific references that were unknown to us and told us, as supervisors, something about Mars or Earth. What all of the participants clearly experienced during the discussion with each other is the fact that no idea is understood before you can explain it to somebody else in your own words. And that is a task not easy to achieve for many people. Since people in England keep talking about basic skills, I think the students clearly advanced in their presentation skills day by day, which became obvious when listening to their final talk. Each testing phase was not as good, straightforward, and logical as the final talk, which was presented by a mixed team of Japanese and English students in a very short time. Congratulations!

Appendix D

The Space Science Workshop: Development of a New ICT Learning Model
by
Lawrence Williams

Background

This was my plan for the Workshop, as posted on the MirandaNet site, Institute of Education, London University, Autumn Term, 2000:

www.mirandanet.ac.uk/pubs/williams.htm

For information on the background to the Workshop, see

www.mirandanet.ac.uk/profiles/nasa.htm

For a direct link to the NASA Glenn Learning Technologies Project web site, see:

http://www.grc.nasa.gov/WWW/K-12/CoE/videoconferences_to_the_uk.htm

A New Learning Model

Integrating aspects of the Holy Cross and NASA curriculum models

The Holy Cross Model

Until now, at Holy Cross we have deliberately shunned using the web, because of its static nature, and have instead used the new ICT tools to develop dynamic projects centered mainly on the creation of Expressive Arts events. Using videoconferencing equipment running over ISDN 2 telephone lines, these have included shared music workshops with the LSO and Japan Philharmonic Orchestras, the "Kabuki Gift" drama, which was performed simultaneously by school students in London and in Osaka, as well as a scientific exchange with NASA scientists.

As indicated in my "Poskole 2000" paper (Charles University, Prague), at Holy Cross we are trying to develop the integration of the new ICT tools for learning, so that each tool is used not only to its maximum individual potential, but at the same time **in harmony with other tools.**

In this way, we hope to see how best to use the new ICT tools in harmony with each other and within a creative framework.

The NASA Model

The NASA model works through the development of pre- and post-conference activities, using the web as an electronic library where relevant and useful scientific information is stored and can be researched by the students. They can also communicate with NASA team members through e-mail and share ideas through the videoconference.

The presentation styles involve either Topic Guest Speakers who share their expertise with the students, or the Panels of Experts, who can share their thoughts both with the students and with each other, during the course of the conference.

The results of the conferences are monitored and evaluated through the web.

Integrating the Two Models

The next logical step in working with the new ICT tools, therefore, is to develop a working model that brings about the further integration of these tools by blending the above **models** into one. The **static** nature of the Web and the **dynamic** nature of the other tools can thus come together creatively.

How this will work:

The Bristol **"Science, Creativity and the Young Mind"** Project Workshop is an example. During the week beginning July 22, 2001, ten groups, each consisting of three English and three Japanese students (a total of sixty students, aged 16 plus), will be given a problem at the beginning of the week. Working with the academic staff at Bristol University as mentors, in most cases, the students will work together to solve "Real World" problems, presenting their findings and solutions to the whole group on Friday.

- The web will be used as the resource for information, which one group of students, **"The NASA Group,"** will access before the Workshop and videoconference begins.

- On the first day of the Workshop (Monday, 10 a.m. US time and 3 p.m. UK time) the six students of the NASA Group (3 from Japan and 3 from the UK) discuss their task with NASA through the first videoconference. This is to ensure that they clearly understand the nature of the problem. (Use of videoconferencing equipment)

- During the week, in the same way that the other groups of students have access to the academic staff at Bristol University, the NASA group will have access to tutorial help through e-mail and fax with NASA experts. (Use of e-mail and attachments)

- Images of work in progress will be sent back to Ohio for comment by the NASA scientists. (Use of digital camera and e-mail)

- The overhead document camera can be used to show diagrams and sketches of the students' solutions. (Use of document camera)

- On Thursday, before all groups present their findings to their peers and tutors in Bristol, the NASA Group will present their work through a final videoconference to their tutors in Cleveland. (Use of videoconferencing kit again)

- Finally, the e-mail messages, the evaluations, and the video clips and stills of the various presentations will be uploaded onto the NASA web site so that the process can be continued and developed. (Further use of the web)

This creates a graceful cycle of ICT use, starting and ending with the web.

In this way, the ICT tools used are essential to the success of the project and are used in harmony with each other. But the web site itself is also developed and, therefore, becomes dynamic rather than static as new ideas are added through similar future projects.

We firmly believe that this interaction between the new ICT tools is the way forward for education in the Information Age, a vision that is shared by our colleagues at NASA.

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Surrey, UK
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E-mail: Lawrencehx@aol.com

Evaluation

I am delighted to report that the Workshop exceeded my highest expectations. Through the expertise of the team assembled by Dr. Eric Albone to support this project, the Space Science Workshop was outstanding in all its aspirations. Supporting this Workshop were Professor Steve Sparks, Fellow of the Royal Society, who gave a useful introduction to the group about the basics of plate tectonics and further supported us with tutorial visits. The students felt honored by his visits. Throughout the week Dr. Carsten Riedel and Stuart Stansfield, both part of Professor Spark's team, excelled as inspirational teachers, working with the students from 9 a.m. to 5 p.m. with coffee and lunch breaks pared to the minimum by the students themselves, who wanted to develop their ideas to the fullest extent. I have a JPEG photo of the group working long after a coffee break was called! Carsten and Stu were the driving force behind the scientific work of the group, challenging the students and encouraging them with outstanding professionalism. I have assessed many teachers during my years as a senior manager, but I willingly assert that these two members of the team were truly outstanding in their expertise, their enthusiasm, and their encouragement of the students.

From the NASA end, Joe Kolecki provided daily tutorial support by videoconference, and, again, was an inspiration to the group. Following the last videoconference with Joe, I expressed our gratitude to him and his team for their help in this venture. His response declared that the Bristol group had achieved a landmark in education! (The complete text is given on Day 5, message nos. ii and iii.)

Among other successes, socially, culturally, and in uniting the academic communities of three continents, this has been a landmark in the development of the integration of ICT for learning, and I warmly thank all of the team for this.

Lawrence Williams

Web links:

Becta's site for the NASA link with Holy Cross:

http://top.ngfl.gov.uk/content.php3?content=content/fw981651524.html&f=0

And the Becta/Holy Cross Drama Report:

http://top.ngfl.gov.uk/content.php3?content=content/b970760668.html&f=0

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13. ABSTRACT ***(Maximum 200 words)***

During the week of July 23, 2001, a workshop called Japan 2001 Science, Creativity and the Young Mind took place at Bristol University in Bristol, England. Coordinated under the direction of Dr. Eric Albone, Clifton Scientific Trust, it brought together 60 British and Japanese students and provided them with a forum for learning and interacting. We at the NASA Glenn Research Center (GRC) in Cleveland, Ohio, had the good fortune to participate with six of those students and their team leaders in a Space Science Workshop. The Space Science Team was led by two Bristol University people from the Earth Sciences Department—Carsten Riedel and Stuart Stansfield—under the direction of Professor Steve Sparks, FRS. The Team was assisted by Lawrence Williams, Director of Studies, Holy Cross School, UK. Funding was provided by the Daiwa Anglo-Japanese Foundation, the Great Britain Sasakawa Foundation, and Japan 2001. Tis report is a compilation of correspondence via e-mail that took place before, during, and immediately after the workshop. A final report from the students on their findings is now in production and will be made available from Clifton Scientific Trust.

14. SUBJECT TERMS

Distance learning; Videoconferencing (ISDN and IP); ICT Learning Model; Mars

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