Panelists

Attendees (7)

- Hosts (1)
  - Mike Toillion
- Presenters (3)
  - Andy Burnett
  - Eric Smith
  - frank rosenzweig
- Participants (3)
  - Ali Mallakin
  - Bob Bruner
  - Melissa

Open Chat (Everyone)

have started this way. Bob Bruner

--------- (12/19/2013 10:46) ---------

Bob Bruner: I meant Hadean, as in Hell.

--------- (12/19/2013 10:50) ---------

Eric Smith: http://www.etymonline.com/index.php?search=hadean+aeon

--------- (12/19/2013 10:56) ---------

Bob Bruner: I am taking an exhibit of meteorites and minerals to the Gordon Conference next month. The y are PYRITE, CHALCOPYRITE, SPHALERITE, GALENA, ALABANDITE, ZIRCON, APATITE, MONTMORILLONITE, PYROXENE, AMPHIBOLE, WULFENITE, TOURMALINE, COLEMANITE, OLIVINE, FORSTERITE, FAYALITE, SERPENTINE, GOETHITE, GYPSUM, MARS SNC METEORITE, VESTA CAMEL DONGA METEORITE, MURCHISON METEORITE, ALLENDE METEORITE AS BEING REPRESENTATIVES OF THEORIES OF THE ORIGIN OF LIFE ON EARTH AND MARS.

Teleconference Instructions (Parti...

Teleconference Line: 866-692-3158
Passcode: 9109668#
Please use *6 (STAR, then 6) to MUTE your phone's mic when not speaking.
More info: https://astrobiologyfuture.org

Simplest Life.pptx

Full Screen

Oldest unlikely to be simplest

5. A rock surface is displaying "polygonal oscillation cracks " in the 3.48 billion years old Dresser Formation, Pilbara region, W. Australia. Such and similar sedimentary structures are of biological origin (MISS). (Noffke et al. 2013 *Astrobiology 13*, 1103)

6.

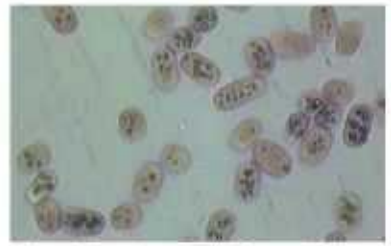

Photo: Chromatium okenii by Raymond Cox, University of Southern Denmark

1
00:00:14,209 --> 00:00:11,499
alright um we are recording this so

2
00:00:17,060 --> 00:00:14,219
ladies gentlemen welcome to the next in

3
00:00:20,240 --> 00:00:17,070
our series of webinars just a few have

4
00:00:23,750 --> 00:00:20,250
been details to deal with the slides for

5
00:00:26,660 --> 00:00:23,760
today's webinar are up on the website

6
00:00:30,109 --> 00:00:26,670
with the exception of one set from Eric

7
00:00:33,830 --> 00:00:30,119
which will be up in just a moment the

8
00:00:36,799 --> 00:00:33,840
video from yesterday's webinar is now

9
00:00:40,490 --> 00:00:36,809
linked to the event from yesterday so we

10
00:00:42,290 --> 00:00:40,500
are completely up to date on that and as

11
00:00:44,750 --> 00:00:42,300
a final reminder for anyone who hasn't

12
00:00:47,240 --> 00:00:44,760
attended one of these events before this

13
00:00:50,389 --> 00:00:47,250

is being recorded so both the text and

14
00:00:53,150 --> 00:00:50,399
anything that you say when we open up

15
00:00:56,450 --> 00:00:53,160
the phone lines will be publicly

16
00:00:59,840 --> 00:00:56,460
available the document that this webinar

17
00:01:02,450 --> 00:00:59,850
relates to is available via the front on

18
00:01:05,469 --> 00:01:02,460
the astrobiology website and in fact it

19
00:01:08,149 --> 00:01:05,479
has been flipped open so you can now add

20
00:01:10,340 --> 00:01:08,159
comments to it we're going to encourage

21
00:01:13,399 --> 00:01:10,350
you to add your comments into the text

22
00:01:15,350 --> 00:01:13,409
boxes as bob has been doing and also

23
00:01:17,090 --> 00:01:15,360
once the presentation is finished we'll

24
00:01:19,550 --> 00:01:17,100
open up the phone lines so we'd be

25
00:01:24,260 --> 00:01:19,560
delighted to hear from you as well with

26
00:01:29,600 --> 00:01:24,270
that Frank thank you very much thank you

27
00:01:33,590 --> 00:01:29,610
Andy and welcome Ali welcome Bob welcome

28
00:01:38,260 --> 00:01:33,600
Melissa so as you guys know this is the

29
00:01:42,740 --> 00:01:38,270
next in a series of webinars that are

30
00:01:48,609 --> 00:01:42,750
based on the activity that focus groups

31
00:01:53,630 --> 00:01:48,619
that were joined together last June

32
00:01:58,609 --> 00:01:53,640
astrobiology a roadmap meeting and so

33
00:02:01,459 --> 00:01:58,619
today's webinar is there's a google

34
00:02:04,609 --> 00:02:01,469
documents that is I believe available

35
00:02:10,760 --> 00:02:04,619
now which poses the question what is the

36
00:02:12,710 --> 00:02:10,770
simplest life look like and all exactly

37
00:02:13,190 --> 00:02:12,720
makes us work there so the authors of

38
00:02:18,470 --> 00:02:13,200

the

39
00:02:25,220 --> 00:02:18,480
with acaba irene chen paul falkowski gym

40
00:02:28,580 --> 00:02:25,230
Lions mix myself to the Burkhardt

41
00:02:33,520 --> 00:02:28,590
Phoenix fault agasshi rage Springsteen

42
00:02:37,790 --> 00:02:33,530
sub will and Lawrence Williams and Eric

43
00:02:41,920 --> 00:02:37,800
Miller will accuse me of Eric Smith will

44
00:02:46,490 --> 00:02:41,930
be talking to us after I'm finished here

45
00:02:48,440 --> 00:02:46,500
so the sort of the sub question to this

46
00:02:50,630 --> 00:02:48,450
or the principles that question is you

47
00:02:54,080 --> 00:02:50,640
know what can synthetic and reductive

48
00:02:57,229 --> 00:02:54,090
approaches tell us about early for life

49
00:03:01,309 --> 00:02:57,239
and I'll say up front is something of a

50
00:03:05,680 --> 00:03:01,319
disclaimer that my own specialty is that

51
00:03:09,339 --> 00:03:05,690
of experimental population genetics and

52
00:03:13,309 --> 00:03:09,349
also interested in the origins of

53
00:03:17,800 --> 00:03:13,319
organelles and multicellularity so I'm a

54
00:03:20,690 --> 00:03:17,810
little bit further removed from these

55
00:03:22,789 --> 00:03:20,700
central questions concerning this origin

56
00:03:26,539 --> 00:03:22,799
of life although I consider myself a

57
00:03:28,930 --> 00:03:26,549
real amateur of his work okay so what

58
00:03:33,020 --> 00:03:28,940
does the simplest life look like we're

59
00:03:35,120 --> 00:03:33,030
in our bio 100 classroom I throw up some

60
00:03:39,650 --> 00:03:35,130
slides like this where we have you know

61
00:03:42,650 --> 00:03:39,660
a molecule like a ribozyme group of he's

62
00:03:47,860 --> 00:03:42,660
a beautiful crayons or a bacteriophage

63
00:03:53,680 --> 00:03:47,870

and then number four on the right is the

64
00:03:58,129 --> 00:03:53,690
smallest of known bacterium

65
00:04:01,360 --> 00:03:58,139
mycobacterium genitalium has smallest

66
00:04:03,470 --> 00:04:01,370
bacterium of a more or less free living

67
00:04:06,680 --> 00:04:03,480
bacterium although there are others that

68
00:04:08,180 --> 00:04:06,690
are intracellular sending-off been

69
00:04:13,610 --> 00:04:08,190
discovered in the last few years that

70
00:04:18,589 --> 00:04:13,620
had even smaller Gina so so but is it's

71
00:04:21,589 --> 00:04:18,599
really what this is all about this may

72
00:04:24,680 --> 00:04:21,599
not actually none of these may represent

73
00:04:26,600 --> 00:04:24,690
what the simplest life on other worlds

74
00:04:29,119 --> 00:04:26,610
they look like certainly may

75
00:04:32,089 --> 00:04:29,129
not even be the senseless life that we

76
00:04:34,939 --> 00:04:32,099
would have recognized as such had we've

77
00:04:38,300 --> 00:04:34,949
been able or were we able to get into

78
00:04:43,159 --> 00:04:38,310
its time-traveling machine and go back

79
00:04:46,520 --> 00:04:43,169
four billion years so we do know and

80
00:04:50,330 --> 00:04:46,530
many of the people participating today

81
00:04:57,490 --> 00:04:50,340
may have seen this paper that just came

82
00:05:00,890 --> 00:04:57,500
out in astrobiology last month where the

83
00:05:07,189 --> 00:05:00,900
publication of this paper vine aki and

84
00:05:10,689 --> 00:05:07,199
hazen and others indicated that there

85
00:05:13,670 --> 00:05:10,699
were clear evidence of bacterial mats

86
00:05:20,209 --> 00:05:13,680
going back three and a half billion

87
00:05:22,550 --> 00:05:20,219
years but as i have an image 6 below so

88
00:05:24,769 --> 00:05:22,560

all the things that we found that could

89
00:05:27,769 --> 00:05:24,779
be construed as being alive or certainly

90
00:05:32,450 --> 00:05:27,779
not likely to be the simplest so for

91
00:05:36,110 --> 00:05:32,460
example here is a picture of a microbial

92
00:05:40,430 --> 00:05:36,120
map in the Civil is it March marsh near

93
00:05:45,769 --> 00:05:40,440
Woods Hole and the purple sulfur

94
00:05:49,159 --> 00:05:45,779
bacteria that set our partners in making

95
00:05:52,909 --> 00:05:49,169
this map an example of those are to the

96
00:05:57,499 --> 00:05:52,919
for the rice from a shim clearly these

97
00:05:59,990 --> 00:05:57,509
organisms are fully formed selves with

98
00:06:02,029 --> 00:06:00,000
their own hereditary has apparatus and

99
00:06:04,909 --> 00:06:02,039
means of harvesting energies for the

100
00:06:07,579 --> 00:06:04,919
environment and so these we're really

101
00:06:10,179 --> 00:06:07,589
wanting to push the questions back much

102
00:06:15,499 --> 00:06:10,189
further than that three and a half

103
00:06:17,480 --> 00:06:15,509
billion year time window so as is the

104
00:06:19,790 --> 00:06:17,490
convention with the development of these

105
00:06:21,670 --> 00:06:19,800
google documents there's a question

106
00:06:23,869 --> 00:06:21,680
there's the explanation and

107
00:06:26,300 --> 00:06:23,879
justification and did a series of so

108
00:06:27,890 --> 00:06:26,310
question so the explanation or we want

109
00:06:31,189 --> 00:06:27,900
to know what are the key events that

110
00:06:35,350 --> 00:06:31,199
went into the formation and early

111
00:06:37,730 --> 00:06:35,360
evolution of life and what features were

112
00:06:40,559 --> 00:06:37,740
exchanged at the time is the first

113
00:06:43,739 --> 00:06:40,569

replicating cell or protocells and

114
00:06:49,260 --> 00:06:43,749
existence and so there on the left it as

115
00:06:53,159 --> 00:06:49,270
an example from Jack's tow sacks website

116
00:06:57,600 --> 00:06:53,169
and also says that's involved by for

117
00:07:02,659 --> 00:06:57,610
presentation as in falses example of a

118
00:07:05,999 --> 00:07:02,669
protocell an enclosed of lipids

119
00:07:09,869 --> 00:07:06,009
structure with some nucleic acid inside

120
00:07:12,079 --> 00:07:09,879
and we also want to know is there

121
00:07:14,909 --> 00:07:12,089
minimal set of vital requirements

122
00:07:19,079 --> 00:07:14,919
including you know genetics of

123
00:07:21,649 --> 00:07:19,089
self-replication translation if proteins

124
00:07:26,309 --> 00:07:21,659
are involved compartmentalization

125
00:07:31,619 --> 00:07:26,319
metabolism so we would like to know in

126
00:07:35,159 --> 00:07:31,629
that great leaf from from my cells and

127
00:07:38,570 --> 00:07:35,169
vesicles and ribozymes to what we would

128
00:07:43,290 --> 00:07:38,580
recognize as it excel you know what what

129
00:07:45,809 --> 00:07:43,300
what if what of these features any

130
00:07:53,189 --> 00:07:45,819
subset or all of them are necessary for

131
00:07:56,059 --> 00:07:53,199
us to call us alive so um we also and

132
00:07:59,939 --> 00:07:56,069
then one of the participants has been

133
00:08:01,949 --> 00:07:59,949
pinging us about this that's how to the

134
00:08:07,799 --> 00:08:01,959
essential traits of life arise from the

135
00:08:12,239 --> 00:08:07,809
Jew chemical environment as Jim pointed

136
00:08:14,249 --> 00:08:12,249
out almost in a kind of Greek way back

137
00:08:18,689 --> 00:08:14,259
in the back in the beginning if there

138
00:08:21,480 --> 00:08:18,699

was really just you know whitewater rock

139
00:08:24,379 --> 00:08:21,490
heaps to work with so how do these

140
00:08:28,100 --> 00:08:24,389
essential trades of life arise from this

141
00:08:31,230 --> 00:08:28,110
geochemistry and what factors do we

142
00:08:35,279 --> 00:08:31,240
consider essential for generating the

143
00:08:41,600 --> 00:08:35,289
first recognizable soothing system so

144
00:08:45,809 --> 00:08:41,610
the group was very interested in pushing

145
00:08:50,269 --> 00:08:45,819
in the next roadmap the idea that we can

146
00:08:54,360 --> 00:08:50,279
approach these enormous questions

147
00:08:57,180 --> 00:08:54,370
experimentally and these experiments

148
00:09:02,250 --> 00:08:57,190
could be wet lab experiments or they

149
00:09:06,170 --> 00:09:02,260
could be in silico experiments they the

150
00:09:08,610 --> 00:09:06,180
the groups all that there was a

151
00:09:12,269 --> 00:09:08,620
potentially a clear path to doing that

152
00:09:15,540 --> 00:09:12,279
I'd like to articulated as I understand

153
00:09:17,130 --> 00:09:15,550
with consent to swab so these

154
00:09:22,230 --> 00:09:17,140
experiments could be based on

155
00:09:25,440 --> 00:09:22,240
simplifying X have cells so everybody

156
00:09:27,360 --> 00:09:25,450
watching I'm sure is familiar with the

157
00:09:31,470 --> 00:09:27,370
work that was published by Craig Venters

158
00:09:36,290 --> 00:09:31,480
group not long ago about of creating

159
00:09:41,250 --> 00:09:36,300
from us new from human synthesized DNA

160
00:09:44,430 --> 00:09:41,260
chumps a functional microbial cells this

161
00:09:46,880 --> 00:09:44,440
is a papers that's now about five years

162
00:09:50,550 --> 00:09:46,890
old that was published in science and

163
00:09:54,150 --> 00:09:50,560

more recently of people in George

164
00:10:01,880 --> 00:09:54,160
church's labs have taken this further

165
00:10:07,460 --> 00:10:04,260
computation of the understanding of what

166
00:10:10,970 --> 00:10:07,470
a minimal cell like Venters

167
00:10:16,980 --> 00:10:10,980
mycobacterium might look like and then

168
00:10:20,460 --> 00:10:16,990
others have taken kind of a bottom-up

169
00:10:23,930 --> 00:10:20,470
approach notably researchers and Jack

170
00:10:26,930 --> 00:10:23,940
szostak slabs of trying to take

171
00:10:29,900 --> 00:10:26,940
replicating entities and

172
00:10:34,410 --> 00:10:29,910
self-replicating vesicles and creating

173
00:10:39,150 --> 00:10:34,420
protocells so one task is to try to

174
00:10:41,220 --> 00:10:39,160
simplify X 10 cells to basically strip

175
00:10:43,620 --> 00:10:41,230
them down to their absolute minimum and

176
00:10:46,890 --> 00:10:43,630
see what they look like and how easily

177
00:10:51,440 --> 00:10:46,900
or how difficult it is to model the

178
00:10:53,730 --> 00:10:51,450
behavior and the other is say the

179
00:10:57,860 --> 00:10:53,740
constituents of frota cells and try to

180
00:11:02,070 --> 00:10:57,870
fill them up from the bottom so these

181
00:11:04,590 --> 00:11:02,080
computational models that could come

182
00:11:06,000 --> 00:11:04,600
from approaches like that of church and

183
00:11:07,510 --> 00:11:06,010
some others that i'll show you in the

184
00:11:11,830 --> 00:11:07,520
next slide I

185
00:11:14,770 --> 00:11:11,840
deity these computational models should

186
00:11:20,320 --> 00:11:14,780
generate hypotheses that can be tested

187
00:11:23,440 --> 00:11:20,330
in the laboratory and it is i think a

188
00:11:27,070 --> 00:11:23,450

dominant theme of the conversations in

189
00:11:29,980 --> 00:11:27,080
our group was that there should be an

190
00:11:32,920 --> 00:11:29,990
interplay between theory and experiment

191
00:11:36,970 --> 00:11:32,930
is trying to gain greater understanding

192
00:11:41,590 --> 00:11:36,980
of these initials fits in leading to the

193
00:11:44,200 --> 00:11:41,600
formation of life so perhaps an

194
00:11:48,040 --> 00:11:44,210
interesting paper that people might look

195
00:11:50,650 --> 00:11:48,050
at along these lines is the paper

196
00:11:54,210 --> 00:11:50,660
published last year in cell by curt it

197
00:11:59,350 --> 00:11:54,220
out where they took mycobacterium

198
00:12:01,300 --> 00:11:59,360
genitalium its smallest free-living I

199
00:12:03,820 --> 00:12:01,310
think he's free living because it's a

200
00:12:08,830 --> 00:12:03,830
parasitic bacteria but at least it's not

201
00:12:11,500 --> 00:12:08,840
an intracellular parasites like some of

202
00:12:13,600 --> 00:12:11,510
those interesting organisms living in

203
00:12:16,450 --> 00:12:13,610
insect deaths is fried by John

204
00:12:20,590 --> 00:12:16,460
McCutcheon recently and Nancy Moran's

205
00:12:23,710 --> 00:12:20,600
his hosts awful advisor anyway the

206
00:12:27,250 --> 00:12:23,720
current out of paper actually does some

207
00:12:31,030 --> 00:12:27,260
brilliant modeling and the objective of

208
00:12:34,890 --> 00:12:31,040
this paper and related papers that have

209
00:12:37,360 --> 00:12:34,900
amounts from this group is to simulate

210
00:12:43,180 --> 00:12:37,370
something which what we think of as

211
00:12:45,580 --> 00:12:43,190
being quite simple namely see what

212
00:12:48,760 --> 00:12:45,590
Jacques Monod called the dream of every

213
00:12:52,860 --> 00:12:48,770

cell which is to come to self so they're

214
00:12:59,620 --> 00:12:52,870
modeling cell division and taking these

215
00:13:03,820 --> 00:12:59,630
various of input of parameters

216
00:13:07,180 --> 00:13:03,830
chromosome transcript RNA geometry of

217
00:13:11,440 --> 00:13:07,190
the cell etc and synthy cell variables

218
00:13:16,590 --> 00:13:11,450
to these cell prophecies as submodels

219
00:13:19,980 --> 00:13:16,600
and then iteratively tried to come to a

220
00:13:21,100 --> 00:13:19,990
model-based understanding of the

221
00:13:25,000 --> 00:13:21,110
bacterial

222
00:13:27,819 --> 00:13:25,010
a process of producing to sell so I

223
00:13:31,780 --> 00:13:27,829
found this interesting quote it right

224
00:13:34,720 --> 00:13:31,790
now running a simulation for a single

225
00:13:36,819 --> 00:13:34,730
cell to divide only one time takes about

226
00:13:41,590 --> 00:13:36,829
ten hours and generates half a gigabyte

227
00:13:45,460 --> 00:13:41,600
of data covert Souls the New York Times

228
00:13:47,319 --> 00:13:45,470
the lead author at Stanford i find it

229
00:13:49,389 --> 00:13:47,329
fat completely fascinating because i

230
00:13:51,810 --> 00:13:49,399
don't know that anyone has ever asked

231
00:13:56,100 --> 00:13:51,820
how much data a living thing truly folks

232
00:13:59,050 --> 00:13:56,110
i would add to that remark that that

233
00:14:03,220 --> 00:13:59,060
that data that he's talking about their

234
00:14:06,250 --> 00:14:03,230
relates to see the cell cycles and

235
00:14:08,500 --> 00:14:06,260
presumably not just the variables within

236
00:14:11,350 --> 00:14:08,510
the cell but also the stimuli that are

237
00:14:14,410 --> 00:14:11,360
external to the cell and there's a lot

238
00:14:18,569 --> 00:14:14,420

more to cells and simply dividing and in

239
00:14:20,650 --> 00:14:18,579
fact as most environmental ma cripes

240
00:14:24,250 --> 00:14:20,660
microbiologists knows perhaps the

241
00:14:26,860 --> 00:14:24,260
overwhelming majority of species on this

242
00:14:29,319 --> 00:14:26,870
planet spend their time in some form of

243
00:14:32,290 --> 00:14:29,329
suspended animation switcher force has

244
00:14:35,759 --> 00:14:32,300
its own programs that would need to be

245
00:14:41,670 --> 00:14:35,769
modeled as well as the exits from that

246
00:14:44,100 --> 00:14:41,680
from that space alright so those are the

247
00:14:48,370 --> 00:14:44,110
explanations so what about justification

248
00:14:52,240 --> 00:14:48,380
well astrobiology operates with implicit

249
00:14:56,560 --> 00:14:52,250
and as time goes on for more explicit

250
00:14:59,590 --> 00:14:56,570
models for fly and our focus in this

251
00:15:02,009 --> 00:14:59,600
roof kept trying either by bottom-up or

252
00:15:07,269 --> 00:15:02,019
top-down methods to come up with a

253
00:15:10,329 --> 00:15:07,279
functioning protocell so this is what we

254
00:15:13,120 --> 00:15:10,339
felt with the introduc t'avais of trying

255
00:15:16,990 --> 00:15:13,130
to get FC at these ultimate questions

256
00:15:20,759 --> 00:15:17,000
about life's origins and so the idea is

257
00:15:24,730 --> 00:15:20,769
that there's a lot of information that

258
00:15:29,430 --> 00:15:24,740
is that that the top down approach

259
00:15:34,540 --> 00:15:29,440
actually starts with off with phylogeny

260
00:15:39,550 --> 00:15:34,550
represented by this recess nature paper

261
00:15:42,800 --> 00:15:39,560
if I gooey and should he shows he dumb

262
00:15:45,230 --> 00:15:42,810
and then on the bottom synthetic biology

263
00:15:50,300 --> 00:15:45,240

which is represented in the bottom panel

264
00:15:53,989 --> 00:15:50,310
on the left where an approach of trying

265
00:15:57,980 --> 00:15:53,999
to put together the components that form

266
00:16:00,650 --> 00:15:57,990
a cell is the object of study set a

267
00:16:04,299 --> 00:16:00,660
protocell basically lies it in

268
00:16:06,769 --> 00:16:04,309
intersection of these activities of

269
00:16:09,350 --> 00:16:06,779
phylogenetic analysis which is really

270
00:16:13,579 --> 00:16:09,360
famously taking all of life diversity

271
00:16:18,980 --> 00:16:13,589
and trying to not just organize it but

272
00:16:23,139 --> 00:16:18,990
to generate testable hypotheses as to

273
00:16:26,840 --> 00:16:23,149
the relationship and the history of

274
00:16:30,889 --> 00:16:26,850
relationships among these texts ampsuit

275
00:16:35,090 --> 00:16:30,899
beings with and we share the planet okay

276
00:16:37,960 --> 00:16:35,100
so knowing this model and here I'm not

277
00:16:41,420 --> 00:16:37,970
talking about a model in terms of

278
00:16:44,480 --> 00:16:41,430
computational models such as that

279
00:16:48,619 --> 00:16:44,490
described by car now but rather the

280
00:16:50,780 --> 00:16:48,629
protocells model can suggest experiments

281
00:16:54,549 --> 00:16:50,790
involving alternate south chemistry so

282
00:16:59,600 --> 00:16:54,559
once we get to this the group felt that

283
00:17:02,449 --> 00:16:59,610
and getting this tool would enable a lot

284
00:17:05,679 --> 00:17:02,459
of experiments to take place that could

285
00:17:10,120 --> 00:17:05,689
themselves be informed by computational

286
00:17:14,079 --> 00:17:10,130
analysis alright so that's the

287
00:17:17,779 --> 00:17:14,089
explanation justification as with the

288
00:17:20,270 --> 00:17:17,789

other topics we were asked to identify a

289
00:17:23,899 --> 00:17:20,280
number of sub questions and in the

290
00:17:28,100 --> 00:17:23,909
roadmap perhaps some of these could be

291
00:17:31,730 --> 00:17:28,110
sorted out as was in this 2008 roadmap

292
00:17:34,669 --> 00:17:31,740
to suggest particular lines of

293
00:17:36,770 --> 00:17:34,679
investigation so we can ask what

294
00:17:39,770 --> 00:17:36,780
evolutionary pressures like you know

295
00:17:42,080 --> 00:17:39,780
selection mutation and griff apply to

296
00:17:46,320 --> 00:17:42,090
earliest loss what environmental

297
00:17:49,490 --> 00:17:46,330
pressures whether they be

298
00:17:52,409 --> 00:17:49,500
abiotic factors like carbon availability

299
00:17:54,000 --> 00:17:52,419
energy sources or biotic factors like a

300
00:17:57,649 --> 00:17:54,010
distribution and abundance of

301
00:18:01,049 --> 00:17:57,659
competitors and predators and parasites

302
00:18:04,350 --> 00:18:01,059
is life a necessary consequence of

303
00:18:06,930 --> 00:18:04,360
certain environmental conditions and a

304
00:18:09,830 --> 00:18:06,940
gem was alluding to this and some of his

305
00:18:13,230 --> 00:18:09,840
remarks before the webinar got underway

306
00:18:17,850 --> 00:18:13,240
as well as what is a minimal energetic

307
00:18:20,700 --> 00:18:17,860
source and mechanism photo auto trophy

308
00:18:22,830 --> 00:18:20,710
has carried out by plants and even by

309
00:18:25,500 --> 00:18:22,840
sign of bacteria is a wonderfully

310
00:18:27,930 --> 00:18:25,510
complex mechanism for what are this were

311
00:18:31,580 --> 00:18:27,940
the simplest chemistry's by which cells

312
00:18:37,279 --> 00:18:31,590
and extract or protocells that extract

313
00:18:40,289 --> 00:18:37,289

energy for carrying out replication and

314
00:18:42,840 --> 00:18:40,299
self-assembly growing from the

315
00:18:46,529 --> 00:18:42,850
environment how to kill a skinny as

316
00:18:49,110 --> 00:18:46,539
Moses emerged how did the elhas of

317
00:18:52,649 --> 00:18:49,120
friend life arrive and how do they

318
00:18:56,460 --> 00:18:52,659
operate in their simplest forms so the

319
00:18:59,370 --> 00:18:56,470
lipid bilayer that surround cells is

320
00:19:01,889 --> 00:18:59,380
also very complicated structure you know

321
00:19:06,659 --> 00:19:01,899
what did the simplest with if I layer

322
00:19:09,450 --> 00:19:06,669
around the proto cells of life what are

323
00:19:12,570 --> 00:19:09,460
the what did the simplest of metabolic

324
00:19:17,269 --> 00:19:12,580
networks the minimal networks required

325
00:19:21,529 --> 00:19:17,279
for harvesting energy and harvesting of

326
00:19:26,370 --> 00:19:21,539
carbon and micro nutrients from the

327
00:19:28,889 --> 00:19:26,380
environments other sub questions is it

328
00:19:31,590 --> 00:19:28,899
implicit in the previous slide is what

329
00:19:34,620 --> 00:19:31,600
is file genetics analysis felt about the

330
00:19:38,519 --> 00:19:34,630
oldest forms of life and the most common

331
00:19:42,620 --> 00:19:38,529
genetic components in synthetic biology

332
00:19:46,769 --> 00:19:42,630
we use to construct a simple life form

333
00:19:49,669 --> 00:19:46,779
from Adams up or do we need to start

334
00:19:52,860 --> 00:19:49,679
with components of living cells a

335
00:19:56,539 --> 00:19:52,870
question here are endosymbiotic good

336
00:20:00,090 --> 00:19:56,549
model for earliest cellular life and so

337
00:20:02,130 --> 00:20:00,100
the mycobacterium model which is

338
00:20:05,340 --> 00:20:02,140

been used to explore the concept of the

339
00:20:08,130 --> 00:20:05,350
minimal genome is in fact it is not an

340
00:20:12,380 --> 00:20:08,140
intracellular but rather an intra

341
00:20:15,840 --> 00:20:12,390
organismal of parasites and in fact

342
00:20:17,520 --> 00:20:15,850
organisms benefit discovered it's only

343
00:20:19,860 --> 00:20:17,530
in the last couple of years that have

344
00:20:22,650 --> 00:20:19,870
these and smaller genomes Gino's on the

345
00:20:28,230 --> 00:20:22,660
order is smaller than viruses and on the

346
00:20:32,220 --> 00:20:28,240
order of similar classes these symbiotic

347
00:20:34,409 --> 00:20:32,230
organisms can only carry out their

348
00:20:36,539 --> 00:20:34,419
functions by virtue of metabolic

349
00:20:39,149 --> 00:20:36,549
interactions with other such organisms

350
00:20:42,600 --> 00:20:39,159
or living within a host that provides

351
00:20:45,539 --> 00:20:42,610
many of the necessities for life and so

352
00:20:47,549 --> 00:20:45,549
while I think here's I'm venturing into

353
00:20:51,470 --> 00:20:47,559
the land of opinion here while I think

354
00:20:55,380 --> 00:20:51,480
that these mutualisms and their minimal

355
00:20:57,120 --> 00:20:55,390
genome contents are very interesting we

356
00:21:01,770 --> 00:20:57,130
need to bear in mind that they are

357
00:21:03,990 --> 00:21:01,780
derived characters not successful one so

358
00:21:06,210 --> 00:21:04,000
pretend what are the relevant spatial

359
00:21:09,120 --> 00:21:06,220
and temporal scales the origin of life

360
00:21:12,020 --> 00:21:09,130
number 11 how the conditions for life

361
00:21:16,169 --> 00:21:12,030
origin differ from the conditions for

362
00:21:18,330 --> 00:21:16,179
sustaining life and how can this inform

363
00:21:21,510 --> 00:21:18,340

our discussion about what food

364
00:21:26,820 --> 00:21:21,520
constitutes a habitable zone on other

365
00:21:32,250 --> 00:21:26,830
world and how might we seek a habitable

366
00:21:36,480 --> 00:21:32,260
zone of remotely of using using probes

367
00:21:39,419 --> 00:21:36,490
and then the last five questions in life

368
00:21:43,080 --> 00:21:39,429
or metabolism function of structures or

369
00:21:45,000 --> 00:21:43,090
information content or energetics what

370
00:21:48,120 --> 00:21:45,010
are the simplest structures we think of

371
00:21:51,240 --> 00:21:48,130
its having a function or at being alive

372
00:21:54,899 --> 00:21:51,250
and weighted itself it is defined by

373
00:21:57,840 --> 00:21:54,909
compartmentalization it is defined as I

374
00:21:59,610 --> 00:21:57,850
suggested and it's what know where it's

375
00:22:05,840 --> 00:21:59,620
because it is not part of the Google

376
00:22:10,049 --> 00:22:05,850
document it is designed by aging which

377
00:22:13,860 --> 00:22:10,059
is really a manifestation of entropy at

378
00:22:17,130 --> 00:22:13,870
work you know in in the living cell

379
00:22:19,830 --> 00:22:17,140
and then does it make sense to think of

380
00:22:22,020 --> 00:22:19,840
earliest life as hopes just to self the

381
00:22:25,049 --> 00:22:22,030
same chemical systems peoples undergoing

382
00:22:28,170 --> 00:22:25,059
Darwinian evolution or did these first

383
00:22:30,810 --> 00:22:28,180
replicators share genes through lateral

384
00:22:34,970 --> 00:22:30,820
gene transfer and starts Darwinian

385
00:22:39,660 --> 00:22:34,980
evolution with mutations selections with

386
00:22:41,880 --> 00:22:39,670
later on and then finally and perhaps

387
00:22:44,730 --> 00:22:41,890
most importantly how does our formation

388
00:22:48,410 --> 00:22:44,740

of the question affects the experiments

389
00:22:52,620 --> 00:22:48,420
that we prove suppose booze so the group

390
00:22:55,020 --> 00:22:52,630
felt that phylogeny and synthetic

391
00:22:57,450 --> 00:22:55,030
biology from the top down and from the

392
00:23:00,330 --> 00:22:57,460
bottom up had a lot to contribute to our

393
00:23:05,430 --> 00:23:00,340
understanding of such as sort of cells

394
00:23:08,150 --> 00:23:05,440
and modeling for themselves but but what

395
00:23:11,190 --> 00:23:08,160
that would tell us about life origins

396
00:23:14,570 --> 00:23:11,200
and so all of these questions that I

397
00:23:19,500 --> 00:23:14,580
posed and it's in the name of the group

398
00:23:22,500 --> 00:23:19,510
presuppose that the type of life that we

399
00:23:24,419 --> 00:23:22,510
are and the type of life that we have

400
00:23:26,790 --> 00:23:24,429
that we're immersed in here on this

401
00:23:33,000 --> 00:23:26,800
planet is in fact the only type of life

402
00:23:36,030 --> 00:23:33,010
that that's possible and so you know our

403
00:23:38,640 --> 00:23:36,040
would we with other life-forms be

404
00:23:41,880 --> 00:23:38,650
invisible to us because we're stuck on

405
00:23:43,860 --> 00:23:41,890
the idea of cellular life you know of

406
00:23:46,610 --> 00:23:43,870
course I'm sure that all of us living

407
00:23:49,980 --> 00:23:46,620
here have our favorite science fiction

408
00:23:53,070 --> 00:23:49,990
short story or novel where some

409
00:23:55,320 --> 00:23:53,080
alternative life form transients our

410
00:23:57,930 --> 00:23:55,330
understanding of failure life my

411
00:24:01,560 --> 00:23:57,940
personal favorites is Bradbury's is

412
00:24:04,040 --> 00:24:01,570
desirable if but I'm sure everybody

413
00:24:07,650 --> 00:24:04,050

could come up with your favorite example

414
00:24:10,740 --> 00:24:07,660
and it's with regard to this number 16

415
00:24:13,230 --> 00:24:10,750
of how it sort of brought to mind

416
00:24:15,540 --> 00:24:13,240
Heisenberg's of fixham that what we

417
00:24:19,710 --> 00:24:15,550
observe is not nature itself but rather

418
00:24:23,520 --> 00:24:19,720
nature exposed to our methods of

419
00:24:25,919 --> 00:24:23,530
questioning so here are some related

420
00:24:28,409 --> 00:24:25,929
questions i'm not going to do

421
00:24:30,450 --> 00:24:28,419
here we dissolve so that we can move on

422
00:24:33,359 --> 00:24:30,460
to our discussion of following Eric's

423
00:24:37,529 --> 00:24:33,369
presentation but this big question what

424
00:24:39,359 --> 00:24:37,539
is the simplest slice look like all of

425
00:24:41,430 --> 00:24:39,369
the answers to this question are

426
00:24:44,909 --> 00:24:41,440
ultimately related to the evolution of

427
00:24:47,279 --> 00:24:44,919
complexity whether its complexity at the

428
00:24:50,330 --> 00:24:47,289
molecular level and the evolution of

429
00:24:53,720 --> 00:24:50,340
ribozymes or in the evolution of a

430
00:24:57,840 --> 00:24:53,730
full-blown cell like mycobacterium of

431
00:25:01,080 --> 00:24:57,850
genitalia and of course complexity

432
00:25:02,940 --> 00:25:01,090
itself I love this slide my friends are

433
00:25:05,399 --> 00:25:02,950
embarrassed by how the simplest things

434
00:25:07,950 --> 00:25:05,409
in life amuse me I'm embarrassed by how

435
00:25:12,359 --> 00:25:07,960
simple my friends off so I will let that

436
00:25:15,509 --> 00:25:12,369
be my song and dance for now and let

437
00:25:17,899 --> 00:25:15,519
Eric go and then we can have our special

438
00:25:24,539 --> 00:25:17,909

so thank you for your attention and

439
00:25:27,149 --> 00:25:24,549
thank you for joining the group today ok

440
00:25:29,570 --> 00:25:27,159
thank you Frank um mike is transferring

441
00:25:33,119 --> 00:25:29,580
the slides to a different a different

442
00:25:35,340 --> 00:25:33,129
set first of all I wanted to thank Frank

443
00:25:38,100 --> 00:25:35,350
and the authors of this document for

444
00:25:41,310 --> 00:25:38,110
inviting an extra layer of commentary I

445
00:25:44,489 --> 00:25:41,320
was not part of the original discussion

446
00:25:46,529 --> 00:25:44,499
group so unfortunately I missed out on

447
00:25:48,149 --> 00:25:46,539
what happened one of the things that

448
00:25:50,310 --> 00:25:48,159
means is that the authors of course are

449
00:25:54,840 --> 00:25:50,320
not to be blamed for any opinions

450
00:25:57,710 --> 00:25:54,850
expressed by me but in some sense having

451
00:26:00,570 --> 00:25:57,720
been an outsider and seen the document

452
00:26:05,070 --> 00:26:00,580
there's a lot of depth and as I recall

453
00:26:08,310 --> 00:26:05,080
the original motivation of doing this

454
00:26:09,779 --> 00:26:08,320
sort of massively open solicitation was

455
00:26:11,850 --> 00:26:09,789
to make sure that the road mapping

456
00:26:13,889 --> 00:26:11,860
effort doesn't foreclose opportunities

457
00:26:15,899 --> 00:26:13,899
that we will later wish to support as

458
00:26:19,080 --> 00:26:15,909
people come in with ideas that we don't

459
00:26:21,480 --> 00:26:19,090
recognize now so I wanted to offer a

460
00:26:23,580 --> 00:26:21,490
couple of points of view that explore

461
00:26:25,320 --> 00:26:23,590
topics that are raised in the document

462
00:26:31,230 --> 00:26:25,330
with an eye toward keeping our options

463
00:26:34,169 --> 00:26:31,240

open um it's very common almost to the

464
00:26:36,520 --> 00:26:34,179
point of being unnoticed that when

465
00:26:39,520 --> 00:26:36,530
people talk about

466
00:26:42,310 --> 00:26:39,530
life whether minimal or the essence of

467
00:26:44,740 --> 00:26:42,320
or anything like that they often refer

468
00:26:48,030 --> 00:26:44,750
to living things but I think here we

469
00:26:52,390 --> 00:26:48,040
have we have the option to leave open an

470
00:26:54,280 --> 00:26:52,400
alternative point of view we could treat

471
00:26:56,770 --> 00:26:54,290
life as if it were characteristic that

472
00:27:00,340 --> 00:26:56,780
things take on whether their cells or

473
00:27:04,000 --> 00:27:00,350
viruses or pre ons or whatever or we

474
00:27:07,000 --> 00:27:04,010
could we could view the biosphere as a

475
00:27:09,550 --> 00:27:07,010
coordinated mosaic of forms of order

476
00:27:10,960 --> 00:27:09,560
that have different origins of the in

477
00:27:12,820 --> 00:27:10,970
the earth and that have been brought

478
00:27:14,740 --> 00:27:12,830
into coordination with each other and

479
00:27:16,060 --> 00:27:14,750
some of these are carried as properties

480
00:27:19,090 --> 00:27:16,070
of things others are carried as

481
00:27:22,300 --> 00:27:19,100
properties of relations but when we do

482
00:27:23,620 --> 00:27:22,310
that it gives us the question whether we

483
00:27:26,080 --> 00:27:23,630
shouldn't be thinking about either

484
00:27:29,020 --> 00:27:26,090
building up to model artificial cells or

485
00:27:31,990 --> 00:27:29,030
stripping down modern cells to arrive at

486
00:27:34,240 --> 00:27:32,000
small artificial cells but we could say

487
00:27:36,220 --> 00:27:34,250
is the proper abstraction and need for

488
00:27:39,120 --> 00:27:36,230

containment and what else should be

489
00:27:42,190 --> 00:27:39,130
considered within that abstraction

490
00:27:44,650 --> 00:27:42,200
certainly of william martin and michael

491
00:27:46,960 --> 00:27:44,660
russell have argued for a mineral poor

492
00:27:49,660 --> 00:27:46,970
hosted origin of early biochemistry

493
00:27:52,240 --> 00:27:49,670
going to avec dosa whose name lacks the

494
00:27:55,870 --> 00:27:52,250
umlauts with apologies made a strong

495
00:27:58,390 --> 00:27:55,880
case that many reactions in early organo

496
00:28:02,020 --> 00:27:58,400
synthesis are easy on sir easier on

497
00:28:04,330 --> 00:28:02,030
surfaces than they are in bulks and so

498
00:28:05,920 --> 00:28:04,340
the question becomes should we be

499
00:28:08,980 --> 00:28:05,930
looking for containment but not

500
00:28:11,350 --> 00:28:08,990
necessarily cells we know in the world

501
00:28:14,080 --> 00:28:11,360
today that many cellular communities

502
00:28:16,900 --> 00:28:14,090
exist in the context of biofilms which

503
00:28:18,760 --> 00:28:16,910
are manufactured secreted matrices that

504
00:28:21,580 --> 00:28:18,770
have consequences for differential

505
00:28:24,670 --> 00:28:21,590
diffusion rates of for changes in

506
00:28:28,270 --> 00:28:24,680
material properties where reactions can

507
00:28:30,100 --> 00:28:28,280
be carried out should given that many

508
00:28:32,380 --> 00:28:30,110
things were exchangeable genes were

509
00:28:34,420 --> 00:28:32,390
exchangeable early if genomes were

510
00:28:36,430 --> 00:28:34,430
incomplete perhaps metabolites were

511
00:28:38,680 --> 00:28:36,440
exchangeable early should we consider

512
00:28:41,200 --> 00:28:38,690
the possibility that a biofilm light

513
00:28:42,790 --> 00:28:41,210

diffusion matrix played an important

514
00:28:45,760 --> 00:28:42,800
role even when cells were in a very

515
00:28:48,610 --> 00:28:45,770
incomplete stage so that perhaps the

516
00:28:49,840 --> 00:28:48,620
cell is not the only important early

517
00:28:52,760 --> 00:28:49,850
form

518
00:28:54,799 --> 00:28:52,770
John McCaskill in presentations over the

519
00:28:57,230 --> 00:28:54,809
years as part of the program for

520
00:28:59,779 --> 00:28:57,240
artificial cellular resolution that we

521
00:29:02,419 --> 00:28:59,789
hosted I guess in Venice for its

522
00:29:04,970 --> 00:29:02,429
duration was working on the problem of

523
00:29:06,680 --> 00:29:04,980
microfluidic devices as a kind of

524
00:29:08,270 --> 00:29:06,690
external scaffolding that would allow

525
00:29:10,760 --> 00:29:08,280
you to separate the problems of

526
00:29:13,490 --> 00:29:10,770
coordination on the way toward making a

527
00:29:15,320 --> 00:29:13,500
protocell one can ask if the goal of

528
00:29:17,840 --> 00:29:15,330
microfluidics were not to lead to a

529
00:29:19,760 --> 00:29:17,850
protocell but to model other relevant

530
00:29:23,000 --> 00:29:19,770
forms of containment what would a

531
00:29:25,039 --> 00:29:23,010
natural way be to organize that kind of

532
00:29:28,700 --> 00:29:25,049
experiment so it remains within the

533
00:29:31,279 --> 00:29:28,710
experimental motivation of this paper

534
00:29:35,810 --> 00:29:31,289
but it may not presume the role of cells

535
00:29:39,200 --> 00:29:35,820
so much Frank set up a point that i'm

536
00:29:42,830 --> 00:29:39,210
very happy to sort of add some

537
00:29:44,750 --> 00:29:42,840
enthusiasm for life is many things it's

538
00:29:47,120 --> 00:29:44,760

many structures and many relations and

539
00:29:49,700 --> 00:29:47,130
many kinds of organization when we think

540
00:29:51,799 --> 00:29:49,710
about minimality there certainly is no

541
00:29:53,720 --> 00:29:51,809
reason to think that all things are

542
00:29:55,700 --> 00:29:53,730
minimized together and the minimization

543
00:29:58,279 --> 00:29:55,710
of one may force maximization of others

544
00:30:00,649 --> 00:29:58,289
the national science foundation hosted a

545
00:30:02,779 --> 00:30:00,659
meeting on minimal life maybe three or

546
00:30:06,680 --> 00:30:02,789
four years ago under a pristine black

547
00:30:09,620 --> 00:30:06,690
oil which was directed to the question

548
00:30:11,779 --> 00:30:09,630
is there a horizon of minimality so that

549
00:30:13,789 --> 00:30:11,789
you can't get smaller in one dimension

550
00:30:16,899 --> 00:30:13,799
without necessarily becoming more

551
00:30:19,909 --> 00:30:16,909
complicated in another again i emphasize

552
00:30:22,399 --> 00:30:19,919
minimal life may not mean minimal living

553
00:30:24,350 --> 00:30:22,409
thing if things are not the right level

554
00:30:26,480 --> 00:30:24,360
to focus on are we concerned with

555
00:30:29,120 --> 00:30:26,490
minimality of genomes as structures from

556
00:30:31,159 --> 00:30:29,130
memory and control are we concerned with

557
00:30:32,990 --> 00:30:31,169
the minimal dependence on the ecosystem

558
00:30:35,510 --> 00:30:33,000
the minimal complexity that the

559
00:30:36,740 --> 00:30:35,520
ecosystem itself has to have are we

560
00:30:39,409 --> 00:30:36,750
concerned with the minimal

561
00:30:41,659 --> 00:30:39,419
self-sufficient biochemistry and under

562
00:30:44,930 --> 00:30:41,669
what conditions fluctuating protected

563
00:30:49,159 --> 00:30:44,940

hot saline etc and these are questions

564
00:30:51,680 --> 00:30:49,169
that can be partly done in the purview

565
00:30:53,870 --> 00:30:51,690
of synthetic biology but they also drift

566
00:30:56,240 --> 00:30:53,880
over into synthetic organic chemistry

567
00:31:00,260 --> 00:30:56,250
and so perhaps that's an area that's an

568
00:31:02,060 --> 00:31:00,270
interface with other position papers not

569
00:31:02,960 --> 00:31:02,070
as central in this one but important to

570
00:31:06,260 --> 00:31:02,970
keep

571
00:31:09,830 --> 00:31:06,270
um the question of the order of steps is

572
00:31:11,779 --> 00:31:09,840
a deep and really hard one molecular

573
00:31:13,430 --> 00:31:11,789
replication is important now but it's a

574
00:31:15,799 --> 00:31:13,440
system property compartments are

575
00:31:18,409 --> 00:31:15,809
important and they also involve many

576
00:31:20,960 --> 00:31:18,419
levels of system segregation phase

577
00:31:23,029 --> 00:31:20,970
separation containment topologies active

578
00:31:25,820 --> 00:31:23,039
transport bioenergetics and so forth

579
00:31:28,640 --> 00:31:25,830
when we think about the order in which

580
00:31:30,320 --> 00:31:28,650
things came online in early life what's

581
00:31:32,270 --> 00:31:30,330
the relation between the advent of

582
00:31:34,250 --> 00:31:32,280
replication and the advent of

583
00:31:37,840 --> 00:31:34,260
compartments what kinds of compartments

584
00:31:40,520 --> 00:31:37,850
minerals porous surfaces vesicles

585
00:31:41,779 --> 00:31:40,530
compose ohms have been proposed by Doran

586
00:31:44,480 --> 00:31:41,789
land set and daniel said grain

587
00:31:46,520 --> 00:31:44,490
collaborators how many distinct

588
00:31:49,100 --> 00:31:46,530

compartments is a cell even how many

589
00:31:52,070 --> 00:31:49,110
distinct compartmentalization roles does

590
00:31:54,950 --> 00:31:52,080
it perform in bioenergetics in catalysis

591
00:31:58,299 --> 00:31:54,960
in the separation of reaction domain in

592
00:32:01,490 --> 00:31:58,309
el mio stasis when we think about

593
00:32:03,680 --> 00:32:01,500
molecular replication what exactly do we

594
00:32:06,289 --> 00:32:03,690
have in mind for molecular replication

595
00:32:08,870 --> 00:32:06,299
it's a system-level feature today that

596
00:32:11,659 --> 00:32:08,880
involves at the minimum RNA and proteins

597
00:32:16,279 --> 00:32:11,669
but its many types of RNA and protein

598
00:32:18,140 --> 00:32:16,289
asia's of highly evolved molecules that

599
00:32:22,390 --> 00:32:18,150
brings to what I think should be the

600
00:32:24,980 --> 00:32:22,400
next slide which is that the problem of

601
00:32:27,289 --> 00:32:24,990
understanding how ribosomal II mediated

602
00:32:30,080 --> 00:32:27,299
translation relates to the rest of life

603
00:32:31,820 --> 00:32:30,090
is just enormously hard and there are

604
00:32:33,649 --> 00:32:31,830
other papers and other investigators in

605
00:32:36,140 --> 00:32:33,659
this meeting who are dedicated to that

606
00:32:37,909 --> 00:32:36,150
particular problem but it strikes me as

607
00:32:40,820 --> 00:32:37,919
one of the most difficult and enigmatic

608
00:32:42,860 --> 00:32:40,830
major transitions to see through harder

609
00:32:45,380 --> 00:32:42,870
in some ways than biochemistry harder in

610
00:32:47,930 --> 00:32:45,390
some ways in cellular ization because

611
00:32:51,230 --> 00:32:47,940
it's an assembly of so many tuned

612
00:32:52,850 --> 00:32:51,240
components into a system so one of the

613
00:32:55,490 --> 00:32:52,860

questions of minimality that seems

614
00:32:58,070 --> 00:32:55,500
pressing to me is how many qualitatively

615
00:33:00,740 --> 00:32:58,080
distinct stages in molecular replication

616
00:33:03,680 --> 00:33:00,750
go through to arrive at the ribosome and

617
00:33:06,289 --> 00:33:03,690
can we in any way reconstruct what those

618
00:33:09,340 --> 00:33:06,299
must have been if there were many levels

619
00:33:12,710 --> 00:33:09,350
of ribosomal or of pre ribosomal

620
00:33:15,640 --> 00:33:12,720
molecular system replication which one's

621
00:33:18,720 --> 00:33:15,650
of those may have been prior to or

622
00:33:21,340 --> 00:33:18,730
posterior to one or another form of

623
00:33:25,180 --> 00:33:21,350
compartmentalization so these are sort

624
00:33:27,610 --> 00:33:25,190
of attempts to unpack details of sub

625
00:33:29,800 --> 00:33:27,620
questions that seem to me to be resident

626
00:33:33,580 --> 00:33:29,810
in this document and I think that's all

627
00:33:43,000 --> 00:33:33,590
that I had to say I'm very happy on to

628
00:33:49,860 --> 00:33:43,010
open to the discussion and you might be

629
00:33:54,460 --> 00:33:49,870
muted find out one again let's see um

630
00:33:56,800 --> 00:33:54,470
thank you to both of you so I think at

631
00:34:01,480 --> 00:33:56,810
this point we can just open our our

632
00:34:05,260 --> 00:34:01,490
phone lines up ally I can see that you

633
00:34:11,710 --> 00:34:05,270
had comments or questions so go right

634
00:34:13,480 --> 00:34:11,720
ahead yes we can yeah okay Sakura from

635
00:34:16,770 --> 00:34:13,490
Frank right yeah it applies of you

636
00:34:22,990 --> 00:34:16,780
mention any dimension synthesis and

637
00:34:25,690 --> 00:34:23,000
basically i'm looking at here reductive

638
00:34:28,149 --> 00:34:25,700

approach obviously you refer to the

639
00:34:30,490 --> 00:34:28,159
lodging and synthetic biology but also

640
00:34:33,460 --> 00:34:30,500
what is important here from point of the

641
00:34:35,950 --> 00:34:33,470
chemistry is we've using the facing

642
00:34:39,340 --> 00:34:35,960
element if you look at my illogical

643
00:34:41,919 --> 00:34:39,350
tentative a protein Ali started her up

644
00:34:46,540 --> 00:34:41,929
but it's hard to hear you can you either

645
00:34:48,340 --> 00:34:46,550
speak up or move closer I just

646
00:34:52,840 --> 00:34:48,350
disconnected in my head suppose really

647
00:34:56,130 --> 00:34:52,850
know that's that's better very ok Frank

648
00:34:59,230 --> 00:34:56,140
in the title here can you hear me yes

649
00:35:01,420 --> 00:34:59,240
projects great there's indication of

650
00:35:03,970 --> 00:35:01,430
synthetic ten reductive approaches

651
00:35:06,520 --> 00:35:03,980
obviously referred to phylogeny and

652
00:35:09,760 --> 00:35:06,530
synthetic biology but one of the point

653
00:35:11,740 --> 00:35:09,770
I'm trying to refer to is a reducing

654
00:35:15,280 --> 00:35:11,750
capacity of elements for example in

655
00:35:17,140 --> 00:35:15,290
biological tissues in entities we are

656
00:35:19,480 --> 00:35:17,150
dealing with nitrogen I was just

657
00:35:21,640 --> 00:35:19,490
discussing with a mirror yesterday is

658
00:35:23,620 --> 00:35:21,650
from New Zealand and if you look at

659
00:35:26,890 --> 00:35:23,630
except the fertilizers and for example

660
00:35:29,350 --> 00:35:26,900
explosives we have a reducing element

661
00:35:31,660 --> 00:35:29,360
that is basically is

662
00:35:33,910 --> 00:35:31,670
the entity of life so having that

663
00:35:36,970 --> 00:35:33,920

reduced in capacity of elements can be

664
00:35:39,880 --> 00:35:36,980
basically a very important element in

665
00:35:41,620 --> 00:35:39,890
initiation of life also carbon other

666
00:35:43,930 --> 00:35:41,630
side for example in for the synthesis

667
00:35:46,630 --> 00:35:43,940
carbon is going to be reduced it's going

668
00:35:49,600 --> 00:35:46,640
to transfer from co tube during process

669
00:35:52,200 --> 00:35:49,610
to example glucose and koi Bible so

670
00:35:54,460 --> 00:35:52,210
these are basically elements that has

671
00:35:56,700 --> 00:35:54,470
reductive capacity not component of

672
00:36:03,250 --> 00:35:56,710
biology but also from point of chemistry

673
00:36:09,460 --> 00:36:03,260
what is a perspecto that Frank I think

674
00:36:13,780 --> 00:36:09,470
you muted just try and only so fun I'm

675
00:36:16,300 --> 00:36:13,790
sorry but I did not understand I did not

676
00:36:20,110 --> 00:36:16,310
understand there was a commentary from

677
00:36:22,660 --> 00:36:20,120
Ali about reductive chemistry but then

678
00:36:25,060 --> 00:36:22,670
it faded off there at the very end so I

679
00:36:28,350 --> 00:36:25,070
hate to make this a cumbersome process

680
00:36:32,290 --> 00:36:28,360
but could you please repeat the question

681
00:36:35,380 --> 00:36:32,300
Frank basically you mentioned it type of

682
00:36:39,840 --> 00:36:35,390
mentioned about phylogeny and synthetic

683
00:36:43,750 --> 00:36:39,850
biology based on synthesis and reductive

684
00:36:45,970 --> 00:36:43,760
process but this reductive process just

685
00:36:48,460 --> 00:36:45,980
ignites something in my mind which is

686
00:36:51,040 --> 00:36:48,470
basically reducing capacity of elements

687
00:36:53,740 --> 00:36:51,050
for example nitrogen as extensive

688
00:36:56,530 --> 00:36:53,750

reducing capacity and if you look at

689
00:36:58,990 --> 00:36:56,540
tissues biological entity nitrogen

690
00:37:01,420 --> 00:36:59,000
extensively involved in these tissues

691
00:37:04,930 --> 00:37:01,430
and these entities and are introduced

692
00:37:07,270 --> 00:37:04,940
for except the synthetic for example

693
00:37:09,940 --> 00:37:07,280
chemicals like a fertilizers or example

694
00:37:12,130 --> 00:37:09,950
explosive it use nitrogen the rest of

695
00:37:14,770 --> 00:37:12,140
the nitrogen planet would be in a form

696
00:37:17,080 --> 00:37:14,780
of reduced form so having nitrogen as

697
00:37:25,000 --> 00:37:17,090
one of the essential elements of life

698
00:37:30,700 --> 00:37:25,010
can be important yes absolutely I agree

699
00:37:34,330 --> 00:37:30,710
actually your case your point I think

700
00:37:37,480 --> 00:37:34,340
that most and Eric maybe you can correct

701
00:37:40,030 --> 00:37:37,490
me if I'm wrong here and Ollie as well I

702
00:37:43,059 --> 00:37:40,040
think most people involved in in

703
00:37:43,059 --> 00:37:43,069
synthetic biology

704
00:37:55,539 --> 00:37:50,219
are really they're thinking mainly about

705
00:37:59,289 --> 00:37:55,549
aerobic processes so there there are a

706
00:38:06,279 --> 00:37:59,299
number of assumptions that are built

707
00:38:08,410 --> 00:38:06,289
into these studies so they've ever been

708
00:38:11,229 --> 00:38:08,420
at least in their current form they're

709
00:38:15,519 --> 00:38:11,239
not starting from the ground up that is

710
00:38:19,689 --> 00:38:15,529
to say with you no consideration you

711
00:38:24,219 --> 00:38:19,699
know the reductive capacity of the

712
00:38:26,410 --> 00:38:24,229
atmosphere and the principal elements

713
00:38:31,479 --> 00:38:26,420

are the forms of those elements that

714
00:38:34,259 --> 00:38:31,489
were available for you know quasi

715
00:38:38,380 --> 00:38:34,269
biological transformations you know for

716
00:38:42,670 --> 00:38:38,390
say 4.1 billion years ago am I getting

717
00:38:44,380 --> 00:38:42,680
your point correct yes thank you and I

718
00:38:48,209 --> 00:38:44,390
have cutter common to which is I think

719
00:38:51,219 --> 00:38:48,219
it's important in your slide you have a

720
00:38:55,479 --> 00:38:51,229
basically bacteriophage which is virus

721
00:38:59,199 --> 00:38:55,489
and also there's indication in section 9

722
00:39:00,939 --> 00:38:59,209
of the sub questions endosymbionts

723
00:39:03,670 --> 00:39:00,949
endosymbionts obviously they need host

724
00:39:06,309 --> 00:39:03,680
but what is interesting so far and I

725
00:39:08,620 --> 00:39:06,319
follow up these basically discussions I

726
00:39:10,599 --> 00:39:08,630
haven't seen the view of neurologists

727
00:39:12,039 --> 00:39:10,609
but we have mostly biologists and

728
00:39:14,529 --> 00:39:12,049
basically molecular biologists and

729
00:39:17,890 --> 00:39:14,539
chemists I think having involved the

730
00:39:20,229 --> 00:39:17,900
viruses as the entity which can be a

731
00:39:26,140 --> 00:39:20,239
question of canisius initiation of life

732
00:39:27,870 --> 00:39:26,150
can be very important not only but not

733
00:39:30,249 --> 00:39:27,880
necessarily they need to host we have a

734
00:39:33,910 --> 00:39:30,259
theory right now hypothesis is called

735
00:39:37,089 --> 00:39:33,920
virus first hypothesis and basically

736
00:39:40,089 --> 00:39:37,099
this indicates that viruses can be

737
00:39:42,219 --> 00:39:40,099
basically as the element of

738
00:39:44,920 --> 00:39:42,229

self-replicating can be initiation of

739
00:39:47,319 --> 00:39:44,930
life and then they find a hose and

740
00:39:51,039 --> 00:39:47,329
develop their structures so wires as

741
00:39:57,459 --> 00:39:51,049
entity can be important element in study

742
00:40:04,549 --> 00:40:02,209
equal a coin and you know can it please

743
00:40:08,239 --> 00:40:04,559
someone jump in and correct my

744
00:40:10,729 --> 00:40:08,249
scientific ignorance but hasn't been

745
00:40:15,039 --> 00:40:10,739
recently been discovered viruses of

746
00:40:18,309 --> 00:40:15,049
viruses is my hallucination here Holly

747
00:40:23,150 --> 00:40:18,319
there are two hypothesis right now about

748
00:40:24,739 --> 00:40:23,160
basically development of viruses one of

749
00:40:26,870 --> 00:40:24,749
them is a regression one of them is

750
00:40:29,569 --> 00:40:26,880
progressive Progressive is referring to

751
00:40:32,509 --> 00:40:29,579
example like it for example retro wires

752
00:40:35,599 --> 00:40:32,519
that RNA is going to transfer to DNA and

753
00:40:37,160 --> 00:40:35,609
so on migrate to nucleus and the host

754
00:40:41,599 --> 00:40:37,170
cells other one is a regressive

755
00:40:43,759 --> 00:40:41,609
hypothesis that basically these to

756
00:40:46,429 --> 00:40:43,769
indicate that the viruses they need the

757
00:40:48,799 --> 00:40:46,439
host but also we have a theory

758
00:40:51,650 --> 00:40:48,809
hypothesis called first virus first

759
00:40:54,609 --> 00:40:51,660
hypothesis that they can basically they

760
00:40:57,739 --> 00:40:54,619
can be initiated and they basically

761
00:41:11,390 --> 00:40:57,749
assembled initially and then they find

762
00:41:14,299 --> 00:41:11,400
their host I can't hear it Frank so that

763
00:41:16,249 --> 00:41:14,309

there was in fact yes we're talking

764
00:41:21,380 --> 00:41:16,259
about a virus finding a host but there

765
00:41:24,049 --> 00:41:21,390
was a it was a French group that found

766
00:41:27,589 --> 00:41:24,059
this is coming back that published a

767
00:41:34,880 --> 00:41:27,599
paper in Nature the three or four years

768
00:41:37,789 --> 00:41:34,890
ago basically a satellite virus which is

769
00:41:42,079 --> 00:41:37,799
in fact itself of erath age so this is

770
00:41:45,289 --> 00:41:42,089
something that I know that the put it

771
00:41:48,759 --> 00:41:45,299
but it itself is parasitizing requires a

772
00:41:52,069 --> 00:41:48,769
host but nevertheless you know the

773
00:41:54,559 --> 00:41:52,079
discovery that the trash kadhal can sort

774
00:41:58,939 --> 00:41:54,569
of be pushed back to viruses and viruses

775
00:42:02,179 --> 00:41:58,949
I think is that you it certainly puts

776
00:42:05,150 --> 00:42:02,189
some points up on the board for a virus

777
00:42:07,759 --> 00:42:05,160
first view of the evolution of line so

778
00:42:09,260 --> 00:42:07,769
it's excellent comments that really

779
00:42:14,300 --> 00:42:09,270
should be in

780
00:42:24,380 --> 00:42:14,310
operated into the the final document on

781
00:42:28,940 --> 00:42:24,390
the simplest life okay other thoughts or

782
00:42:32,240 --> 00:42:28,950
questions that anyone wants to raise or

783
00:42:33,680 --> 00:42:32,250
that could help the author team who will

784
00:42:35,960 --> 00:42:33,690
not easily be able to watch this video

785
00:42:37,970 --> 00:42:35,970
as well because all of them by aliens

786
00:42:51,730 --> 00:42:37,980
are represented here anything else that

787
00:42:58,760 --> 00:42:55,280
this is Bob Brunner can you hear me yes

788
00:43:02,390 --> 00:42:58,770

we can go ahead both I brought up some

789
00:43:05,690 --> 00:43:02,400
points early in the discussion I'd like

790
00:43:08,960 --> 00:43:05,700
to cover those if that's all right yes

791
00:43:14,140 --> 00:43:08,970
please got now the first thing I brought

792
00:43:19,510 --> 00:43:14,150
up was these uh biofilms which Bob Hazen

793
00:43:27,760 --> 00:43:19,520
called flat life and he just wrote a

794
00:43:34,310 --> 00:43:27,770
paper that came out last month and is

795
00:43:38,380 --> 00:43:34,320
the title is the Paleo mineralogy of the

796
00:43:44,660 --> 00:43:38,390
Hadean Eon a preliminary species list

797
00:43:48,650 --> 00:43:44,670
now in his body of his paper he talks

798
00:43:52,510 --> 00:43:48,660
about the diverse roles of mineral

799
00:43:55,340 --> 00:43:52,520
surfaces in protecting selecting

800
00:43:59,660 --> 00:43:55,350
concentrating templating and catalyzing

801
00:44:05,180 --> 00:43:59,670
reactions of prebiotic organic molecules

802
00:44:08,990 --> 00:44:05,190
and so I don't know if the term flat

803
00:44:12,620 --> 00:44:09,000
life is still being used but anyway that

804
00:44:17,290 --> 00:44:12,630
gets into some of the stuff of Gunther

805
00:44:20,880 --> 00:44:17,300
Bach der Hauser and Martin and so forth

806
00:44:27,100 --> 00:44:20,890
concerning these biofilms

807
00:44:30,700 --> 00:44:27,110
now i am going to the gordon conference

808
00:44:36,220 --> 00:44:30,710
next month and i have selected some

809
00:44:38,140 --> 00:44:36,230
minerals to take as an exhibit i'm i'm a

810
00:44:45,390 --> 00:44:38,150
volunteer at the Denver Museum of Nature

811
00:44:49,960 --> 00:44:45,400
and Science and I decided to pick

812
00:44:54,400 --> 00:44:49,970
minerals that are the most discussed in

813
00:44:57,210 --> 00:44:54,410

the common origin of life theories so

814
00:45:01,780 --> 00:44:57,220
for instance the first five I list on my

815
00:45:04,810 --> 00:45:01,790
comment there pyrite chalcopyrite sarah

816
00:45:11,380 --> 00:45:04,820
light Galena and ala bandai Torf really

817
00:45:13,330 --> 00:45:11,390
from armin malka janian a famous origin

818
00:45:20,410 --> 00:45:13,340
of life theorists and of course the

819
00:45:21,790 --> 00:45:20,420
pyrite is also from Ferris at rpi so you

820
00:45:26,350 --> 00:45:21,800
sort of kill two birds with one stone

821
00:45:32,890 --> 00:45:26,360
there they also are part of Gunther Bach

822
00:45:35,350 --> 00:45:32,900
ders Hauser theory then we have Steve

823
00:45:39,310 --> 00:45:35,360
Benner who came up with the theory that

824
00:45:42,040 --> 00:45:39,320
life could not have started on the earth

825
00:45:46,330 --> 00:45:42,050
because we were lacking some critical

826
00:45:48,100 --> 00:45:46,340
borates and molybdate and the only way

827
00:45:52,270 --> 00:45:48,110
those could have been created was on the

828
00:45:57,270 --> 00:45:52,280
planet Mars so it's interesting that in

829
00:46:02,680 --> 00:45:57,280
the list of the Hadean era mineral that

830
00:46:05,500 --> 00:46:02,690
Bob Hazen put forward there's 420 on the

831
00:46:10,360 --> 00:46:05,510
list and the three that Benner is

832
00:46:15,450 --> 00:46:10,370
talking about are not on that list then

833
00:46:18,010 --> 00:46:15,460
we have that those those are tourmaline

834
00:46:20,440 --> 00:46:18,020
peridot and coma night wolf a night and

835
00:46:24,730 --> 00:46:20,450
then of course we have Mike Russell at

836
00:46:26,500 --> 00:46:24,740
NASA who is talking about olivene say

837
00:46:32,890 --> 00:46:26,510
light force right and montmorillonite

838
00:46:33,220 --> 00:46:32,900

I'm sorry serpentine in that process and

839
00:46:35,250 --> 00:46:33,230
there's

840
00:46:40,599 --> 00:46:35,260
any other scientists that talk about the

841
00:46:42,640 --> 00:46:40,609
serpentine process then we have the Mars

842
00:46:45,570 --> 00:46:42,650
people are talking about what's at the

843
00:46:51,550 --> 00:46:45,580
bottom of Mount sharp montmorillonite

844
00:46:53,590 --> 00:46:51,560
some paroxetine and hazen suggested am

845
00:46:56,380 --> 00:46:53,600
feeble would be another one in that

846
00:46:59,400 --> 00:46:56,390
series and then there's course the proof

847
00:47:04,330 --> 00:46:59,410
of water on Mars which is the gypsum and

848
00:47:07,570 --> 00:47:04,340
good tight and then there's the dating

849
00:47:11,080 --> 00:47:07,580
minerals ER cons and appetites it moises

850
00:47:15,760 --> 00:47:11,090
uses in his work so there's not that

851
00:47:19,030 --> 00:47:15,770
many the minerals that somebody could

852
00:47:24,030 --> 00:47:19,040
take and make a study of the properties

853
00:47:28,750 --> 00:47:24,040
of those minerals in creating biofilms

854
00:47:31,950 --> 00:47:28,760
you know that the theory is that the and

855
00:47:36,849 --> 00:47:31,960
you know you can read doctors hauser or

856
00:47:39,609 --> 00:47:36,859
milk oj nian about how the and also

857
00:47:42,580 --> 00:47:39,619
Russell about how the these some

858
00:47:45,490 --> 00:47:42,590
minerals they trade protons and

859
00:47:49,720 --> 00:47:45,500
electrons back and forth with the

860
00:47:53,230 --> 00:47:49,730
organic molecules making them larger and

861
00:47:55,870 --> 00:47:53,240
larger and forming into possible life so

862
00:47:57,790 --> 00:47:55,880
those are the two points I wanted to

863
00:48:04,720 --> 00:47:57,800

make and I'd love to hear some comments

864
00:48:07,390 --> 00:48:04,730
from some of you folks I bought this is

865
00:48:10,780 --> 00:48:07,400
Eric thank you also for some emails that

866
00:48:15,030 --> 00:48:10,790
you sent to me and George Cody long ago

867
00:48:19,210 --> 00:48:15,040
sort of at the beginning of this process

868
00:48:20,800 --> 00:48:19,220
yeah it would be wonderful if there were

869
00:48:24,000 --> 00:48:20,810
more people working on this it would be

870
00:48:26,130 --> 00:48:24,010
wonderful if there were a thicker

871
00:48:29,200 --> 00:48:26,140
representation of the expertise of

872
00:48:31,780 --> 00:48:29,210
geologists both ad and earth geologists

873
00:48:34,680 --> 00:48:31,790
and also planetary scientists who can

874
00:48:39,820 --> 00:48:34,690
say a good bit in detail about other

875
00:48:41,859 --> 00:48:39,830
environments in this area you know my

876
00:48:43,840 --> 00:48:41,869
hope is that with mary ann michael's

877
00:48:44,220 --> 00:48:43,850
having structured the process as they

878
00:48:46,980 --> 00:48:44,230
have

879
00:48:49,560 --> 00:48:46,990
there's been ample room for that voice

880
00:48:53,540 --> 00:48:49,570
to be present here so that if then

881
00:48:56,730 --> 00:48:53,550
people come offering to do work on

882
00:48:58,650 --> 00:48:56,740
mineral organo synthesis there will be

883
00:49:00,480 --> 00:48:58,660
room in the NASA budget to support it

884
00:49:03,960 --> 00:49:00,490
because a lot of it is just scanning

885
00:49:07,109 --> 00:49:03,970
parameter space you know in addition to

886
00:49:09,000 --> 00:49:07,119
the mineral environment we have to we

887
00:49:11,430 --> 00:49:09,010
have sort of a parameter space of

888
00:49:14,670 --> 00:49:11,440

temperature pH ionic strength salinity

889
00:49:16,800 --> 00:49:14,680
and then what you think the relevant

890
00:49:19,020 --> 00:49:16,810
inputs are do you have carbon monoxide

891
00:49:22,349 --> 00:49:19,030
do you have more active organics like

892
00:49:26,120 --> 00:49:22,359
pyruvate this essentially requires

893
00:49:29,630 --> 00:49:26,130
manpower with a relatively sophisticated

894
00:49:31,560 --> 00:49:29,640
organic geochemistry bent to design

895
00:49:33,390 --> 00:49:31,570
experiments that can survey this

896
00:49:34,650 --> 00:49:33,400
parameter space efficiently in areas

897
00:49:38,880 --> 00:49:34,660
that are likely to turn up something

898
00:49:41,040 --> 00:49:38,890
useful and so anything we can do to make

899
00:49:50,789 --> 00:49:41,050
room to support such programs if good

900
00:50:02,759 --> 00:49:55,919
I would concur i would add that you know

901
00:50:05,719 --> 00:50:02,769
I when I was a postdoc I had the the the

902
00:50:11,759 --> 00:50:05,729
greatest honor and privilege of hearing

903
00:50:16,439 --> 00:50:11,769
grinter dr. Hauser at at MBL give one of

904
00:50:19,199 --> 00:50:16,449
the evening lectures it was really this

905
00:50:21,209 --> 00:50:19,209
was a notorious to the end of his life

906
00:50:24,839 --> 00:50:21,219
it was a really quite a stunning

907
00:50:29,249 --> 00:50:24,849
presentation and although I don't do it

908
00:50:32,939 --> 00:50:29,259
anymore for some some of my research

909
00:50:35,759 --> 00:50:32,949
maybe seven or eight years ago dealt

910
00:50:38,929 --> 00:50:35,769
with iron and sulfate reducing bacteria

911
00:50:41,819 --> 00:50:38,939
if granted these are very complicated

912
00:50:43,679 --> 00:50:41,829
organisms I'm not even proposing that

913
00:50:48,749 --> 00:50:43,689

they are be considered in these sort of

914
00:50:51,479 --> 00:50:48,759
you know origin of origin of life

915
00:50:55,679 --> 00:50:51,489
experiments but near the list I've

916
00:50:58,769 --> 00:50:55,689
retained an affection for that and I

917
00:51:02,279 --> 00:50:58,779
would say that and Eric maybe you can

918
00:51:07,729 --> 00:51:02,289
give me a yay or nay on that I would say

919
00:51:13,160 --> 00:51:07,739
that the there were perhaps not as many

920
00:51:18,630 --> 00:51:13,170
geologists or specifically geochemist a

921
00:51:20,459 --> 00:51:18,640
participating in the process as as as I

922
00:51:24,269 --> 00:51:20,469
might have liked to abstain is that

923
00:51:25,620 --> 00:51:24,279
would you agree or it up yeah I concur

924
00:51:27,989 --> 00:51:25,630
with that you know this is a strange

925
00:51:31,229 --> 00:51:27,999
thing in the community because it's

926
00:51:33,779 --> 00:51:31,239
clear that the expertise exists among

927
00:51:39,179 --> 00:51:33,789
people who are in this discussion and

928
00:51:42,299 --> 00:51:39,189
even many who were at Wallops um my

929
00:51:44,099 --> 00:51:42,309
personal take on this is that space

930
00:51:46,109 --> 00:51:44,109
means to be made to form communities

931
00:51:48,509 --> 00:51:46,119
which means giving a sufficient time

932
00:51:51,329 --> 00:51:48,519
horizon to encourage people to learn

933
00:51:54,150 --> 00:51:51,339
from each other because it's a long

934
00:51:56,699 --> 00:51:54,160
reach from the planetary science to find

935
00:51:59,069 --> 00:51:56,709
out what's geologically plausible so the

936
00:52:00,989 --> 00:51:59,079
mineralogical expertise to understand

937
00:52:03,880 --> 00:52:00,999
what the electron and proton exchange

938
00:52:06,400 --> 00:52:03,890

properties are of particular minerals in

939
00:52:09,789 --> 00:52:06,410
particular conditions to the organic

940
00:52:12,789 --> 00:52:09,799
chemistry to understand what relevant

941
00:52:14,829 --> 00:52:12,799
reaction classes are to search for two

942
00:52:16,690 --> 00:52:14,839
then computational chemistry problems

943
00:52:20,440 --> 00:52:16,700
how can networks complete where can you

944
00:52:21,730 --> 00:52:20,450
get concentration and then to bring this

945
00:52:24,220 --> 00:52:21,740
together with the things that

946
00:52:27,039 --> 00:52:24,230
astrobiology people have often looked at

947
00:52:31,120 --> 00:52:27,049
which is how do the end products of

948
00:52:33,670 --> 00:52:31,130
these synthetic systems provide a path

949
00:52:36,279 --> 00:52:33,680
into what we understand as life and its

950
00:52:38,109 --> 00:52:36,289
dynamics today but this is an

951
00:52:41,049 --> 00:52:38,119
extraordinarily long intellectual reach

952
00:52:42,880 --> 00:52:41,059
for any expert in any domain to engage

953
00:52:46,299 --> 00:52:42,890
well with the people on the other

954
00:52:48,220 --> 00:52:46,309
domains so I don't know I don't know

955
00:52:49,750 --> 00:52:48,230
what one can do you work on it privately

956
00:52:52,269 --> 00:52:49,760
to try to build community where you can

957
00:52:54,839 --> 00:52:52,279
and then you cheerlead from the sides to

958
00:52:56,950 --> 00:52:54,849
hope that organizations like NASA will

959
00:53:05,859 --> 00:52:56,960
institutionally encourage making these

960
00:53:12,779 --> 00:53:05,869
collaborations sticker that's I mean

961
00:53:17,170 --> 00:53:12,789
what what funds biogeochemistry work is

962
00:53:19,870 --> 00:53:17,180
whether it's in SF but also BOE and boe

963
00:53:26,279 --> 00:53:19,880

in particular interested they be

964
00:53:30,789 --> 00:53:26,289
contaminating of of aqueous phase

965
00:53:33,400 --> 00:53:30,799
radionuclides and also dealing with

966
00:53:35,559 --> 00:53:33,410
things like you know of arsenic toxicity

967
00:53:38,620 --> 00:53:35,569
in the waters and so there's a there's

968
00:53:41,289 --> 00:53:38,630
been define its chunk of money that's

969
00:53:44,769 --> 00:53:41,299
gone to the biogeochemistry community

970
00:53:46,809 --> 00:53:44,779
over the last you know 20 years ago that

971
00:53:51,099 --> 00:53:46,819
has supported a lot of wonderful basic

972
00:53:55,329 --> 00:53:51,109
research but it's really been you know

973
00:53:57,579 --> 00:53:55,339
the actual I say that the aim of most of

974
00:54:00,430 --> 00:53:57,589
this research has not been you know sort

975
00:54:04,180 --> 00:54:00,440
of open-ended what what are the variety

976
00:54:07,630 --> 00:54:04,190
of geochemistry that could you know

977
00:54:11,049 --> 00:54:07,640
provide a scaffold for protocells and

978
00:54:14,759 --> 00:54:11,059
for primitive energy transformations but

979
00:54:17,050 --> 00:54:14,769
rather how do we better understand

980
00:54:20,440 --> 00:54:17,060
ex-staff organisms and they

981
00:54:24,250 --> 00:54:20,450
interactions with these minerals with

982
00:54:26,530 --> 00:54:24,260
view towards uh you know the pushing

983
00:54:30,280 --> 00:54:26,540
aqueous phase of metal concentrations

984
00:54:32,260 --> 00:54:30,290
one way or done yes this is a thing that

985
00:54:34,390 --> 00:54:32,270
came up to some degree within the

986
00:54:37,030 --> 00:54:34,400
wallops conversation so perhaps it's

987
00:54:38,950 --> 00:54:37,040
useful in this webinar to sort of have

988
00:54:41,440 --> 00:54:38,960

it available in the record so people can

989
00:54:44,410 --> 00:54:41,450
know it happened there's still a lot

990
00:54:49,270 --> 00:54:44,420
that is not understood about states of

991
00:54:52,180 --> 00:54:49,280
carbon in the Earth's mantle and crust

992
00:54:53,530 --> 00:54:52,190
and in the sub crossville water systems

993
00:54:57,100 --> 00:54:53,540
there are some things that are

994
00:54:59,850 --> 00:54:57,110
understood but in geophysics the experts

995
00:55:02,590 --> 00:54:59,860
are far from having a full synthesis

996
00:55:04,900 --> 00:55:02,600
there is basic science to be done there

997
00:55:08,110 --> 00:55:04,910
that's of interest to the geophysicist

998
00:55:10,720 --> 00:55:08,120
and geochemist perhaps this is an

999
00:55:12,670 --> 00:55:10,730
opportunity for astrobiology to sort of

1000
00:55:15,460 --> 00:55:12,680
advertise itself as a source of basic

1001
00:55:23,710 --> 00:55:15,470
science and geochemistry and planetary

1002
00:55:25,360 --> 00:55:23,720
science the combined resources okay we

1003
00:55:29,110 --> 00:55:25,370
are just coming up to the top of the

1004
00:55:32,350 --> 00:55:29,120
hour unless there are any further

1005
00:55:36,900 --> 00:55:32,360
comments that people want to chip in I

1006
00:55:39,670 --> 00:55:36,910
would like to thank our presenters and

1007
00:55:43,810 --> 00:55:39,680
just to remind you that this video will

1008
00:55:47,470 --> 00:55:43,820
be up on the website shortly takes a day

1009
00:55:50,740 --> 00:55:47,480
or so to to crunch it so if you want to

1010
00:55:52,690 --> 00:55:50,750
refer any of your colleagues to it just

1011
00:55:55,630 --> 00:55:52,700
come back and have a look in the events

1012
00:55:57,250 --> 00:55:55,640
section on the website and you'll be

1013
00:56:01,840 --> 00:55:57,260

able to get the link directly to this

1014
00:56:04,690 --> 00:56:01,850
video and I see Frank has a point yeah

1015
00:56:09,310 --> 00:56:04,700
and I would encourage Valley and above

1016
00:56:12,550 --> 00:56:09,320
as Melissa and Paulie and a thief if he

1017
00:56:17,710 --> 00:56:12,560
wanted to write directly your comments

1018
00:56:23,020 --> 00:56:17,720
to Eric or myself hi I'm Frank Rosen

1019
00:56:26,370 --> 00:56:23,030
swagg at you montana edu and I would be

1020
00:56:30,040 --> 00:56:26,380
very keen on communicating those

1021
00:56:30,820 --> 00:56:30,050
comments of your collective thoughts to

1022
00:56:34,720 --> 00:56:30,830
the groups

1023
00:56:39,700 --> 00:56:34,730
that when the meetings and occur to sort

1024
00:56:42,490 --> 00:56:39,710
of refine this this question that your

1025
00:56:45,730 --> 00:56:42,500
opinions will be taken into account and

1026
00:56:48,550 --> 00:56:45,740
just to build on that if your comments

1027
00:56:50,590 --> 00:56:48,560
relate directly to the paper and I can

1028
00:56:53,560 --> 00:56:50,600
see that poorly is saying they will it

1029
00:56:56,020 --> 00:56:53,570
has as well early um the paper is now

1030
00:56:58,060 --> 00:56:56,030
open for commenting so if you have

1031
00:56:59,890 --> 00:56:58,070
general discussions that you want to

1032
00:57:02,130 --> 00:56:59,900
make with I can Frank that's one thing

1033
00:57:04,870 --> 00:57:02,140
but if you can help the team by

1034
00:57:06,850 --> 00:57:04,880
commenting directly in the paper it's a

1035
00:57:09,490 --> 00:57:06,860
very simple process you go to the paper

1036
00:57:11,770 --> 00:57:09,500
we ask you ideally to log into your

1037
00:57:13,450 --> 00:57:11,780
Google account first so that we know who

1038
00:57:15,490 --> 00:57:13,460

you are when you add the comment because

1039
00:57:18,820 --> 00:57:15,500
it makes it easier if people want to

1040
00:57:20,530 --> 00:57:18,830
come back to you for clarification then

1041
00:57:23,260 --> 00:57:20,540
that's a great thing to do as well we

1042
00:57:26,260 --> 00:57:23,270
need to get as much input for the papers

1043
00:57:29,770 --> 00:57:26,270
as we can so that they can move on to

1044
00:57:32,710 --> 00:57:29,780
the next stage with that I think we are

1045
00:57:34,920 --> 00:57:32,720
now out of time so thank you to our

1046
00:57:39,280 --> 00:57:34,930
presenters and you to our attendees and

1047
00:57:43,360 --> 00:57:39,290
our next event is going to be in the new

1048
00:57:45,640 --> 00:57:43,370
year I think it's the eighth but all the

1049
00:57:47,800 --> 00:57:45,650
details will be on the website and they

1050
00:57:51,460 --> 00:57:47,810
will go out in Agra gether and please