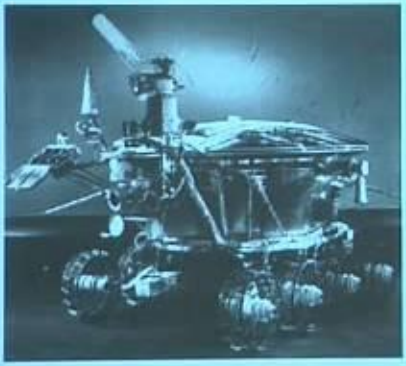
1969 - 1976 Robotic Achievements in the Shadow of Apollo

Robotic Lunar Rovers and Sample Return

Rover Launch History

1969, Feb 19 Launch failure
1970, Nov 10 **Luna 17**/Lunokhod 1
1973, Jan 8 **Luna 21**/Lunokhod 2



First Robotic Lunar Rover - Lunokhod 1

Sample Return Launch History

1969, Jun 14 Launch failure
1969, Jul 13 **Luna 15**, crashed
1969, Sep 23 Launch failure
1969, Oct 22 Launch failure
1969, Feb 6 Launch failure
1970, Sep 12 **Luna 16**, success
1971, Sep 2 **Luna 18**, failed at landing
1972, Feb 14 **Luna 20**, success
1974 Nov 2 **Luna 23**, damaged on landing
1975, Oct 16 Launch failure
1976, Aug 9 **Luna 24**, success

First Lunar Sample Return – Luna 16

1
00:00:28,230 --> 00:00:27,029
how about now ah

2
00:00:30,390 --> 00:00:28,240
there we go

3
00:00:31,990 --> 00:00:30,400
i'm live again okay so welcome back

4
00:00:34,150 --> 00:00:32,000
everybody to day two of solar system

5
00:00:35,750 --> 00:00:34,160
exploration at 50. our symposium

6
00:00:37,830 --> 00:00:35,760
co-sponsored by the national air space

7
00:00:40,310 --> 00:00:37,840
museum uh science mission director at

8
00:00:43,110 --> 00:00:40,320
nasa headquarters jpl and of course the

9
00:00:44,310 --> 00:00:43,120
nasa history office um we had i think a

10
00:00:45,670 --> 00:00:44,320
really interesting day yesterday and

11
00:00:47,510 --> 00:00:45,680
we've got another interesting day ahead

12
00:00:49,270 --> 00:00:47,520
for you today a little less over

13
00:00:51,189 --> 00:00:49,280

scheduled today than yesterday so a

14
00:00:53,189 --> 00:00:51,199
little more time for people to chat and

15
00:00:54,950 --> 00:00:53,199
do some things uh so i think you'll

16
00:00:56,470 --> 00:00:54,960
enjoy the day and be sure to stick

17
00:00:57,430 --> 00:00:56,480
around for uh the afternoon panel i

18
00:00:59,750 --> 00:00:57,440
think it's gonna be a really interesting

19
00:01:01,349 --> 00:00:59,760
one our closing panel

20
00:01:02,869 --> 00:01:01,359
uh in case you forgot i'm bill berry and

21
00:01:03,750 --> 00:01:02,879
has the chief historian

22
00:01:05,189 --> 00:01:03,760
and

23
00:01:06,390 --> 00:01:05,199
before we introduce our keynote speaker

24
00:01:08,149 --> 00:01:06,400
today let me run over a couple of

25
00:01:09,910 --> 00:01:08,159
administrative announcements for those

26
00:01:11,510 --> 00:01:09,920
who weren't here yesterday

27
00:01:13,270 --> 00:01:11,520
the safety briefing is if something

28
00:01:15,350 --> 00:01:13,280
happens and we need to exit the building

29
00:01:17,109 --> 00:01:15,360
exit the doors to your left over here

30
00:01:18,630 --> 00:01:17,119
unless you're told otherwise and it'll

31
00:01:19,510 --> 00:01:18,640
get you outside

32
00:01:20,870 --> 00:01:19,520
um

33
00:01:22,789 --> 00:01:20,880
for our courtesy announcement for the

34
00:01:24,390 --> 00:01:22,799
day remember to turn your cell phones to

35
00:01:27,350 --> 00:01:24,400
vibrate mode or some other quiet mode so

36
00:01:30,630 --> 00:01:27,360
we don't interrupt the speakers um

37
00:01:31,749 --> 00:01:30,640
and lunch today is on your own

38
00:01:33,350 --> 00:01:31,759

so

39
00:01:35,830 --> 00:01:33,360
and we have a tradition here at our nasa

40
00:01:37,910 --> 00:01:35,840
history symposia that

41
00:01:40,069 --> 00:01:37,920
you always take a buddy to lunch so

42
00:01:41,350 --> 00:01:40,079
don't go eat lunch on your own go find

43
00:01:42,630 --> 00:01:41,360
somebody pick somebody that you haven't

44
00:01:44,950 --> 00:01:42,640
ever talked to before or somebody that

45
00:01:46,710 --> 00:01:44,960
you want to develop an acquaintance with

46
00:01:48,310 --> 00:01:46,720
take them out to lunch and go have lunch

47
00:01:50,230 --> 00:01:48,320
together so we'll have a break for lunch

48
00:01:51,910 --> 00:01:50,240
this afternoon for that

49
00:01:53,910 --> 00:01:51,920
again we're doing a live webcast today

50
00:01:55,990 --> 00:01:53,920
so welcome to everybody who's online and

51
00:01:57,350 --> 00:01:56,000
for those of you here in the room uh

52
00:01:58,149 --> 00:01:57,360
please remember that uh if you're gonna

53
00:02:00,950 --> 00:01:58,159
ask a question we do have the

54
00:02:02,709 --> 00:02:00,960
microphones in the aisleways there

55
00:02:04,069 --> 00:02:02,719
make sure you're on microphone when

56
00:02:06,389 --> 00:02:04,079
you're talking so that everybody on the

57
00:02:07,429 --> 00:02:06,399
web can get us and also that it's

58
00:02:09,350 --> 00:02:07,439
appropriately archived because the

59
00:02:10,790 --> 00:02:09,360
webcast will be available in the future

60
00:02:13,910 --> 00:02:10,800
for people to watch or if you want to

61
00:02:16,229 --> 00:02:13,920
come back and watch yourself again

62
00:02:18,150 --> 00:02:16,239
okay again my thanks to our host

63
00:02:19,990 --> 00:02:18,160

lockheed martin and to all the staff

64
00:02:21,350 --> 00:02:20,000
that's worked on us who

65
00:02:23,030 --> 00:02:21,360
if it was successful yesterday it was

66
00:02:24,790 --> 00:02:23,040
largely a result of the work of a lot of

67
00:02:26,790 --> 00:02:24,800
people that behind the scenes that uh

68
00:02:29,510 --> 00:02:26,800
that you don't see you know not i.e not

69
00:02:30,790 --> 00:02:29,520
me so um uh i

70
00:02:31,990 --> 00:02:30,800
great thanks for all those folks who

71
00:02:34,390 --> 00:02:32,000
will make comments about that at the

72
00:02:35,589 --> 00:02:34,400
close of the day again today but without

73
00:02:37,750 --> 00:02:35,599
further ado let me introduce linda

74
00:02:45,670 --> 00:02:37,760
billings who will kick out our keynote

75
00:02:49,430 --> 00:02:47,190
i'm pleased and honored to be able to

76
00:02:51,589 --> 00:02:49,440
introduce our morning keynote speakers

77
00:02:53,509 --> 00:02:51,599
who i'm sure will wake us all up if

78
00:02:56,070 --> 00:02:53,519
we're not already awake uh with a very

79
00:02:59,270 --> 00:02:56,080
interesting talk which i'm i've been

80
00:03:01,750 --> 00:02:59,280
anxiously awaiting to hear um

81
00:03:04,470 --> 00:03:01,760
i remember when i first met wes hunters

82
00:03:05,750 --> 00:03:04,480
he had just left jpl for headquarters

83
00:03:09,110 --> 00:03:05,760
and

84
00:03:10,790 --> 00:03:09,120
speak at a career day at the thomas

85
00:03:13,030 --> 00:03:10,800
jefferson high school for science and

86
00:03:15,670 --> 00:03:13,040
technology in virginia

87
00:03:16,949 --> 00:03:15,680
and i remember asking him why the heck

88
00:03:18,710 --> 00:03:16,959

would anybody want to leave southern

89
00:03:21,750 --> 00:03:18,720
california for here

90
00:03:23,509 --> 00:03:21,760
but he stayed miraculously and as we've

91
00:03:25,830 --> 00:03:23,519
heard yesterday

92
00:03:28,470 --> 00:03:25,840
has accomplished a lot

93
00:03:30,550 --> 00:03:28,480
for the field of science and he's

94
00:03:32,869 --> 00:03:30,560
currently chairing nasa's

95
00:03:35,030 --> 00:03:32,879
the nasa advisory council's

96
00:03:37,990 --> 00:03:35,040
science advisory committee and i

97
00:03:42,149 --> 00:03:38,000
particularly admire wes for um taking a

98
00:03:45,030 --> 00:03:42,159
stand uh and stepping down

99
00:03:47,190 --> 00:03:45,040
at a time few years in the past

100
00:03:49,830 --> 00:03:47,200
and then coming back

101
00:03:52,070 --> 00:03:49,840
to take charge of that committee and i

102
00:03:54,789 --> 00:03:52,080
just yesterday met

103
00:03:57,110 --> 00:03:54,799
academician mikhail merov a great

104
00:03:59,270 --> 00:03:57,120
pleasure and i'm not going to read bios

105
00:04:00,550 --> 00:03:59,280
here

106
00:04:02,869 --> 00:04:00,560
but um

107
00:04:04,390 --> 00:04:02,879
academician merov um you've heard about

108
00:04:06,710 --> 00:04:04,400
his accomplishments yesterday too and

109
00:04:08,309 --> 00:04:06,720
we'll hear more today uh

110
00:04:10,309 --> 00:04:08,319
he's a member of the russian academy of

111
00:04:12,710 --> 00:04:10,319
sciences and uh the international

112
00:04:14,390 --> 00:04:12,720
academy of astronautics and wes has been

113
00:04:16,710 --> 00:04:14,400

very active in the international academy

114
00:04:19,270 --> 00:04:16,720
of astronautics so i'm sure these two

115
00:04:22,710 --> 00:04:19,280
have done a lot through iaa over the

116
00:04:24,790 --> 00:04:22,720
years and so as not to take up any of

117
00:04:26,790 --> 00:04:24,800
the time from the interesting story they

118
00:04:35,590 --> 00:04:26,800
have to tell i'm going to let them come

119
00:04:39,350 --> 00:04:38,469
well good morning everybody

120
00:04:41,350 --> 00:04:39,360
or

121
00:04:43,350 --> 00:04:41,360
bible utra if you happen to speak a

122
00:04:44,710 --> 00:04:43,360
little russian

123
00:04:51,909 --> 00:04:44,720
let me make sure i know how this thing

124
00:04:51,919 --> 00:04:59,430
well that one's not mine

125
00:04:59,440 --> 00:05:06,710
help from back there

126
00:05:06,720 --> 00:05:14,710
no thanks

127
00:05:14,720 --> 00:05:30,310
that way aim it that way

128
00:05:33,990 --> 00:05:32,150
no you don't want to hear me sing that

129
00:05:37,189 --> 00:05:34,000
wouldn't that would that would that

130
00:05:41,510 --> 00:05:39,270
okay here we go well

131
00:05:43,670 --> 00:05:41,520
what uh mikhail and i would like to do

132
00:05:44,950 --> 00:05:43,680
this morning is to tell you a bit

133
00:05:46,870 --> 00:05:44,960
about the

134
00:05:48,550 --> 00:05:46,880
other robotic lunar and planetary

135
00:05:50,870 --> 00:05:48,560
exploration program

136
00:05:53,350 --> 00:05:50,880
uh that of the soviet union uh with an

137
00:05:55,990 --> 00:05:53,360
emphasis really on the early years

138
00:05:58,830 --> 00:05:56,000

during its formulation and development

139
00:06:00,629 --> 00:05:58,840
period between 1960 and

140
00:06:01,990 --> 00:06:00,639
1975

141
00:06:03,990 --> 00:06:02,000
uh

142
00:06:07,670 --> 00:06:04,000
you know it was really born as part of

143
00:06:09,749 --> 00:06:07,680
the cold war just as our own was

144
00:06:11,590 --> 00:06:09,759
and because most events

145
00:06:13,749 --> 00:06:11,600
in the soviet program

146
00:06:15,749 --> 00:06:13,759
were happened behind the iron curtain

147
00:06:18,070 --> 00:06:15,759
and were virtually unknown

148
00:06:20,870 --> 00:06:18,080
outside the closed circle of soviet

149
00:06:23,270 --> 00:06:20,880
secrecy other than their successes it

150
00:06:26,309 --> 00:06:23,280
really provided a rather mysterious

151
00:06:28,950 --> 00:06:26,319
stimulus in the american program

152
00:06:30,629 --> 00:06:28,960
but behind that wall it was really a

153
00:06:32,550 --> 00:06:30,639
tale of adventure

154
00:06:35,749 --> 00:06:32,560
and of excitement

155
00:06:39,029 --> 00:06:35,759
and also suspense tragedy a real

156
00:06:41,909 --> 00:06:39,039
dramatic program uh and it also is a

157
00:06:45,189 --> 00:06:41,919
tale of great accomplishment

158
00:06:46,870 --> 00:06:45,199
alongside very debilitating losses

159
00:06:49,189 --> 00:06:46,880
and driven really by a thirst for

160
00:06:49,909 --> 00:06:49,199
technological achievement just as our

161
00:06:52,390 --> 00:06:49,919
own

162
00:06:54,790 --> 00:06:52,400
and desire for international recognition

163
00:06:56,390 --> 00:06:54,800

and respect

164
00:06:58,230 --> 00:06:56,400
now in the early years of space

165
00:07:00,390 --> 00:06:58,240
exploration in both the us and the

166
00:07:03,990 --> 00:07:00,400
soviet union that they were driven by

167
00:07:05,830 --> 00:07:04,000
strong personalities in those days men

168
00:07:08,710 --> 00:07:05,840
singular singular men who were

169
00:07:10,629 --> 00:07:08,720
visionaries superb engineers

170
00:07:12,710 --> 00:07:10,639
and strong leaders now in the u.s of

171
00:07:15,430 --> 00:07:12,720
course it was werner von braun

172
00:07:18,790 --> 00:07:15,440
and in the soviet union it was this man

173
00:07:21,350 --> 00:07:18,800
sergey pavlovich koryoff

174
00:07:23,110 --> 00:07:21,360
not the mysterious designer his name was

175
00:07:25,670 --> 00:07:23,120
a state secret

176
00:07:27,990 --> 00:07:25,680
until he died

177
00:07:31,110 --> 00:07:28,000
and he was just like verner he was

178
00:07:33,749 --> 00:07:31,120
mostly interested in space exploration

179
00:07:36,390 --> 00:07:33,759
but you only get a job as a designer of

180
00:07:40,309 --> 00:07:36,400
military rockets and he was the man who

181
00:07:42,390 --> 00:07:40,319
designed the soviet union's first icbm

182
00:07:45,029 --> 00:07:42,400
the r7

183
00:07:47,350 --> 00:07:45,039
and to influence the government uh to

184
00:07:49,110 --> 00:07:47,360
conduct space exploration with his

185
00:07:52,070 --> 00:07:49,120
rockets he teamed up with the head of

186
00:07:53,270 --> 00:07:52,080
the soviet academy of sciences mr slough

187
00:07:55,589 --> 00:07:53,280
keldish

188
00:07:58,550 --> 00:07:55,599

who was a public face

189
00:08:02,629 --> 00:07:58,560
and who was known in the soviet union as

190
00:08:05,029 --> 00:08:02,639
the chief theoretician of the program

191
00:08:07,430 --> 00:08:05,039
well the soviet rockets were much more

192
00:08:09,350 --> 00:08:07,440
powerful than the u.s rockets in the

193
00:08:10,629 --> 00:08:09,360
early days and therefore they were a

194
00:08:12,950 --> 00:08:10,639
great boon

195
00:08:15,749 --> 00:08:12,960
for space exploration payloads and

196
00:08:18,790 --> 00:08:15,759
korkov made a good advantage of that

197
00:08:20,469 --> 00:08:18,800
the r7 icbm was first tested in april

198
00:08:22,950 --> 00:08:20,479
1957

199
00:08:25,029 --> 00:08:22,960
and korolev had to fight the army

200
00:08:27,909 --> 00:08:25,039
get permission to use it during test

201
00:08:29,909 --> 00:08:27,919
flights to launch a satellite i don't

202
00:08:32,469 --> 00:08:29,919
know what the result of that was in

203
00:08:34,149 --> 00:08:32,479
october 1957

204
00:08:36,469 --> 00:08:34,159
and then

205
00:08:38,469 --> 00:08:36,479
in order to do lunar missions he

206
00:08:40,310 --> 00:08:38,479
invented a three-stage version called

207
00:08:41,829 --> 00:08:40,320
the luna

208
00:08:44,070 --> 00:08:41,839
and then later in order to go to the

209
00:08:47,269 --> 00:08:44,080
planets he devised the four stage

210
00:08:48,550 --> 00:08:47,279
version which was called ammonia

211
00:08:51,430 --> 00:08:48,560
and

212
00:08:53,990 --> 00:08:51,440
that vehicle could throw five times the

213
00:08:56,310 --> 00:08:54,000

weight of the atlas agena so it was a

214
00:08:58,470 --> 00:08:56,320
great advantage for him i could throw

215
00:09:01,190 --> 00:08:58,480
about 1600 kilograms to the moon and

216
00:09:02,150 --> 00:09:01,200
about up to 1200 kilograms to mars and

217
00:09:04,470 --> 00:09:02,160
venus

218
00:09:06,150 --> 00:09:04,480
and the r7 as you all know became the

219
00:09:08,150 --> 00:09:06,160
most successful space launcher in

220
00:09:10,550 --> 00:09:08,160
history and the day is known as the

221
00:09:12,389 --> 00:09:10,560
soyuz for both manned and unmanned

222
00:09:14,389 --> 00:09:12,399
uh

223
00:09:17,430 --> 00:09:14,399
twice

224
00:09:19,350 --> 00:09:17,440
well in 1958 the u.s announced that it

225
00:09:20,790 --> 00:09:19,360
was going to launch a spacecraft to the

226
00:09:22,150 --> 00:09:20,800
moon

227
00:09:23,670 --> 00:09:22,160
coral of course paid quite a bit of

228
00:09:26,150 --> 00:09:23,680
attention to that

229
00:09:27,750 --> 00:09:26,160
uh and he decided to repair a spacecraft

230
00:09:29,990 --> 00:09:27,760
the lunar spacecraft and that

231
00:09:31,990 --> 00:09:30,000
three-stage version of the launcher

232
00:09:35,990 --> 00:09:32,000
to beat the americans

233
00:09:39,030 --> 00:09:36,000
uh and during that fall of 1958

234
00:09:41,430 --> 00:09:39,040
soviet union and and the us traded uh

235
00:09:43,829 --> 00:09:41,440
three launch failures

236
00:09:45,030 --> 00:09:43,839
and it was rather a dramatic contest on

237
00:09:47,509 --> 00:09:45,040
both sides

238
00:09:49,190 --> 00:09:47,519

the soviet union was clearly aware of

239
00:09:50,550 --> 00:09:49,200
what the us was doing they knew the

240
00:09:51,990 --> 00:09:50,560
launch dates

241
00:09:53,269 --> 00:09:52,000
and they were trying to blindside the

242
00:09:56,470 --> 00:09:53,279
americans

243
00:09:58,870 --> 00:09:56,480
the u.s was groping blindly to try and

244
00:10:00,710 --> 00:09:58,880
seize the lead but it was korloff who

245
00:10:03,350 --> 00:10:00,720
was successful

246
00:10:04,630 --> 00:10:03,360
the age of robotic lunar and planetary

247
00:10:06,550 --> 00:10:04,640
exploration

248
00:10:11,190 --> 00:10:06,560
began with the successful launch of luna

249
00:10:14,710 --> 00:10:11,200
1 on january the 2nd 1959

250
00:10:16,310 --> 00:10:14,720
now it was the first spacecraft to leave

251
00:10:18,710 --> 00:10:16,320
earth's gravity field

252
00:10:20,949 --> 00:10:18,720
first to fly by the moon and the first

253
00:10:23,190 --> 00:10:20,959
to enter heliocentric orbit but it

254
00:10:24,790 --> 00:10:23,200
missed its prime objective which was to

255
00:10:27,509 --> 00:10:24,800
actually impact the moon

256
00:10:28,550 --> 00:10:27,519
uh and so luna 2 was the first to do

257
00:10:30,829 --> 00:10:28,560
that

258
00:10:33,910 --> 00:10:30,839
later in the year on september 14

259
00:10:35,829 --> 00:10:33,920
1959 and luna 3 was the first to

260
00:10:38,870 --> 00:10:35,839
circumfle the moon

261
00:10:40,630 --> 00:10:38,880
and to photograph the far side luna 3

262
00:10:42,630 --> 00:10:40,640
was also the first spacecraft with

263
00:10:46,470 --> 00:10:42,640

3-axis attitude control which had to

264
00:10:49,110 --> 00:10:46,480
have in order to do the imaging

265
00:10:51,110 --> 00:10:49,120
well bolstered by his lunar success

266
00:10:52,150 --> 00:10:51,120
korliov wanted to go to mars and venus

267
00:10:54,710 --> 00:10:52,160
next

268
00:10:56,790 --> 00:10:54,720
and so to meet planetary launch windows

269
00:10:58,470 --> 00:10:56,800
in 1960

270
00:11:01,030 --> 00:10:58,480
he needed to build the four stage

271
00:11:03,190 --> 00:11:01,040
version of the r7

272
00:11:05,269 --> 00:11:03,200
and a planetary spacecraft to go on top

273
00:11:07,190 --> 00:11:05,279
of it within eight months

274
00:11:08,949 --> 00:11:07,200
all of which he did

275
00:11:11,030 --> 00:11:08,959
rather amazing actually

276
00:11:14,230 --> 00:11:11,040
uh so the first launch of the four stage

277
00:11:16,069 --> 00:11:14,240
malmia carried a mars spacecraft

278
00:11:17,910 --> 00:11:16,079
but it was that well that was actually

279
00:11:19,350 --> 00:11:17,920
the first spacecraft with solar panels

280
00:11:21,670 --> 00:11:19,360
you can see them there onboard

281
00:11:23,750 --> 00:11:21,680
propulsion which is under the dome

282
00:11:25,350 --> 00:11:23,760
at the top of the spacecraft

283
00:11:27,509 --> 00:11:25,360
and long-range communications you can

284
00:11:29,350 --> 00:11:27,519
see the parabolic antenna

285
00:11:32,069 --> 00:11:29,360
unfortunately both launches to mars

286
00:11:46,230 --> 00:11:32,079
failed due to the launch vehicle and

287
00:11:46,240 --> 00:11:50,310
control problems

288
00:11:56,790 --> 00:11:52,430

now in 19 these

289
00:11:57,990 --> 00:11:56,800
1960-1961 launches were rather rushed

290
00:12:00,470 --> 00:11:58,000
they had only eight months to get them

291
00:12:02,550 --> 00:12:00,480
ready so now corolla took the next two

292
00:12:04,629 --> 00:12:02,560
years to improve the malnea and the

293
00:12:06,870 --> 00:12:04,639
spacecraft as well

294
00:12:08,389 --> 00:12:06,880
and the spacecraft was a brand new

295
00:12:10,550 --> 00:12:08,399
modular design

296
00:12:14,310 --> 00:12:10,560
with a standard cruise module and an

297
00:12:17,350 --> 00:12:14,320
entertain interchangeable science module

298
00:12:20,310 --> 00:12:17,360
and the other a probe for entry missions

299
00:12:22,629 --> 00:12:20,320
uh and then you can see them here

300
00:12:25,269 --> 00:12:22,639
the propulsion system is on the top

301
00:12:27,269 --> 00:12:25,279
uh in 1962

302
00:12:29,110 --> 00:12:27,279
six of these spacecraft were launched to

303
00:12:31,430 --> 00:12:29,120
mars and venus three to mars and three

304
00:12:33,910 --> 00:12:31,440
to venus and five of these six were

305
00:12:36,069 --> 00:12:33,920
victimized by their launch vehicle

306
00:12:37,590 --> 00:12:36,079
uh and the only one that succeeded was

307
00:12:40,310 --> 00:12:37,600
mars one

308
00:12:41,750 --> 00:12:40,320
first spacecraft launched towards mars

309
00:12:44,069 --> 00:12:41,760
but it suffered

310
00:12:47,829 --> 00:12:44,079
attitude control problems and was lost

311
00:12:51,990 --> 00:12:50,150
well after his successes at

312
00:12:53,269 --> 00:12:52,000
impacting and imaging the moon from

313
00:12:56,069 --> 00:12:53,279

flyby

314
00:12:57,509 --> 00:12:56,079
orlov had stood down to develop these

315
00:12:59,269 --> 00:12:57,519
new planetary spacecraft that he

316
00:13:01,190 --> 00:12:59,279
launched in 62

317
00:13:04,629 --> 00:13:01,200
and also at the same time to design a

318
00:13:06,550 --> 00:13:04,639
new lunar spacecraft for soft landing

319
00:13:09,590 --> 00:13:06,560
this new lunar spacecraft was based

320
00:13:10,629 --> 00:13:09,600
primarily also on that 2mv planetary

321
00:13:12,870 --> 00:13:10,639
design

322
00:13:15,350 --> 00:13:12,880
uh had two modules at a cruise stage and

323
00:13:16,150 --> 00:13:15,360
then a detachable lunar lander

324
00:13:18,310 --> 00:13:16,160
and

325
00:13:20,310 --> 00:13:18,320
these earlier lunars lunas

326
00:13:21,670 --> 00:13:20,320
one through three through direct

327
00:13:24,230 --> 00:13:21,680
trajectories

328
00:13:26,710 --> 00:13:24,240
uh from the three-stage r7

329
00:13:29,430 --> 00:13:26,720
these spacecraft used the four-stage r7

330
00:13:32,310 --> 00:13:29,440
and were injected from earth orbit using

331
00:13:33,910 --> 00:13:32,320
the restartable force stage

332
00:13:35,590 --> 00:13:33,920
these spacecraft had no solar panels

333
00:13:37,430 --> 00:13:35,600
they were they were powered by battery

334
00:13:41,189 --> 00:13:37,440
because of the short flight time

335
00:13:44,949 --> 00:13:41,199
and uh the 100 kilogram soft lander used

336
00:13:47,189 --> 00:13:44,959
airbags for terminal shock

337
00:13:48,550 --> 00:13:47,199
remember pathfinder

338
00:13:53,189 --> 00:13:48,560

um

339
00:14:00,069 --> 00:13:56,230
in addition to frustration at the moon

340
00:14:01,670 --> 00:14:00,079
uh in 63 to 65

341
00:14:03,910 --> 00:14:01,680
the soviets were

342
00:14:09,189 --> 00:14:06,790
frustrated at mars and venus as well

343
00:14:10,069 --> 00:14:09,199
but these lessons from mars one

344
00:14:13,110 --> 00:14:10,079
uh

345
00:14:15,110 --> 00:14:13,120
forced a complete redesign of the two mv

346
00:14:17,030 --> 00:14:15,120
it became the three mv

347
00:14:19,110 --> 00:14:17,040
and work to increase the reliability of

348
00:14:21,030 --> 00:14:19,120
the ammonia launch vehicle particularly

349
00:14:22,949 --> 00:14:21,040
that troublesome four stage

350
00:14:25,269 --> 00:14:22,959
was often did not ignite

351
00:14:26,550 --> 00:14:25,279
for the second burn

352
00:14:28,310 --> 00:14:26,560
and so there were

353
00:14:31,670 --> 00:14:28,320
flight tests planned for this new

354
00:14:33,110 --> 00:14:31,680
spacecraft and the upgraded malnea

355
00:14:36,949 --> 00:14:33,120
these were the flights you see there in

356
00:14:39,590 --> 00:14:36,959
november 63 in february of 64.

357
00:14:40,389 --> 00:14:39,600
but these just revealed more problems

358
00:14:41,269 --> 00:14:40,399
and

359
00:14:50,389 --> 00:14:41,279
the

360
00:14:52,470 --> 00:14:50,399
went ahead and launched a venus

361
00:14:54,550 --> 00:14:52,480
and

362
00:14:56,829 --> 00:14:54,560
you can see the results there the the

363
00:14:59,110 --> 00:14:56,839

zond one was actually launched

364
00:15:01,670 --> 00:14:59,120
successfully but it became clear right

365
00:15:03,590 --> 00:15:01,680
after launch that

366
00:15:04,870 --> 00:15:03,600
the spacecraft was not going to make it

367
00:15:06,550 --> 00:15:04,880
to its target

368
00:15:08,470 --> 00:15:06,560
and so in fact it was written it was

369
00:15:09,509 --> 00:15:08,480
called zond one instead of the narrow

370
00:15:11,910 --> 00:15:09,519
two

371
00:15:13,910 --> 00:15:11,920
and then later in the year zone 2 was

372
00:15:16,230 --> 00:15:13,920
launched to mars

373
00:15:17,910 --> 00:15:16,240
it was also recognized immediately after

374
00:15:19,670 --> 00:15:17,920
launch that it would not make its target

375
00:15:22,069 --> 00:15:19,680
it was having difficulties as well had

376
00:15:23,350 --> 00:15:22,079
multiple problems

377
00:15:25,509 --> 00:15:23,360
and so then they went the soviets

378
00:15:27,189 --> 00:15:25,519
decided to go back to a flight test to

379
00:15:28,389 --> 00:15:27,199
try to solve all these problems with the

380
00:15:31,509 --> 00:15:28,399
spacecraft

381
00:15:33,910 --> 00:15:31,519
and so on 65 they launched zon 3

382
00:15:35,590 --> 00:15:33,920
not in a mars window but just to test

383
00:15:37,670 --> 00:15:35,600
the spacecraft to see if it could fly

384
00:15:41,110 --> 00:15:37,680
out to mars distance

385
00:15:43,829 --> 00:15:41,120
and test all of its onboard capabilities

386
00:15:46,310 --> 00:15:43,839
during the flight past the moon

387
00:15:47,430 --> 00:15:46,320
and it succeeded at that

388
00:15:49,110 --> 00:15:47,440

and

389
00:15:52,069 --> 00:15:49,120
became known actually as a lunar mission

390
00:15:53,910 --> 00:15:52,079
when in fact it was a mars test mission

391
00:15:55,430 --> 00:15:53,920
but it survived after about eight months

392
00:15:58,069 --> 00:15:55,440
but didn't quite make it all the way out

393
00:16:00,629 --> 00:15:58,079
to mars orbit and then later in the year

394
00:16:02,629 --> 00:16:00,639
uh they launched veneras two and three

395
00:16:04,230 --> 00:16:02,639
uh now these had some thermal problems

396
00:16:06,310 --> 00:16:04,240
but they actually made it to their

397
00:16:07,990 --> 00:16:06,320
target the first planetary spacecraft

398
00:16:09,990 --> 00:16:08,000
the soviets launched actually made it to

399
00:16:11,829 --> 00:16:10,000
their target but

400
00:16:14,790 --> 00:16:11,839
unfortunately just as they were reaching

401
00:16:15,749 --> 00:16:14,800
a target they failed

402
00:16:18,310 --> 00:16:15,759
this was

403
00:16:19,910 --> 00:16:18,320
frustrating very frustrating losses but

404
00:16:21,910 --> 00:16:19,920
encouraging enough because they got to

405
00:16:24,069 --> 00:16:21,920
their targets that that would lead to

406
00:16:28,949 --> 00:16:24,079
new attempts in the next opportunity

407
00:16:32,949 --> 00:16:29,990
well

408
00:16:35,269 --> 00:16:32,959
corolla's institution okb1

409
00:16:37,910 --> 00:16:35,279
was responsible for both human

410
00:16:41,110 --> 00:16:37,920
and for robotic spaceflight

411
00:16:43,430 --> 00:16:41,120
but by 1965 when the soviets had decided

412
00:16:45,110 --> 00:16:43,440
to compete with the us for a manned

413
00:16:47,030 --> 00:16:45,120

landing on the moon

414
00:16:49,670 --> 00:16:47,040
they were fully occupied with the human

415
00:16:51,990 --> 00:16:49,680
space flight program and corlev realized

416
00:16:53,509 --> 00:16:52,000
he really could not do both

417
00:16:55,910 --> 00:16:53,519
so he reluctantly transferred

418
00:16:58,629 --> 00:16:55,920
responsibility for the robotic lunar and

419
00:17:01,910 --> 00:16:58,639
planetary program to his friend

420
00:17:03,030 --> 00:17:01,920
uh georgie babakan uh and at npo

421
00:17:05,350 --> 00:17:03,040
lavichkin

422
00:17:07,429 --> 00:17:05,360
in late 1965

423
00:17:10,949 --> 00:17:07,439
and lavichen modified

424
00:17:13,829 --> 00:17:10,959
okb wins lunar spacecraft and

425
00:17:17,990 --> 00:17:13,839
actually succeeded on the very first try

426
00:17:19,189 --> 00:17:18,000
early in 1966 only days after coryo's

427
00:17:21,189 --> 00:17:19,199
death

428
00:17:23,750 --> 00:17:21,199
and although lagging at venus and mars

429
00:17:25,829 --> 00:17:23,760
the soviets once again had beaten the us

430
00:17:28,710 --> 00:17:25,839
to a space milestone saw landing on the

431
00:17:30,630 --> 00:17:28,720
moon and sending pictures back

432
00:17:33,430 --> 00:17:30,640
luna 9 was the first soft landing on the

433
00:17:37,110 --> 00:17:33,440
moon and returned these panoramic images

434
00:17:39,270 --> 00:17:37,120
surveyor 1 followed in june 1966

435
00:17:42,710 --> 00:17:39,280
and then in december that year a second

436
00:17:45,669 --> 00:17:42,720
one luna 13 was sent to the moon by the

437
00:17:50,710 --> 00:17:47,750
well anxious to beat the americans to

438
00:17:52,630 --> 00:17:50,720

lunar orbit as well

439
00:17:55,029 --> 00:17:52,640
and that was announced by the americans

440
00:17:56,789 --> 00:17:55,039
for mid-1966

441
00:17:58,230 --> 00:17:56,799
the soviets

442
00:18:01,750 --> 00:17:58,240
cobbled together

443
00:18:02,950 --> 00:18:01,760
an orbiter uh using their luna 913

444
00:18:04,630 --> 00:18:02,960
vehicle

445
00:18:07,750 --> 00:18:04,640
replacing the lander

446
00:18:10,230 --> 00:18:07,760
with a pressurized module containing

447
00:18:14,150 --> 00:18:10,240
some readily available instruments

448
00:18:15,590 --> 00:18:14,160
and after one launch failure in march of

449
00:18:17,590 --> 00:18:15,600
uh that year

450
00:18:19,029 --> 00:18:17,600
they managed to succeed with luna 10

451
00:18:21,990 --> 00:18:19,039
which was the first

452
00:18:24,549 --> 00:18:22,000
lunar orbiter and the u.s followed that

453
00:18:27,029 --> 00:18:24,559
later on with orbiter 1

454
00:18:28,870 --> 00:18:27,039
and actually obtained the first images

455
00:18:30,549 --> 00:18:28,880
of the moon from lunar orbit which is a

456
00:18:31,990 --> 00:18:30,559
sign the u.s was kind of beginning to

457
00:18:34,230 --> 00:18:32,000
catch up

458
00:18:35,190 --> 00:18:34,240
with the soviets

459
00:18:37,990 --> 00:18:35,200
the

460
00:18:39,990 --> 00:18:38,000
soviets came up with an improved series

461
00:18:42,470 --> 00:18:40,000
beginning with luna 11. the imagery

462
00:18:43,669 --> 00:18:42,480
didn't work on luna 11 but it did on

463
00:18:45,350 --> 00:18:43,679

luna 12

464
00:18:47,590 --> 00:18:45,360
and the series was quite successful in

465
00:18:49,430 --> 00:18:47,600
really mapping the lunar environment and

466
00:18:51,750 --> 00:18:49,440
obtaining data for

467
00:18:52,950 --> 00:18:51,760
the soviet's manned program

468
00:18:54,789 --> 00:18:52,960
they mapped

469
00:18:56,549 --> 00:18:54,799
lunar gravity they actually discovered

470
00:18:57,750 --> 00:18:56,559
mass cons

471
00:18:59,750 --> 00:18:57,760
before

472
00:19:01,669 --> 00:18:59,760
the u.s did but they never published in

473
00:19:03,590 --> 00:19:01,679
time and so the u.s gets the credit for

474
00:19:05,830 --> 00:19:03,600
having discovered them

475
00:19:07,350 --> 00:19:05,840
they measured radiation magnetic field

476
00:19:08,630 --> 00:19:07,360
activity around the moon the lunar

477
00:19:12,470 --> 00:19:08,640
environment

478
00:19:14,390 --> 00:19:12,480
they imaged some cosmonaut landing areas

479
00:19:18,549 --> 00:19:14,400
and they did some technology tests on

480
00:19:23,830 --> 00:19:21,350
well during the same time period

481
00:19:25,750 --> 00:19:23,840
as these new lunar successes

482
00:19:29,590 --> 00:19:25,760
lavaskan made significant improvement to

483
00:19:31,270 --> 00:19:29,600
korolev's planetary spacecraft as well

484
00:19:33,270 --> 00:19:31,280
for the venus missions they beefed up

485
00:19:35,669 --> 00:19:33,280
the probe to handle

486
00:19:37,270 --> 00:19:35,679
18 atmospheres in a temperature of 400

487
00:19:39,590 --> 00:19:37,280
degrees c

488
00:19:42,870 --> 00:19:39,600

and they were rewarded with an immediate

489
00:19:45,510 --> 00:19:42,880
success which is the first spacecraft

490
00:19:47,909 --> 00:19:45,520
to penetrate the venusian atmosphere

491
00:19:50,390 --> 00:19:47,919
and that was venera 4

492
00:19:52,070 --> 00:19:50,400
and it measured the composition of the

493
00:19:53,590 --> 00:19:52,080
lunar atmosphere and it measured

494
00:19:55,029 --> 00:19:53,600
temperature and it measured pressure

495
00:19:56,789 --> 00:19:55,039
during its descent

496
00:19:58,950 --> 00:19:56,799
through the atmosphere

497
00:20:00,549 --> 00:19:58,960
but there was initial confusion over

498
00:20:03,350 --> 00:20:00,559
whether venera 4 had actually reached

499
00:20:05,590 --> 00:20:03,360
the surface or not a signal ceased at a

500
00:20:07,590 --> 00:20:05,600
particular time and the altimeter had

501
00:20:09,430 --> 00:20:07,600
not been operating properly

502
00:20:12,149 --> 00:20:09,440
uh and later it became clear that it was

503
00:20:14,390 --> 00:20:12,159
really lost at an altitude of about 24

504
00:20:16,870 --> 00:20:14,400
24 kilometers but that controversy was

505
00:20:18,390 --> 00:20:16,880
not settled in time for the next window

506
00:20:21,350 --> 00:20:18,400
when they were launching veneras five

507
00:20:24,149 --> 00:20:21,360
and six the probe was strengthened

508
00:20:25,669 --> 00:20:24,159
to about 25 bars and they used smaller

509
00:20:27,909 --> 00:20:25,679
shoots to get through the atmosphere

510
00:20:29,350 --> 00:20:27,919
quicker for more rapid descent before

511
00:20:30,310 --> 00:20:29,360
the temperature in the probe got too

512
00:20:33,350 --> 00:20:30,320
high

513
00:20:34,789 --> 00:20:33,360

uh so both were really not expected to

514
00:20:36,470 --> 00:20:34,799
get to the surface and of course they

515
00:20:41,270 --> 00:20:36,480
didn't they broke up at about 18

516
00:20:44,470 --> 00:20:42,390
well

517
00:20:45,830 --> 00:20:44,480
while all this was going on at venus and

518
00:20:48,950 --> 00:20:45,840
the moon

519
00:20:52,470 --> 00:20:48,960
lavagin decided after they inherited the

520
00:20:55,190 --> 00:20:52,480
mars program to abandon the three mv

521
00:20:57,350 --> 00:20:55,200
from mars after so many failures

522
00:20:58,789 --> 00:20:57,360
none haven't even come close

523
00:21:01,590 --> 00:20:58,799
and adopted

524
00:21:03,669 --> 00:21:01,600
a new heavy spacecraft design that would

525
00:21:05,990 --> 00:21:03,679
be launched by this brand new powerful

526
00:21:06,950 --> 00:21:06,000
proton rocket

527
00:21:09,190 --> 00:21:06,960
and

528
00:21:10,710 --> 00:21:09,200
also mariner 4 had by that time shown

529
00:21:12,070 --> 00:21:10,720
that the martian atmosphere was

530
00:21:13,669 --> 00:21:12,080
exceedingly thin

531
00:21:16,230 --> 00:21:13,679
which required a whole new type of

532
00:21:18,870 --> 00:21:16,240
lander than what they had been designing

533
00:21:20,630 --> 00:21:18,880
uh and so what they came up with was a a

534
00:21:22,070 --> 00:21:20,640
bold and new

535
00:21:24,549 --> 00:21:22,080
demanding

536
00:21:26,149 --> 00:21:24,559
science of a set of science objectives

537
00:21:29,750 --> 00:21:26,159
for for mars

538
00:21:30,549 --> 00:21:29,760

uh and that was uh in 1969 to get

539
00:21:35,029 --> 00:21:30,559
the

540
00:21:37,750 --> 00:21:35,039
design a proper entry vehicle and to get

541
00:21:41,270 --> 00:21:37,760
the ephemeris data on mars and then in

542
00:21:44,710 --> 00:21:41,280
1969 they would upstage

543
00:21:46,870 --> 00:21:44,720
the u.s mariners with a probe

544
00:21:48,950 --> 00:21:46,880
and then in 71

545
00:21:51,190 --> 00:21:48,960
they would upstage the american orbiters

546
00:21:53,510 --> 00:21:51,200
with a lander

547
00:21:55,190 --> 00:21:53,520
they had a three-year development

548
00:21:57,750 --> 00:21:55,200
challenge this was diverted by all that

549
00:22:00,310 --> 00:21:57,760
work to be successful in venus

550
00:22:02,149 --> 00:22:00,320
and they used a brand new lunar

551
00:22:03,750 --> 00:22:02,159
spacecraft design that had been designed

552
00:22:05,430 --> 00:22:03,760
for the proton

553
00:22:07,590 --> 00:22:05,440
uh that was

554
00:22:08,789 --> 00:22:07,600
going to be used for the van program

555
00:22:10,789 --> 00:22:08,799
actually

556
00:22:12,390 --> 00:22:10,799
and then after having used that design

557
00:22:14,630 --> 00:22:12,400
they decided that it wasn't really going

558
00:22:16,070 --> 00:22:14,640
to work all that well for mars and so

559
00:22:17,909 --> 00:22:16,080
they had to go back and redesign the

560
00:22:19,990 --> 00:22:17,919
spacecraft they only had 13 months left

561
00:22:21,350 --> 00:22:20,000
to do that

562
00:22:25,270 --> 00:22:21,360
they did it

563
00:22:27,510 --> 00:22:25,280

now it was a big spacecraft it was 3 500

564
00:22:28,870 --> 00:22:27,520
kilogram orbiter and a 280 kilogram

565
00:22:33,350 --> 00:22:28,880
probe

566
00:22:35,510 --> 00:22:33,360
orbit in 69 but they had to delete the

567
00:22:38,230 --> 00:22:35,520
probe late in the development because it

568
00:22:40,390 --> 00:22:38,240
was getting into mass problems and

569
00:22:41,909 --> 00:22:40,400
not doing well on its tests

570
00:22:43,190 --> 00:22:41,919
and so they replaced it with an orbital

571
00:22:45,669 --> 00:22:43,200
module

572
00:22:48,070 --> 00:22:45,679
but as it turned out

573
00:22:50,870 --> 00:22:48,080
both the protons on these attempted

574
00:22:53,990 --> 00:22:50,880
launches exploded actually very close to

575
00:22:55,830 --> 00:22:54,000
the ground so u.s monitoring didn't have

576
00:22:57,830 --> 00:22:55,840
time to figure out where these things

577
00:23:00,149 --> 00:22:57,840
were going to be headed because they

578
00:23:02,470 --> 00:23:00,159
exploded so close to the ground couldn't

579
00:23:03,830 --> 00:23:02,480
get any trajectory data on them

580
00:23:06,230 --> 00:23:03,840
these were

581
00:23:08,149 --> 00:23:06,240
rather bold and in hindsight

582
00:23:09,110 --> 00:23:08,159
overwhelming objectives to try to

583
00:23:11,350 --> 00:23:09,120
attempt

584
00:23:12,710 --> 00:23:11,360
a soft lander after having no previous

585
00:23:15,510 --> 00:23:12,720
success

586
00:23:17,510 --> 00:23:15,520
on mars and only 33 and then finally 13

587
00:23:19,750 --> 00:23:17,520
months to implement a new new launcher

588
00:23:21,430 --> 00:23:19,760

this is an enormous amount of risk

589
00:23:22,789 --> 00:23:21,440
the

590
00:23:25,110 --> 00:23:22,799
compelled by

591
00:23:26,630 --> 00:23:25,120
competition with the us

592
00:23:28,470 --> 00:23:26,640
and the launch failures may have saved a

593
00:23:32,950 --> 00:23:28,480
lot of embarrassment so spacecraft were

594
00:23:39,270 --> 00:23:35,270
well while the u.s closed in

595
00:23:41,110 --> 00:23:39,280
on a manned landing on the moon in 1969

596
00:23:44,470 --> 00:23:41,120
the the soviet union

597
00:23:45,909 --> 00:23:44,480
realized they were too far behind

598
00:23:47,990 --> 00:23:45,919
there's another story behind all of that

599
00:23:49,990 --> 00:23:48,000
i have no time to tell you

600
00:23:51,510 --> 00:23:50,000
so they decided to counter with robotic

601
00:23:53,830 --> 00:23:51,520
missions to try to get a sample back

602
00:23:55,029 --> 00:23:53,840
before the apollo 11

603
00:23:56,789 --> 00:23:55,039
return

604
00:23:59,110 --> 00:23:56,799
and they already had in development this

605
00:24:00,470 --> 00:23:59,120
new proton launched lunar spacecraft

606
00:24:02,710 --> 00:24:00,480
that i alluded to

607
00:24:05,590 --> 00:24:02,720
and its purpose was to land a large

608
00:24:07,269 --> 00:24:05,600
rover to support their lunar cosmonaut

609
00:24:08,870 --> 00:24:07,279
program

610
00:24:11,990 --> 00:24:08,880
and in an effort to upstage the us

611
00:24:15,269 --> 00:24:12,000
apollo 11 they just modified this

612
00:24:17,590 --> 00:24:15,279
vehicle with a sample return

613
00:24:20,230 --> 00:24:17,600

device by replacing the rover with the

614
00:24:22,549 --> 00:24:20,240
sample return avionics

615
00:24:25,350 --> 00:24:22,559
toroid which you can see there

616
00:24:27,110 --> 00:24:25,360
and a sampling device and a return

617
00:24:28,630 --> 00:24:27,120
vehicle and they

618
00:24:30,789 --> 00:24:28,640
they really were very clever in

619
00:24:32,789 --> 00:24:30,799
trajectory design they use an ingenious

620
00:24:34,789 --> 00:24:32,799
return direct trajectory design that

621
00:24:35,750 --> 00:24:34,799
only worked for very specific spots on

622
00:24:37,830 --> 00:24:35,760
the moon

623
00:24:40,149 --> 00:24:37,840
but its advantage was that with proper

624
00:24:43,190 --> 00:24:40,159
timing it'll eliminate completely the

625
00:24:44,789 --> 00:24:43,200
need for any return navigation you just

626
00:24:46,630 --> 00:24:44,799
fire straight up and you're guaranteed

627
00:24:48,630 --> 00:24:46,640
to come back to the earth

628
00:24:50,470 --> 00:24:48,640
uh no need for mid-course corrections or

629
00:24:52,070 --> 00:24:50,480
anything

630
00:24:54,149 --> 00:24:52,080
well

631
00:24:57,990 --> 00:24:54,159
work began on this sample return

632
00:25:01,029 --> 00:24:58,000
modification in late 1968 just months

633
00:25:03,430 --> 00:25:01,039
before apollo 11 and it's amazing that

634
00:25:05,750 --> 00:25:03,440
such a complex spacecraft could be so

635
00:25:06,789 --> 00:25:05,760
readily modified in so incredibly short

636
00:25:08,390 --> 00:25:06,799
time

637
00:25:11,669 --> 00:25:08,400
and it's really a testament to russian

638
00:25:14,630 --> 00:25:11,679

culture which is hey just do it

639
00:25:16,870 --> 00:25:14,640
dismiss all the hardship involved use

640
00:25:19,430 --> 00:25:16,880
whatever is at hand

641
00:25:21,029 --> 00:25:19,440
fix on the fly or fix during and after

642
00:25:22,789 --> 00:25:21,039
the build

643
00:25:25,190 --> 00:25:22,799
and they made it work

644
00:25:27,269 --> 00:25:25,200
uh one spacecraft

645
00:25:30,149 --> 00:25:27,279
failure was a launch in june but

646
00:25:32,070 --> 00:25:30,159
later in july luna 15 actually reached

647
00:25:33,029 --> 00:25:32,080
lunar orbit

648
00:25:35,510 --> 00:25:33,039
and

649
00:25:37,590 --> 00:25:35,520
failed on july 13th

650
00:25:39,909 --> 00:25:37,600
during its attempt to land

651
00:25:40,830 --> 00:25:39,919
with the apollo 11 astronauts still on

652
00:25:46,310 --> 00:25:40,840
the

653
00:25:48,710 --> 00:25:46,320
missions were successful beginning with

654
00:25:50,710 --> 00:25:48,720
luna 16

655
00:25:53,430 --> 00:25:50,720
and two of the three rover missions were

656
00:25:55,909 --> 00:25:53,440
successful beginning with 17 and these

657
00:26:01,029 --> 00:25:55,919
are robotic achievements that have never

658
00:26:07,029 --> 00:26:03,909
well after their success with luna 16

659
00:26:09,350 --> 00:26:07,039
sample return and luna 17 rover the

660
00:26:10,390 --> 00:26:09,360
basic spacecraft was also modified for

661
00:26:12,470 --> 00:26:10,400
orbiters

662
00:26:15,669 --> 00:26:12,480
the objectives were tied to the lunar

663
00:26:19,190 --> 00:26:17,669

mainly to obtain surface imaging at very

664
00:26:21,510 --> 00:26:19,200
high resolution

665
00:26:22,870 --> 00:26:21,520
do altimetry measurements for topography

666
00:26:24,549 --> 00:26:22,880
do remote

667
00:26:26,149 --> 00:26:24,559
measurements of surface composition and

668
00:26:27,590 --> 00:26:26,159
dielectric properties

669
00:26:29,110 --> 00:26:27,600
to an accurate mapping of the lunar

670
00:26:30,070 --> 00:26:29,120
gravity field

671
00:26:32,230 --> 00:26:30,080
and

672
00:26:34,950 --> 00:26:32,240
more environmental modeling monitoring

673
00:26:36,950 --> 00:26:34,960
of radiation plasma and micrometeorites

674
00:26:39,029 --> 00:26:36,960
both were successful but very few

675
00:26:41,350 --> 00:26:39,039
results were ever published these were

676
00:26:44,630 --> 00:26:41,360
the last robotic elements of the soviet

677
00:26:47,029 --> 00:26:44,640
program to line cosmonauts on the moon

678
00:26:50,310 --> 00:26:47,039
which program was finally terminated in

679
00:26:51,269 --> 00:26:50,320
the mid 1970s

680
00:26:54,390 --> 00:26:51,279
and

681
00:26:56,149 --> 00:26:54,400
tension turns back to the planets

682
00:26:58,549 --> 00:26:56,159
and finally

683
00:27:02,470 --> 00:26:58,559
in 1970 after

684
00:27:04,470 --> 00:27:02,480
11 attempts in almost 10 years

685
00:27:07,110 --> 00:27:04,480
soviets achieved success at landing on

686
00:27:09,669 --> 00:27:07,120
the surface of venus with the venus the

687
00:27:12,870 --> 00:27:09,679
narrow 7 capsule the narrow 7 capsules

688
00:27:15,549 --> 00:27:12,880

sacrificed a great deal of its payload

689
00:27:17,909 --> 00:27:15,559
and in order to beef it up to handle

690
00:27:20,870 --> 00:27:17,919
180 bars

691
00:27:23,909 --> 00:27:20,880
and 540 degrees centigrade

692
00:27:25,269 --> 00:27:23,919
for 90 minutes it was expected

693
00:27:28,230 --> 00:27:25,279
to

694
00:27:29,990 --> 00:27:28,240
fly through the atmosphere and and land

695
00:27:31,430 --> 00:27:30,000
they also use an even smaller chute

696
00:27:33,669 --> 00:27:31,440
parachute

697
00:27:34,950 --> 00:27:33,679
to get to the surface quicker

698
00:27:36,470 --> 00:27:34,960
and

699
00:27:38,630 --> 00:27:36,480
maximize the amount of time on the

700
00:27:39,510 --> 00:27:38,640
surface unfortunately that parachute

701
00:27:41,350 --> 00:27:39,520
failed

702
00:27:42,310 --> 00:27:41,360
and it ripped

703
00:27:44,310 --> 00:27:42,320
first

704
00:27:51,350 --> 00:27:44,320
and

705
00:27:53,430 --> 00:27:51,360
you can you can see here the uh

706
00:27:55,669 --> 00:27:53,440
the where the parachute was deployed

707
00:27:56,870 --> 00:27:55,679
this is the doppler signal

708
00:27:59,269 --> 00:27:56,880
where it was deployed where it was

709
00:28:01,669 --> 00:27:59,279
unreefed where it ripped and then the

710
00:28:03,669 --> 00:28:01,679
swoop in oscillation as it strum

711
00:28:06,310 --> 00:28:03,679
streamed behind the spacecraft finally

712
00:28:08,870 --> 00:28:06,320
it failed and separated uh completely

713
00:28:10,549 --> 00:28:08,880

and the capsule free fell to the surface

714
00:28:13,190 --> 00:28:10,559
you can see that little bit of signal in

715
00:28:14,870 --> 00:28:13,200
the noise that was on the surface

716
00:28:16,149 --> 00:28:14,880
the soviets didn't discover this until

717
00:28:18,070 --> 00:28:16,159
about a couple of months after landing

718
00:28:19,990 --> 00:28:18,080
we thought it had crashed

719
00:28:21,830 --> 00:28:20,000
and then somebody doing the data

720
00:28:24,310 --> 00:28:21,840
analysis discovered this

721
00:28:26,070 --> 00:28:24,320
23 minutes of signal post landing and

722
00:28:28,549 --> 00:28:26,080
that probably happened because the

723
00:28:29,909 --> 00:28:28,559
capsule bounced and then tilted over and

724
00:28:31,590 --> 00:28:29,919
the antenna was not pointing in the

725
00:28:32,389 --> 00:28:31,600
proper direction

726
00:28:41,990 --> 00:28:32,399
uh

727
00:28:44,070 --> 00:28:42,000
twilight side all these all these past

728
00:28:47,029 --> 00:28:44,080
probes have been sent to the dark side

729
00:28:49,190 --> 00:28:47,039
sent to the twilight side in order to

730
00:28:50,710 --> 00:28:49,200
fulfill the surface science objectives

731
00:28:52,789 --> 00:28:50,720
of this program

732
00:28:54,549 --> 00:28:52,799
and to get information on the light

733
00:28:58,470 --> 00:28:54,559
levels at the surface for later more

734
00:29:00,470 --> 00:28:58,480
sophisticated landers with cameras

735
00:29:02,470 --> 00:29:00,480
venera eight was it was a perfect

736
00:29:04,950 --> 00:29:02,480
success uh it got profiles of

737
00:29:06,630 --> 00:29:04,960
temperature pressure wind

738
00:29:08,470 --> 00:29:06,640

solar flux through the atmosphere

739
00:29:10,549 --> 00:29:08,480
identified the three cloud layers in the

740
00:29:13,190 --> 00:29:10,559
upper atmosphere measured atmospheric

741
00:29:14,310 --> 00:29:13,200
composition identified sulfuric acid in

742
00:29:18,149 --> 00:29:14,320
the clouds

743
00:29:19,230 --> 00:29:18,159
and on the surface it found in 93 bars

744
00:29:25,190 --> 00:29:19,240
and

745
00:29:31,029 --> 00:29:27,590
well next back to mars

746
00:29:32,950 --> 00:29:31,039
uh and uh for the 1971

747
00:29:35,830 --> 00:29:32,960
opportunity the soviets completely

748
00:29:37,510 --> 00:29:35,840
abandoned that mars 69 design

749
00:29:39,909 --> 00:29:37,520
uh and had

750
00:29:41,909 --> 00:29:39,919
time enough to completely redesign the

751
00:29:44,470 --> 00:29:41,919
whole mars spacecraft

752
00:29:48,230 --> 00:29:44,480
this time it was a 3 400 kilogram

753
00:29:50,470 --> 00:29:48,240
orbiter with 1200 kilogram entry vehicle

754
00:29:52,230 --> 00:29:50,480
and a 360 kilogram

755
00:29:54,149 --> 00:29:52,240
lander

756
00:29:55,990 --> 00:29:54,159
they had failed to get the atmosphere

757
00:29:57,750 --> 00:29:56,000
and ephemeris data they really needed

758
00:29:59,590 --> 00:29:57,760
back in 69

759
00:30:01,350 --> 00:29:59,600
but they did get the atmospheric data

760
00:30:02,710 --> 00:30:01,360
from mariners 6 and 7 because these

761
00:30:04,950 --> 00:30:02,720
results were published in the open

762
00:30:07,269 --> 00:30:04,960
literature and that allowed them to

763
00:30:09,190 --> 00:30:07,279

design the edl system

764
00:30:11,269 --> 00:30:09,200
but the u.s would not release the

765
00:30:14,149 --> 00:30:11,279
ephemeris from the engineering data this

766
00:30:17,430 --> 00:30:14,159
was back in battle brezhnev days

767
00:30:18,950 --> 00:30:17,440
and uh so the soviets decided on using

768
00:30:20,789 --> 00:30:18,960
three spacecraft

769
00:30:23,190 --> 00:30:20,799
uh one of which was an early orbiter

770
00:30:25,430 --> 00:30:23,200
sent before the lander spacecraft it

771
00:30:26,950 --> 00:30:25,440
would go into orbit around mars and act

772
00:30:28,230 --> 00:30:26,960
as a beacon

773
00:30:31,110 --> 00:30:28,240
for the

774
00:30:32,710 --> 00:30:31,120
spacecraft that would follow

775
00:30:35,430 --> 00:30:32,720
but they also at the same time

776
00:30:38,470 --> 00:30:35,440
incorporated a rather clever

777
00:30:42,149 --> 00:30:38,480
but very risky backup system

778
00:30:44,470 --> 00:30:42,159
using automatic onboard

779
00:30:46,950 --> 00:30:44,480
optical navigation at the planet to

780
00:30:49,269 --> 00:30:46,960
correct the trajectory and target the

781
00:30:50,710 --> 00:30:49,279
entry vehicles in case

782
00:30:52,789 --> 00:30:50,720
there was a failure and it's a good

783
00:30:55,110 --> 00:30:52,799
thing they did that because in fact the

784
00:30:57,029 --> 00:30:55,120
pathfinder orbital launch did fail

785
00:30:58,389 --> 00:30:57,039
and so they had to rely on this

786
00:31:00,470 --> 00:30:58,399
automatic

787
00:31:03,029 --> 00:31:00,480
optical navigation system

788
00:31:05,190 --> 00:31:03,039

which actually worked

789
00:31:07,750 --> 00:31:05,200
almost perfectly

790
00:31:11,269 --> 00:31:07,760
this shows you the edl

791
00:31:13,669 --> 00:31:11,279
sequence for the 1971 and also the 1973

792
00:31:15,909 --> 00:31:13,679
missions which followed the orbiter was

793
00:31:17,269 --> 00:31:15,919
targeted for the mars orbit insertion

794
00:31:19,350 --> 00:31:17,279
point

795
00:31:20,870 --> 00:31:19,360
on approach which meant that the edl

796
00:31:23,509 --> 00:31:20,880
system

797
00:31:25,430 --> 00:31:23,519
required propulsion in order to target

798
00:31:27,590 --> 00:31:25,440
to the proper entry point

799
00:31:29,590 --> 00:31:27,600
uh the edl package was deployed at about

800
00:31:33,269 --> 00:31:29,600
minus six hours

801
00:31:35,350 --> 00:31:33,279
uh the solid rocket was fired to target

802
00:31:36,630 --> 00:31:35,360
the vehicle to its entry point

803
00:31:39,190 --> 00:31:36,640
then that

804
00:31:40,950 --> 00:31:39,200
that the system was ejected the

805
00:31:42,630 --> 00:31:40,960
spacecraft was oriented towards the

806
00:31:44,630 --> 00:31:42,640
proper entry angle

807
00:31:46,950 --> 00:31:44,640
uh and since spun up

808
00:31:49,669 --> 00:31:46,960
uh with those small

809
00:31:52,470 --> 00:31:49,679
little small solid rockets and after

810
00:31:54,710 --> 00:31:52,480
peak deceleration at about two g's

811
00:31:56,070 --> 00:31:54,720
it was spun back down again

812
00:31:57,750 --> 00:31:56,080
and then the descent

813
00:32:00,070 --> 00:31:57,760

sequence was triggered after reaching

814
00:32:02,149 --> 00:32:00,080
about mach 3.5

815
00:32:04,070 --> 00:32:02,159
with a pilot chute and a drogue chute

816
00:32:07,029 --> 00:32:04,080
and a reefed main

817
00:32:08,549 --> 00:32:07,039
and after after that the lander was

818
00:32:10,710 --> 00:32:08,559
exposed

819
00:32:12,549 --> 00:32:10,720
the main was unreefed

820
00:32:14,789 --> 00:32:12,559
and then when it got near the surface at

821
00:32:17,350 --> 00:32:14,799
about 20 meters altitude about 10 meters

822
00:32:21,430 --> 00:32:17,360
per second velocity the retro rockets

823
00:32:26,789 --> 00:32:23,830
as far as how this mission went for the

824
00:32:28,710 --> 00:32:26,799
landers mars 2 was unfortunately

825
00:32:31,190 --> 00:32:28,720
improperly targeted

826
00:32:34,389 --> 00:32:31,200
on a steep entry angle and crashed

827
00:32:36,630 --> 00:32:34,399
but mars 3 landed successfully

828
00:32:39,110 --> 00:32:36,640
it turned on its transmitter about 90

829
00:32:41,029 --> 00:32:39,120
seconds after landing

830
00:32:43,029 --> 00:32:41,039
and then transmitted about 20 seconds

831
00:32:47,990 --> 00:32:43,039
worth of data which turns out to be

832
00:32:50,630 --> 00:32:48,000
mostly mostly noise and then died

833
00:32:53,190 --> 00:32:50,640
the orbiters also had telemetry and

834
00:32:55,029 --> 00:32:53,200
camera problems and they were they had a

835
00:32:56,710 --> 00:32:55,039
dust storm to deal with

836
00:32:59,509 --> 00:32:56,720
uh and so a little data was obtained

837
00:33:01,430 --> 00:32:59,519
from mars two but from mars three about

838
00:33:03,029 --> 00:33:01,440

sixty images were obtained

839
00:33:03,990 --> 00:33:03,039
uh and there

840
00:33:06,230 --> 00:33:04,000
it

841
00:33:09,269 --> 00:33:06,240
got new data on the atmosphere

842
00:33:12,230 --> 00:33:09,279
on surface properties gravity uh and uh

843
00:33:15,509 --> 00:33:12,240
the orbital environment of mars

844
00:33:17,269 --> 00:33:15,519
well at the next mars opportunity

845
00:33:19,750 --> 00:33:17,279
the soviets were aware

846
00:33:20,870 --> 00:33:19,760
of plans for viking

847
00:33:23,509 --> 00:33:20,880
and

848
00:33:26,950 --> 00:33:23,519
they were rather chagrined by

849
00:33:29,190 --> 00:33:26,960
the mariner 9 success relative to their

850
00:33:30,389 --> 00:33:29,200
1971 fleet

851
00:33:33,190 --> 00:33:30,399
and so they were determined to beat the

852
00:33:36,310 --> 00:33:33,200
u.s to the service in 1973

853
00:33:40,549 --> 00:33:36,320
73 turned out to be a period of detent

854
00:33:44,710 --> 00:33:40,559
and so data from mars 2 3 and venera 8

855
00:33:49,029 --> 00:33:46,789
for the ephemeris

856
00:33:51,509 --> 00:33:49,039
atmospheric models of the planet and

857
00:33:55,190 --> 00:33:51,519
murder 9 imagery of potential landing

858
00:33:57,190 --> 00:33:55,200
sites but this 1973 fleet was doomed to

859
00:34:00,310 --> 00:33:57,200
a fatal error

860
00:34:03,110 --> 00:34:00,320
the mars 73 electronics substituted a

861
00:34:04,830 --> 00:34:03,120
new aluminum lead transistor

862
00:34:08,869 --> 00:34:04,840
for a the

863
00:34:10,069 --> 00:34:08,879

1971 gold lead transistor

864
00:34:12,389 --> 00:34:10,079
and this was used throughout the

865
00:34:14,310 --> 00:34:12,399
spacecraft very common transistor and

866
00:34:15,190 --> 00:34:14,320
they only discovered a few months before

867
00:34:17,510 --> 00:34:15,200
launch

868
00:34:21,109 --> 00:34:17,520
that these actually had a very short

869
00:34:23,430 --> 00:34:21,119
lifetime to failure on the order of the

870
00:34:25,030 --> 00:34:23,440
flight time of the spacecraft

871
00:34:26,550 --> 00:34:25,040
and it was just simply too late for

872
00:34:28,069 --> 00:34:26,560
substitution it was used throughout the

873
00:34:29,909 --> 00:34:28,079
spacecraft

874
00:34:32,069 --> 00:34:29,919
and the 50

875
00:34:34,470 --> 00:34:32,079
calculated failure rate

876
00:34:36,310 --> 00:34:34,480
uh would have dictated postponement in

877
00:34:38,629 --> 00:34:36,320
the u.s uh and

878
00:34:40,790 --> 00:34:38,639
the soviet engineers argued for delay

879
00:34:43,909 --> 00:34:40,800
but in a rush to beat the u.s to the

880
00:34:45,430 --> 00:34:43,919
surface the soviet mission us the soviet

881
00:34:49,270 --> 00:34:45,440
decision makers

882
00:34:51,990 --> 00:34:49,280
uh simply decided to go ahead

883
00:34:55,190 --> 00:34:52,000
they launched these four protons

884
00:34:58,150 --> 00:34:55,200
they launched two five ton orbiters

885
00:35:00,390 --> 00:34:58,160
and two five ton fly by landers

886
00:35:02,069 --> 00:35:00,400
with these transistors in them and all

887
00:35:04,069 --> 00:35:02,079
four of these spacecraft experienced

888
00:35:06,710 --> 00:35:04,079

serious failures

889
00:35:10,150 --> 00:35:06,720
on route to mars and at mars

890
00:35:14,470 --> 00:35:12,870
mars 4 had serious computer problems it

891
00:35:15,829 --> 00:35:14,480
could not make its second mid-course

892
00:35:17,990 --> 00:35:15,839
correction

893
00:35:20,390 --> 00:35:18,000
and the engine failed to fire to put it

894
00:35:22,310 --> 00:35:20,400
into a big long-looping orbit

895
00:35:23,270 --> 00:35:22,320
and it flew past the planet taking a few

896
00:35:25,430 --> 00:35:23,280
pictures

897
00:35:28,630 --> 00:35:25,440
mars five actually achieved orbit but

898
00:35:30,630 --> 00:35:28,640
the mars orbit insertion event triggered

899
00:35:33,109 --> 00:35:30,640
the pressurization leak

900
00:35:36,069 --> 00:35:33,119
and it failed after 14 days now that

901
00:35:37,190 --> 00:35:36,079
there were no orbiters at mars to do

902
00:35:38,710 --> 00:35:37,200
relays

903
00:35:40,230 --> 00:35:38,720
of data that would come from the

904
00:35:42,069 --> 00:35:40,240
subsequent landers

905
00:35:44,630 --> 00:35:42,079
and the best they could do was to get

906
00:35:46,870 --> 00:35:44,640
data from these landers during

907
00:35:47,990 --> 00:35:46,880
the flyby from the flyby spacecraft that

908
00:35:51,430 --> 00:35:48,000
dropped them

909
00:35:52,230 --> 00:35:51,440
during a short period after landing

910
00:35:53,670 --> 00:35:52,240
well

911
00:35:55,430 --> 00:35:53,680
mars 6

912
00:35:56,870 --> 00:35:55,440
after it conducted its first

913
00:35:58,710 --> 00:35:56,880

mid course

914
00:36:00,390 --> 00:35:58,720
it's downlink failed

915
00:36:02,230 --> 00:36:00,400
well the russians could get no data from

916
00:36:04,630 --> 00:36:02,240
the spacecraft so they uplinked in the

917
00:36:07,829 --> 00:36:04,640
blind hoping it would work

918
00:36:09,829 --> 00:36:07,839
uh the spacecraft that automatically

919
00:36:11,670 --> 00:36:09,839
determined its course and made its

920
00:36:13,270 --> 00:36:11,680
corrections

921
00:36:15,670 --> 00:36:13,280
and then when it got to the planet it

922
00:36:17,910 --> 00:36:15,680
did the optical navigation

923
00:36:19,109 --> 00:36:17,920
did the entry system retargeting

924
00:36:20,630 --> 00:36:19,119
uh and

925
00:36:22,310 --> 00:36:20,640
all that was successful and the first

926
00:36:24,310 --> 00:36:22,320
time the soviets knew that spacecraft

927
00:36:27,190 --> 00:36:24,320
was still there was when they started to

928
00:36:29,430 --> 00:36:27,200
get the data stream from

929
00:36:31,190 --> 00:36:29,440
the descending vehicle through the flyby

930
00:36:32,950 --> 00:36:31,200
spacecraft

931
00:36:34,630 --> 00:36:32,960
absolutely amazing

932
00:36:37,430 --> 00:36:34,640
it's a monumental achievement in

933
00:36:39,030 --> 00:36:37,440
autonomy but the lander lost signal just

934
00:36:41,829 --> 00:36:39,040
as it was dropped

935
00:36:43,910 --> 00:36:41,839
to the surface mars 7

936
00:36:45,910 --> 00:36:43,920
they deployed the entry system

937
00:36:46,790 --> 00:36:45,920
but did not fire

938
00:36:49,190 --> 00:36:46,800

and so

939
00:36:50,790 --> 00:36:49,200
it simply missed the planet

940
00:36:53,270 --> 00:36:50,800
the soviets got some temperature and

941
00:36:54,470 --> 00:36:53,280
pressure and doppler data from the mars

942
00:36:56,069 --> 00:36:54,480
6 descent

943
00:36:58,150 --> 00:36:56,079
they got some data from the marsh 5

944
00:36:59,510 --> 00:36:58,160
orbiter on the ionosphere the atmosphere

945
00:37:02,310 --> 00:36:59,520
something on the surface and some

946
00:37:04,790 --> 00:37:02,320
imagery but little result for such a

947
00:37:06,950 --> 00:37:04,800
massive investment

948
00:37:08,710 --> 00:37:06,960
well

949
00:37:10,230 --> 00:37:08,720
later years turned out to be much better

950
00:37:11,349 --> 00:37:10,240
for the soviets and

951
00:37:14,230 --> 00:37:11,359
uh

952
00:37:17,190 --> 00:37:14,240
they this was probably their golden age

953
00:37:19,030 --> 00:37:17,200
and uh they had uh

954
00:37:21,589 --> 00:37:19,040
great success with their subsequent

955
00:37:25,030 --> 00:37:21,599
venera program veneras 9 and 16 these

956
00:37:25,910 --> 00:37:25,040
big sophisticated landers on mars

957
00:37:27,670 --> 00:37:25,920
and

958
00:37:29,750 --> 00:37:27,680
probably the pinnacle of the soviet

959
00:37:32,310 --> 00:37:29,760
program were the vega missions

960
00:37:34,550 --> 00:37:32,320
which i don't have any time to tell you

961
00:37:35,670 --> 00:37:34,560
in the 1980s

962
00:37:37,829 --> 00:37:35,680
and then

963
00:37:39,510 --> 00:37:37,839

failure revisited them again with the

964
00:37:40,470 --> 00:37:39,520
failure of the phobos

965
00:37:43,430 --> 00:37:40,480
missions

966
00:37:44,310 --> 00:37:43,440
and finally the 1996 loss

967
00:37:46,470 --> 00:37:44,320
of

968
00:37:49,190 --> 00:37:46,480
mars 96

969
00:37:52,310 --> 00:37:49,200
which was simply a humiliating final uh

970
00:37:55,510 --> 00:37:52,320
to the soviet adventure in robotic

971
00:37:58,870 --> 00:37:57,510
well

972
00:38:01,670 --> 00:37:58,880
the soviet

973
00:38:03,030 --> 00:38:01,680
program was is really kind of a tragic

974
00:38:04,790 --> 00:38:03,040
loss of

975
00:38:06,470 --> 00:38:04,800
vision and enterprise and expertise

976
00:38:08,710 --> 00:38:06,480
these folks just disappeared after mars

977
00:38:10,470 --> 00:38:08,720
96 for a long time

978
00:38:12,310 --> 00:38:10,480
they had the courage and enthusiasm to

979
00:38:14,790 --> 00:38:12,320
try things that were really considered

980
00:38:16,150 --> 00:38:14,800
rather difficult to do almost impossible

981
00:38:17,829 --> 00:38:16,160
they had a superb

982
00:38:20,550 --> 00:38:17,839
expertise in engineering design and

983
00:38:23,430 --> 00:38:20,560
development terrific engineers

984
00:38:25,750 --> 00:38:23,440
they used a great deal of innovation

985
00:38:28,870 --> 00:38:25,760
using technology that was available in

986
00:38:30,790 --> 00:38:28,880
order to accomplish the task at hand

987
00:38:32,790 --> 00:38:30,800
they were masters of material

988
00:38:35,510 --> 00:38:32,800

development and engineering

989
00:38:37,990 --> 00:38:35,520
their propulsion systems are unmatched

990
00:38:40,710 --> 00:38:38,000
they showed a lot of excellence in

991
00:38:42,550 --> 00:38:40,720
celestial mechanics and navigation and

992
00:38:44,470 --> 00:38:42,560
guidance

993
00:38:46,790 --> 00:38:44,480
and they showed

994
00:38:47,589 --> 00:38:46,800
excellence in automation and software

995
00:38:50,710 --> 00:38:47,599
which

996
00:38:52,950 --> 00:38:50,720
rather unravel later on in their program

997
00:38:56,550 --> 00:38:52,960
uh but they did produce a stable of very

998
00:38:59,030 --> 00:38:56,560
powerful and readily available rockets

999
00:39:00,870 --> 00:38:59,040
and they're really done in by the poor

1000
00:39:03,270 --> 00:39:00,880
reliability of these launch vehicles

1001
00:39:05,030 --> 00:39:03,280
early in their history until about the

1002
00:39:06,790 --> 00:39:05,040
mid 70s

1003
00:39:09,829 --> 00:39:06,800
and they became very much better they

1004
00:39:11,910 --> 00:39:09,839
were handicapped by a rather poor

1005
00:39:13,750 --> 00:39:11,920
electronics technology

1006
00:39:15,750 --> 00:39:13,760
all of their flight vehicles were

1007
00:39:16,550 --> 00:39:15,760
pressurized

1008
00:39:18,310 --> 00:39:16,560
they

1009
00:39:20,790 --> 00:39:18,320
had a weak

1010
00:39:22,230 --> 00:39:20,800
engineering system engineering

1011
00:39:23,190 --> 00:39:22,240
discipline

1012
00:39:24,390 --> 00:39:23,200
and

1013
00:39:31,750 --> 00:39:24,400

they

1014
00:39:37,349 --> 00:39:35,190
poor buildings and things for

1015
00:39:40,230 --> 00:39:37,359
ground system testing they didn't do

1016
00:39:42,390 --> 00:39:40,240
sufficient ground system testing

1017
00:39:45,349 --> 00:39:42,400
and they probably the worst was this

1018
00:39:47,750 --> 00:39:45,359
very complex this entangled

1019
00:39:48,630 --> 00:39:47,760
and heavy-handed national system they

1020
00:39:51,190 --> 00:39:48,640
had

1021
00:39:52,710 --> 00:39:51,200
for control and supply

1022
00:39:54,550 --> 00:39:52,720
uh

1023
00:39:56,630 --> 00:39:54,560
but in the early years in spite of all

1024
00:39:58,950 --> 00:39:56,640
of this after after 15 years of the

1025
00:40:00,630 --> 00:39:58,960
program they achieved a very large

1026
00:40:01,910 --> 00:40:00,640
number of firsts

1027
00:40:04,550 --> 00:40:01,920
and among them

1028
00:40:06,550 --> 00:40:04,560
uh they were the first on the moon

1029
00:40:08,950 --> 00:40:06,560
they were first on venus

1030
00:40:23,190 --> 00:40:08,960
actually first on mars

1031
00:40:26,710 --> 00:40:24,870
good morning

1032
00:40:28,870 --> 00:40:26,720
first of all let me say that i'm very

1033
00:40:30,710 --> 00:40:28,880
much pleased to be here

1034
00:40:32,710 --> 00:40:30,720
appreciate the invitation to take part

1035
00:40:36,309 --> 00:40:32,720
in this symposium

1036
00:40:39,109 --> 00:40:36,319
and also i would like to appreciate

1037
00:40:40,390 --> 00:40:39,119
the joint efforts we undertaken jointly

1038
00:40:41,589 --> 00:40:40,400

with

1039
00:40:47,510 --> 00:40:41,599
us

1040
00:40:50,630 --> 00:40:47,520
on soviet robots

1041
00:40:52,870 --> 00:40:50,640
because at the first time in the history

1042
00:40:55,190 --> 00:40:52,880
it's absolutely objectively

1043
00:40:56,950 --> 00:40:55,200
reflect the situation in the former

1044
00:40:59,910 --> 00:40:56,960
soviet union

1045
00:41:01,430 --> 00:40:59,920
and it's allowed us

1046
00:41:04,950 --> 00:41:01,440
to

1047
00:41:08,069 --> 00:41:04,960
the problems

1048
00:41:10,790 --> 00:41:08,079
from the different viewpoints

1049
00:41:12,150 --> 00:41:10,800
but in very

1050
00:41:14,550 --> 00:41:12,160
accurate

1051
00:41:17,349 --> 00:41:14,560
and very realistic historical

1052
00:41:19,430 --> 00:41:17,359
retrospective

1053
00:41:20,550 --> 00:41:19,440
um

1054
00:41:23,030 --> 00:41:20,560
well

1055
00:41:24,309 --> 00:41:23,040
wes perfectly

1056
00:41:26,710 --> 00:41:24,319
reported

1057
00:41:29,510 --> 00:41:26,720
the main issues

1058
00:41:30,870 --> 00:41:29,520
of this book

1059
00:41:33,190 --> 00:41:30,880
and a

1060
00:41:36,069 --> 00:41:33,200
very proper description

1061
00:41:39,510 --> 00:41:36,079
of the situation that we had

1062
00:41:41,910 --> 00:41:39,520
throughout the first several decades

1063
00:41:43,109 --> 00:41:41,920

of space era

1064
00:41:44,630 --> 00:41:43,119
and

1065
00:41:47,589 --> 00:41:44,640
well

1066
00:41:49,430 --> 00:41:47,599
i've been a part of this process

1067
00:41:52,470 --> 00:41:49,440
throughout the

1068
00:41:53,589 --> 00:41:52,480
years beginning of the first luna

1069
00:41:56,069 --> 00:41:53,599
missions

1070
00:41:58,069 --> 00:41:56,079
so i witnessed the situation just

1071
00:41:59,750 --> 00:41:58,079
sitting inside

1072
00:42:01,670 --> 00:41:59,760
and

1073
00:42:03,270 --> 00:42:01,680
well

1074
00:42:04,390 --> 00:42:03,280
i wouldn't like

1075
00:42:06,150 --> 00:42:04,400
just

1076
00:42:08,150 --> 00:42:06,160
to leave you

1077
00:42:11,589 --> 00:42:08,160
with the impression

1078
00:42:14,470 --> 00:42:11,599
that everything is already over

1079
00:42:17,910 --> 00:42:14,480
that we completely you know

1080
00:42:18,950 --> 00:42:17,920
just finished our efforts

1081
00:42:20,470 --> 00:42:18,960
and

1082
00:42:21,349 --> 00:42:20,480
i will try

1083
00:42:23,430 --> 00:42:21,359
to

1084
00:42:24,870 --> 00:42:23,440
complement a little bit

1085
00:42:27,430 --> 00:42:24,880
the talk

1086
00:42:30,950 --> 00:42:27,440
verse gave you to you

1087
00:42:34,230 --> 00:42:30,960
and to tell about the current situation

1088
00:42:36,150 --> 00:42:34,240

in the modern in the current russia

1089
00:42:38,150 --> 00:42:36,160
and just to

1090
00:42:40,230 --> 00:42:38,160
give a few

1091
00:42:41,910 --> 00:42:40,240
actually principal

1092
00:42:43,829 --> 00:42:41,920
items

1093
00:42:46,230 --> 00:42:43,839
to

1094
00:42:47,430 --> 00:42:46,240
tell about some

1095
00:42:48,790 --> 00:42:47,440
new

1096
00:42:51,190 --> 00:42:48,800
ideas

1097
00:42:55,270 --> 00:42:51,200
and the process which currently

1098
00:42:59,109 --> 00:42:56,630
okay

1099
00:43:02,390 --> 00:42:59,119
so

1100
00:43:04,309 --> 00:43:02,400
union

1101
00:43:06,950 --> 00:43:04,319
badly impacted

1102
00:43:10,550 --> 00:43:06,960
on the situation in the country

1103
00:43:12,069 --> 00:43:10,560
and it was followed by social economical

1104
00:43:13,670 --> 00:43:12,079
turmoil

1105
00:43:14,710 --> 00:43:13,680
upheaven

1106
00:43:15,589 --> 00:43:14,720
and

1107
00:43:18,069 --> 00:43:15,599
well

1108
00:43:20,710 --> 00:43:18,079
actually impacted badly impacted on the

1109
00:43:23,349 --> 00:43:20,720
space program

1110
00:43:25,670 --> 00:43:23,359
specifically on the planetary

1111
00:43:27,990 --> 00:43:25,680
exploration

1112
00:43:29,990 --> 00:43:28,000
well space budget was shrank

1113
00:43:31,349 --> 00:43:30,000

dramatically

1114
00:43:33,109 --> 00:43:31,359
for

1115
00:43:36,870 --> 00:43:33,119
nearly 10 years

1116
00:43:37,990 --> 00:43:36,880
we had very poor governmental supply

1117
00:43:39,829 --> 00:43:38,000
and

1118
00:43:42,230 --> 00:43:39,839
space facilities

1119
00:43:44,470 --> 00:43:42,240
were probably destroyed

1120
00:43:47,430 --> 00:43:44,480
many people linked

1121
00:43:50,790 --> 00:43:47,440
lose the people and

1122
00:43:52,550 --> 00:43:50,800
cooperative links

1123
00:43:54,150 --> 00:43:52,560
broken

1124
00:43:56,950 --> 00:43:54,160
skill personnel

1125
00:43:58,470 --> 00:43:56,960
in space science and technology

1126
00:44:00,470 --> 00:43:58,480
lost

1127
00:44:01,430 --> 00:44:00,480
it was really awful situation in the

1128
00:44:03,589 --> 00:44:01,440
country

1129
00:44:05,190 --> 00:44:03,599
and mars 96

1130
00:44:08,550 --> 00:44:05,200
it was prepared

1131
00:44:10,710 --> 00:44:08,560
as a such very poor background you know

1132
00:44:12,390 --> 00:44:10,720
it was actually you know i've been in

1133
00:44:15,750 --> 00:44:12,400
the facilities and the lavican

1134
00:44:17,670 --> 00:44:15,760
enterprise it was assembled by the

1135
00:44:20,630 --> 00:44:17,680
partially hungry people

1136
00:44:22,790 --> 00:44:20,640
so we couldn't expect that it will be

1137
00:44:25,190 --> 00:44:22,800
success and this all happened

1138
00:44:28,150 --> 00:44:25,200

mars 96

1139
00:44:29,349 --> 00:44:28,160
in which participated 22 countries

1140
00:44:30,710 --> 00:44:29,359
failed

1141
00:44:33,270 --> 00:44:30,720
and

1142
00:44:35,589 --> 00:44:33,280
well it was great disaster

1143
00:44:38,230 --> 00:44:35,599
and really again

1144
00:44:39,190 --> 00:44:38,240
very badly impacted on the planetary

1145
00:44:40,150 --> 00:44:39,200
program

1146
00:44:42,870 --> 00:44:40,160
well

1147
00:44:46,470 --> 00:44:45,190
initially it looks like

1148
00:44:52,309 --> 00:44:46,480
no

1149
00:44:54,630 --> 00:44:52,319
but i will try you to tell you

1150
00:44:57,510 --> 00:44:54,640
that the situation right now

1151
00:44:59,910 --> 00:44:57,520
much more optimistic and that's why i'm

1152
00:45:01,190 --> 00:44:59,920
quoting at the

1153
00:45:02,550 --> 00:45:01,200
upper part

1154
00:45:08,150 --> 00:45:02,560
the

1155
00:45:10,150 --> 00:45:08,160
famous american author mark twain

1156
00:45:11,750 --> 00:45:10,160
rumors about

1157
00:45:14,150 --> 00:45:11,760
my death

1158
00:45:16,829 --> 00:45:14,160
are too exaggerated

1159
00:45:20,870 --> 00:45:16,839
that's the situation to us right

1160
00:45:23,829 --> 00:45:21,910
after

1161
00:45:28,069 --> 00:45:23,839
march 96 loss

1162
00:45:30,630 --> 00:45:28,079
we decided to completely renovate

1163
00:45:38,150 --> 00:45:34,309

basic idea called the planetary missions

1164
00:45:39,990 --> 00:45:38,160
and it was originally a group of several

1165
00:45:43,750 --> 00:45:40,000
enthusiastic people

1166
00:45:46,710 --> 00:45:43,760
we work for nothing i just reported at

1167
00:45:49,030 --> 00:45:46,720
the first idea about the new concept of

1168
00:45:50,069 --> 00:45:49,040
the planetary spacecraft in one of the

1169
00:45:52,630 --> 00:45:50,079
meeting

1170
00:45:54,390 --> 00:45:52,640
at the end of 90s and some good

1171
00:45:56,470 --> 00:45:54,400
colleagues of maya addressed me and said

1172
00:45:59,670 --> 00:45:56,480
well okay you are

1173
00:46:02,630 --> 00:45:59,680
working not being paid you are either

1174
00:46:04,390 --> 00:46:02,640
romantic or completely stupid i said

1175
00:46:06,710 --> 00:46:04,400
both

1176
00:46:09,109 --> 00:46:06,720
okay anyway

1177
00:46:10,710 --> 00:46:09,119
it was completely new approach

1178
00:46:13,750 --> 00:46:10,720
and

1179
00:46:16,309 --> 00:46:13,760
it was essentially the basic spacecraft

1180
00:46:19,270 --> 00:46:16,319
which underlined the phobos ground

1181
00:46:23,109 --> 00:46:19,280
mission we targeted just to return back

1182
00:46:24,230 --> 00:46:23,119
to the poorly implemented uh phobos 88

1183
00:46:26,870 --> 00:46:24,240
mission

1184
00:46:31,349 --> 00:46:26,880
with a completely new spacecraft and

1185
00:46:33,430 --> 00:46:31,359
it's shown the main concept i mean the

1186
00:46:41,430 --> 00:46:33,440
spacecraft profile

1187
00:46:46,630 --> 00:46:41,440
and the

1188
00:46:49,349 --> 00:46:47,829

flight

1189
00:46:51,030 --> 00:46:49,359
toward

1190
00:46:53,829 --> 00:46:51,040
mars and phobos

1191
00:46:55,030 --> 00:46:53,839
in this sketch

1192
00:46:57,349 --> 00:46:55,040
well

1193
00:46:59,589 --> 00:46:57,359
unfortunately because

1194
00:47:02,150 --> 00:46:59,599
insufficient finding

1195
00:47:05,910 --> 00:47:02,160
the mission postponed three times

1196
00:47:07,190 --> 00:47:05,920
originally it was scheduled for 204

1197
00:47:07,910 --> 00:47:07,200
204

1198
00:47:11,670 --> 00:47:07,920
but

1199
00:47:14,630 --> 00:47:11,680
actually it was launched in 2011

1200
00:47:16,950 --> 00:47:14,640
we very much relied on this mission

1201
00:47:19,349 --> 00:47:16,960
and i personally worked on the mission

1202
00:47:21,829 --> 00:47:19,359
for in about 15 years

1203
00:47:22,710 --> 00:47:21,839
and when it failed

1204
00:47:25,109 --> 00:47:22,720
and

1205
00:47:27,910 --> 00:47:25,119
couldn't leave the

1206
00:47:30,390 --> 00:47:27,920
uh leo orbit

1207
00:47:32,549 --> 00:47:30,400
it was like it's a personal tragedy to

1208
00:47:34,150 --> 00:47:32,559
myself even

1209
00:47:36,390 --> 00:47:34,160
basically

1210
00:47:40,150 --> 00:47:36,400
the failure was caused

1211
00:47:43,510 --> 00:47:40,160
by the factors rooted in the destroying

1212
00:47:46,069 --> 00:47:43,520
90s in our planetary program that is

1213
00:47:50,309 --> 00:47:46,079

some kind of the harvesting just what we

1214
00:47:52,549 --> 00:47:50,319
had with the phobos ground mission

1215
00:47:55,349 --> 00:47:52,559
okay as i said

1216
00:47:57,910 --> 00:47:55,359
not so bad everything right now

1217
00:48:00,630 --> 00:47:57,920
i will try to get you acquainted with

1218
00:48:04,230 --> 00:48:00,640
the principal steps forward we are right

1219
00:48:05,349 --> 00:48:04,240
now undertaken and this is russian space

1220
00:48:06,870 --> 00:48:05,359
program

1221
00:48:08,150 --> 00:48:06,880
on science

1222
00:48:09,349 --> 00:48:08,160
generally

1223
00:48:11,589 --> 00:48:09,359
but

1224
00:48:13,430 --> 00:48:11,599
this is

1225
00:48:15,270 --> 00:48:13,440
bottom band

1226
00:48:17,510 --> 00:48:15,280
it's just missions

1227
00:48:19,990 --> 00:48:17,520
for the solar

1228
00:48:22,230 --> 00:48:20,000
sun exploration and astrophysical

1229
00:48:23,349 --> 00:48:22,240
mission i will not comment it

1230
00:48:28,710 --> 00:48:23,359
also

1231
00:48:37,030 --> 00:48:33,670
okay that's it's s of middle of two or

1232
00:48:40,390 --> 00:48:37,040
and right now it's already modified

1233
00:48:41,670 --> 00:48:40,400
because the time change very fast

1234
00:48:48,390 --> 00:48:41,680
anyway

1235
00:48:53,030 --> 00:48:51,430
fobo soil was failed as i said

1236
00:48:54,470 --> 00:48:53,040
right now

1237
00:48:57,750 --> 00:48:54,480
excuse me

1238
00:48:59,349 --> 00:48:57,760

they focused on the moon exploration

1239
00:49:02,710 --> 00:48:59,359
and in the moon

1240
00:49:05,829 --> 00:49:04,150
exploration

1241
00:49:09,589 --> 00:49:05,839
we just

1242
00:49:10,710 --> 00:49:09,599
plan to launch in the coming years three

1243
00:49:14,069 --> 00:49:10,720
missions

1244
00:49:16,309 --> 00:49:14,079
first one is the luna globe but here

1245
00:49:17,750 --> 00:49:16,319
it's shown only one spacecraft because

1246
00:49:20,710 --> 00:49:17,760
it's originally

1247
00:49:23,510 --> 00:49:20,720
fought to be just an assembly both

1248
00:49:24,390 --> 00:49:23,520
orbiter and lander right now

1249
00:49:28,230 --> 00:49:24,400
we

1250
00:49:33,190 --> 00:49:28,240
launch in 2015 luna globe lender

1251
00:49:33,990 --> 00:49:33,200
followed by luna uh globe orbiter

1252
00:49:35,910 --> 00:49:34,000
in

1253
00:49:38,230 --> 00:49:35,920
2016.

1254
00:49:40,470 --> 00:49:38,240
luna resource it's more

1255
00:49:43,430 --> 00:49:40,480
large scale it's

1256
00:49:45,910 --> 00:49:43,440
well very small rover which will be

1257
00:49:47,829 --> 00:49:45,920
complemented and just joined to the

1258
00:49:51,270 --> 00:49:47,839
spacecraft

1259
00:49:54,309 --> 00:49:51,280
by the request of the indian

1260
00:49:57,829 --> 00:49:54,319
site because the indians participated

1261
00:50:00,710 --> 00:49:57,839
originally in this program and even we

1262
00:50:01,990 --> 00:50:00,720
intended to launch lunarisus on the

1263
00:50:04,069 --> 00:50:02,000

indian

1264
00:50:07,109 --> 00:50:04,079
launcher but

1265
00:50:10,549 --> 00:50:07,119
they encountered some problems with the

1266
00:50:13,510 --> 00:50:10,559
testing of their stage a second stage

1267
00:50:16,390 --> 00:50:13,520
engine and right now it decided that we

1268
00:50:18,069 --> 00:50:16,400
will do it by our own so for lunar

1269
00:50:19,910 --> 00:50:18,079
program for the coming year we have

1270
00:50:22,790 --> 00:50:19,920
three launchers already

1271
00:50:25,030 --> 00:50:22,800
committed and i think this program will

1272
00:50:28,230 --> 00:50:25,040
be implemented

1273
00:50:31,349 --> 00:50:28,240
well next is the venera g but whenever d

1274
00:50:33,589 --> 00:50:31,359
it was scheduled originally for 2 or 16

1275
00:50:37,670 --> 00:50:33,599
but right now it postponed

1276
00:50:40,950 --> 00:50:37,680
after 2 or 20 something like i guess to

1277
00:50:44,390 --> 00:50:40,960
23 25.

1278
00:50:47,990 --> 00:50:44,400
also it's at mars net but mars net

1279
00:50:49,270 --> 00:50:48,000
it's just it was original concept

1280
00:50:52,390 --> 00:50:49,280
and

1281
00:50:54,150 --> 00:50:52,400
this is a sort of the small vehicles

1282
00:50:57,190 --> 00:50:54,160
judiciously

1283
00:50:59,109 --> 00:50:57,200
distributed over the surface and control

1284
00:51:03,510 --> 00:50:59,119
by the flying computer

1285
00:51:07,349 --> 00:51:03,520
actually very wise very nice concept and

1286
00:51:10,630 --> 00:51:07,359
right now it's also cancelled because

1287
00:51:13,510 --> 00:51:10,640
after americans stepped down from the

1288
00:51:17,829 --> 00:51:13,520

program exomars which were invited by

1289
00:51:21,190 --> 00:51:17,839
the europeans the doors became open and

1290
00:51:24,470 --> 00:51:21,200
we entered the doors and right now this

1291
00:51:28,150 --> 00:51:24,480
uh already agreement exists committed

1292
00:51:32,309 --> 00:51:28,160
with the europeans and its looks like

1293
00:51:37,030 --> 00:51:32,319
exomars not mars net will be implemented

1294
00:51:39,630 --> 00:51:37,040
in the two phases first phase 2016

1295
00:51:43,349 --> 00:51:39,640
it will be orbiter and

1296
00:51:44,390 --> 00:51:43,359
2018 it will be lower on the mars

1297
00:51:48,390 --> 00:51:44,400
surface

1298
00:51:51,670 --> 00:51:48,400
and uh finally not finally actually the

1299
00:51:53,910 --> 00:51:51,680
lunar program will be followed by the

1300
00:51:55,829 --> 00:51:53,920
it's already in the blueprint

1301
00:51:59,430 --> 00:51:55,839
this will be followed by the two

1302
00:52:01,670 --> 00:51:59,440
missions very capable lunar rover with

1303
00:52:04,230 --> 00:52:01,680
the capable manipulator

1304
00:52:07,670 --> 00:52:04,240
in order to pick up different samples

1305
00:52:10,870 --> 00:52:07,680
and then with the return

1306
00:52:14,069 --> 00:52:10,880
rocket will be landed just beside this

1307
00:52:20,390 --> 00:52:17,750
both lunar globe lunar resource and also

1308
00:52:22,630 --> 00:52:20,400
the follow-up missions are targeted to

1309
00:52:24,870 --> 00:52:22,640
be landed in the uh

1310
00:52:27,990 --> 00:52:24,880
south pole in order

1311
00:52:31,430 --> 00:52:28,000
with the main idea beginning of the luna

1312
00:52:35,670 --> 00:52:31,440
globe just to study volatiles and first

1313
00:52:36,630 --> 00:52:35,680

of all the water deposits in this soil

1314
00:52:40,549 --> 00:52:36,640
okay

1315
00:52:43,109 --> 00:52:40,559
and finally we are going also to

1316
00:52:45,430 --> 00:52:43,119
continue our efforts for the mars

1317
00:52:48,870 --> 00:52:45,440
exploration and

1318
00:52:51,349 --> 00:52:48,880
in our blueprint mars sample return is

1319
00:52:53,349 --> 00:52:51,359
scheduled for 2

1320
00:52:54,549 --> 00:52:53,359
000 22.

1321
00:52:57,910 --> 00:52:54,559
i hope

1322
00:53:01,349 --> 00:52:57,920
it will be possibly possible to do

1323
00:53:04,309 --> 00:53:01,359
well let me conclude with the very nice

1324
00:53:05,990 --> 00:53:04,319
quoting from the american

1325
00:53:08,150 --> 00:53:06,000
uh good

1326
00:53:11,030 --> 00:53:08,160
publisher writer

1327
00:53:14,710 --> 00:53:11,040
david harland who just published his

1328
00:53:17,990 --> 00:53:14,720
comment on the our this and my book on

1329
00:53:21,990 --> 00:53:18,000
soviet robots and i don't need just to

1330
00:53:25,109 --> 00:53:22,000
read it but just only right to pay your

1331
00:53:27,030 --> 00:53:25,119
ask to draw your attention that it was

1332
00:53:31,030 --> 00:53:27,040
demonstrate

1333
00:53:33,990 --> 00:53:31,040
that planetary scientists and engineers

1334
00:53:36,069 --> 00:53:34,000
in the soviet union russia have been

1335
00:53:39,349 --> 00:53:36,079
working with

1336
00:53:42,549 --> 00:53:39,359
uh minimal resources poor political

1337
00:53:45,430 --> 00:53:42,559
support and less than optimal

1338
00:53:49,510 --> 00:53:45,440

technologies many years

1339
00:53:52,870 --> 00:53:49,520
and in the conclusion that phobos ground

1340
00:53:56,069 --> 00:53:52,880
must be viewed as part of long train of

1341
00:53:59,510 --> 00:53:56,079
missions over the years i hope it is not

1342
00:54:02,710 --> 00:53:59,520
the last such missions undertaken just

1343
00:54:05,990 --> 00:54:02,720
what i try to show you and try to

1344
00:54:06,950 --> 00:54:06,000
persuade you actually actually let me

1345
00:54:08,470 --> 00:54:06,960
con

1346
00:54:10,630 --> 00:54:08,480
also repeat

1347
00:54:13,349 --> 00:54:10,640
like mark twain

1348
00:54:17,349 --> 00:54:13,359
rumors about our

1349
00:54:20,230 --> 00:54:17,359
death about that planetary program in

1350
00:54:29,510 --> 00:54:20,240
modern russia too much exaggerated thank

1351
00:54:33,510 --> 00:54:31,349
we are running over but uh the next

1352
00:54:36,789 --> 00:54:33,520
panel we're uh short of paper so we're

1353
00:54:38,470 --> 00:54:36,799
gonna run a little bit let's take about

1354
00:54:44,870 --> 00:54:38,480
three questions how about why should

1355
00:54:49,670 --> 00:54:47,270
here with you

1356
00:54:52,150 --> 00:54:49,680
uh this question is uh directed to

1357
00:54:53,030 --> 00:54:52,160
mikhail uh as you

1358
00:54:55,910 --> 00:54:53,040
uh

1359
00:54:56,950 --> 00:54:55,920
correctly pointed out the united states

1360
00:54:59,750 --> 00:54:56,960
had

1361
00:55:02,230 --> 00:54:59,760
changed its um approach now with mars

1362
00:55:05,829 --> 00:55:02,240
and backed off its agreement with esa

1363
00:55:07,910 --> 00:55:05,839

for the 16 trace gas orbiter and the 18

1364
00:55:10,390 --> 00:55:07,920
exomars rover

1365
00:55:15,589 --> 00:55:13,109
as you also mentioned the aspects of

1366
00:55:18,230 --> 00:55:15,599
that now are are

1367
00:55:21,589 --> 00:55:18,240
allowing russia to to make a more solid

1368
00:55:23,190 --> 00:55:21,599
agreement uh with esap how is that

1369
00:55:26,470 --> 00:55:23,200
helping

1370
00:55:29,030 --> 00:55:26,480
raise the cost and and expertise and

1371
00:55:30,789 --> 00:55:29,040
attracting new engineers and

1372
00:55:33,670 --> 00:55:30,799
into into the uh

1373
00:55:34,390 --> 00:55:33,680
russian program is that helping oh thank

1374
00:55:36,630 --> 00:55:34,400
you

1375
00:55:39,190 --> 00:55:36,640
well

1376
00:55:40,390 --> 00:55:39,200
according to the agreement we signed i

1377
00:55:41,670 --> 00:55:40,400
mean

1378
00:55:47,750 --> 00:55:41,680
russian

1379
00:55:51,270 --> 00:55:47,760
popovkin and the head of isa it was just

1380
00:55:55,270 --> 00:55:52,789
single efforts

1381
00:55:58,150 --> 00:55:55,280
it was not specifically committed to

1382
00:56:00,630 --> 00:55:58,160
make something jointly okay it will be

1383
00:56:04,710 --> 00:56:00,640
different component which we assembly in

1384
00:56:10,309 --> 00:56:07,670
and well i could compliment also i do

1385
00:56:13,589 --> 00:56:10,319
not envisage that it will be some kind

1386
00:56:14,630 --> 00:56:13,599
of the additional support for in for

1387
00:56:17,829 --> 00:56:14,640
example

1388
00:56:20,710 --> 00:56:17,839

in terms of the western technology

1389
00:56:26,150 --> 00:56:20,720
invested in the program no we will be

1390
00:56:28,789 --> 00:56:27,589
well okay

1391
00:56:30,549 --> 00:56:28,799
uh as

1392
00:56:31,349 --> 00:56:30,559
thank you wes

1393
00:56:32,950 --> 00:56:31,359
well

1394
00:56:34,150 --> 00:56:32,960
you know

1395
00:56:35,270 --> 00:56:34,160
certainly

1396
00:56:36,390 --> 00:56:35,280
the more

1397
00:56:38,549 --> 00:56:36,400
uh

1398
00:56:40,150 --> 00:56:38,559
joint efforts will be

1399
00:56:41,430 --> 00:56:40,160
in the area

1400
00:56:43,510 --> 00:56:41,440
of the

1401
00:56:46,230 --> 00:56:43,520
bringing people together

1402
00:56:48,309 --> 00:56:46,240
but this already you know just a good

1403
00:56:51,589 --> 00:56:48,319
experience we're having for throughout

1404
00:56:53,910 --> 00:56:51,599
the years because you know our

1405
00:56:56,390 --> 00:56:53,920
specialists first of all our scientists

1406
00:56:58,470 --> 00:56:56,400
working together with americans and with

1407
00:57:01,349 --> 00:56:58,480
europeans and

1408
00:57:03,670 --> 00:57:01,359
for example venus express and venus

1409
00:57:06,549 --> 00:57:03,680
and mars mars express and venus express

1410
00:57:09,190 --> 00:57:06,559
missions they are just you know uh

1411
00:57:13,670 --> 00:57:09,200
equipped with something like possibly 50

1412
00:57:16,230 --> 00:57:13,680
percent of the russian instruments

1413
00:57:19,829 --> 00:57:16,240

and engineering also

1414
00:57:21,910 --> 00:57:19,839
doing very closely together

1415
00:57:24,069 --> 00:57:21,920
hi a great talk um you know we've heard

1416
00:57:25,510 --> 00:57:24,079
a lot here uh yesterday about the

1417
00:57:26,549 --> 00:57:25,520
political support for the american

1418
00:57:28,870 --> 00:57:26,559
program

1419
00:57:31,030 --> 00:57:28,880
and i'm curious about the

1420
00:57:33,109 --> 00:57:31,040
process on the soviet side by which all

1421
00:57:34,390 --> 00:57:33,119
these missions were proposed and

1422
00:57:35,190 --> 00:57:34,400
approved and where you could whether you

1423
00:57:37,430 --> 00:57:35,200
could

1424
00:57:39,030 --> 00:57:37,440
talk a little bit about the process um

1425
00:57:40,630 --> 00:57:39,040
who were the decision makers who were

1426
00:57:42,230 --> 00:57:40,640
the people who need to be persuaded to

1427
00:57:44,069 --> 00:57:42,240
support these things

1428
00:57:45,349 --> 00:57:44,079
presumably the role of the ministry of

1429
00:57:47,109 --> 00:57:45,359
general machine building but also

1430
00:57:49,270 --> 00:57:47,119
perhaps the central committee what are

1431
00:57:51,109 --> 00:57:49,280
the roles of you know the institute of

1432
00:57:53,190 --> 00:57:51,119
space research

1433
00:57:55,670 --> 00:57:53,200
the academy of sciences

1434
00:57:57,589 --> 00:57:55,680
how much basically how much support did

1435
00:57:59,670 --> 00:57:57,599
the corolla and the watching design

1436
00:58:02,150 --> 00:57:59,680
bureaus enjoy how did that

1437
00:58:04,150 --> 00:58:02,160
support rise and fall over time through

1438
00:58:07,589 --> 00:58:04,160

the soviet period at least

1439
00:58:13,270 --> 00:58:08,390
right

1440
00:58:15,670 --> 00:58:13,990
well

1441
00:58:17,750 --> 00:58:15,680
mikhail knows a lot more about this than

1442
00:58:19,750 --> 00:58:17,760
i do yeah and he helped me a lot to

1443
00:58:22,630 --> 00:58:19,760
write about the exact same things in the

1444
00:58:24,230 --> 00:58:22,640
book so it's a long story it's a complex

1445
00:58:26,069 --> 00:58:24,240
complicated story

1446
00:58:27,829 --> 00:58:26,079
uh and so it

1447
00:58:29,430 --> 00:58:27,839
it would take us 15 minutes to answer

1448
00:58:32,069 --> 00:58:29,440
all that but read the book it's all in

1449
00:58:33,109 --> 00:58:32,079
there all right well i i could only add

1450
00:58:35,910 --> 00:58:33,119
you know

1451
00:58:38,230 --> 00:58:35,920
uh in the former years which wes told

1452
00:58:40,870 --> 00:58:38,240
you about

1453
00:58:43,190 --> 00:58:40,880
we had no lacking

1454
00:58:45,589 --> 00:58:43,200
with the financial support

1455
00:58:48,230 --> 00:58:45,599
because it was cold war motivation you

1456
00:58:50,549 --> 00:58:48,240
know like a project scientist let me say

1457
00:58:52,789 --> 00:58:50,559
a bill showered money

1458
00:58:55,030 --> 00:58:52,799
if it was some kind lacking i just

1459
00:58:57,829 --> 00:58:55,040
addressed to the decision makers and

1460
00:59:00,549 --> 00:58:57,839
said okay americans will beat us

1461
00:59:01,670 --> 00:59:00,559
it was great motivation

1462
00:59:03,349 --> 00:59:01,680
but

1463
00:59:05,510 --> 00:59:03,359

not right now

1464
00:59:07,829 --> 00:59:05,520
and right now the situation dramatically

1465
00:59:10,549 --> 00:59:07,839
changed and we will be completely

1466
00:59:13,750 --> 00:59:10,559
lacking of resources throughout the

1467
00:59:16,230 --> 00:59:13,760
20 years right now the situation very

1468
00:59:22,230 --> 00:59:16,240
very positively changed and we have

1469
00:59:26,549 --> 00:59:24,309
first of all um that was a really

1470
00:59:29,109 --> 00:59:26,559
fascinating joint presentation by both

1471
00:59:31,510 --> 00:59:29,119
of you and uh i thank you both for both

1472
00:59:33,750 --> 00:59:31,520
for your uh efforts and and sharing all

1473
00:59:36,630 --> 00:59:33,760
this this interesting information and

1474
00:59:38,789 --> 00:59:36,640
and perspective with us um

1475
00:59:39,910 --> 00:59:38,799
in in hearing all this one is struck

1476
00:59:42,710 --> 00:59:39,920
again

1477
00:59:46,309 --> 00:59:42,720
by the the great contrast in the the

1478
00:59:48,470 --> 00:59:46,319
soviet um successes at venus compared to

1479
00:59:50,549 --> 00:59:48,480
the record at mars

1480
00:59:54,309 --> 00:59:50,559
and uh especially hearing these details

1481
00:59:54,950 --> 00:59:54,319
uh the history with mars is a is really

1482
01:00:02,390 --> 00:59:54,960
a

1483
01:00:04,549 --> 01:00:02,400
i wonder

1484
01:00:06,309 --> 01:00:04,559
my question is about your perspective on

1485
01:00:08,950 --> 01:00:06,319
that contrast between the record of

1486
01:00:12,230 --> 01:00:08,960
success at venus and the record of

1487
01:00:13,750 --> 01:00:12,240
of not so much success at mars and

1488
01:00:15,190 --> 01:00:13,760

we've heard a lot of details about how

1489
01:00:17,910 --> 01:00:15,200
all these mars missions could have

1490
01:00:19,829 --> 01:00:17,920
worked and almost worked uh and but my

1491
01:00:21,990 --> 01:00:19,839
question is beyond uh just the sort of

1492
01:00:24,309 --> 01:00:22,000
series of unfortunate events is there

1493
01:00:27,990 --> 01:00:24,319
some more profound explanation that you

1494
01:00:29,109 --> 01:00:28,000
have for this great uh contrast

1495
01:00:33,270 --> 01:00:29,119
first of all

1496
01:00:37,670 --> 01:00:34,150
well

1497
01:00:41,510 --> 01:00:39,349
in the years we

1498
01:00:44,789 --> 01:00:41,520
several times failed

1499
01:00:48,549 --> 01:00:44,799
it was some kind even of

1500
01:00:48,559 --> 01:00:52,870
very very

1501
01:00:58,309 --> 01:00:55,750
i would say not scientific concept

1502
01:01:02,710 --> 01:00:58,319
but somebody sitting on mars preventing

1503
01:01:03,589 --> 01:01:02,720
us to have success okay unlike for venus

1504
01:01:04,950 --> 01:01:03,599
well

1505
01:01:08,829 --> 01:01:04,960
but

1506
01:01:11,109 --> 01:01:08,839
we certainly and i showed you in my

1507
01:01:14,630 --> 01:01:11,119
slides to us

1508
01:01:18,390 --> 01:01:14,640
it was really great lessons learned

1509
01:01:20,630 --> 01:01:18,400
and we very profoundly analyzed that

1510
01:01:23,349 --> 01:01:20,640
everything which happened with us

1511
01:01:26,630 --> 01:01:23,359
specifically we are trying to undertake

1512
01:01:30,630 --> 01:01:26,640
new mars mission okay and it's also

1513
01:01:33,990 --> 01:01:30,640

specifically concerns focus ground laws

1514
01:01:39,750 --> 01:01:34,000
because you know for as i said it's

1515
01:01:42,309 --> 01:01:39,760
rooted in our former you know lacking in

1516
01:01:45,589 --> 01:01:42,319
both in technology

1517
01:01:50,710 --> 01:01:48,230
absolutely agree with wes that it was

1518
01:01:51,589 --> 01:01:50,720
first of all electronics

1519
01:01:55,109 --> 01:01:51,599
okay

1520
01:01:59,190 --> 01:01:55,119
and the avionics actually but

1521
01:02:01,589 --> 01:01:59,200
we realize re analyze it and the new

1522
01:02:09,589 --> 01:02:01,599
approach for the mission is completely

1523
01:02:09,599 --> 01:02:11,990
okay

1524
01:02:15,510 --> 01:02:14,150
i i think that was one of the most

1525
01:02:22,630 --> 01:02:15,520
amazing presentations i've seen a lot of

1526
01:02:27,750 --> 01:02:26,309
and we're gonna we will trim 15 minutes

1527
01:02:29,109 --> 01:02:27,760
let's take a break and be back here