



1
00:00:01,000 --> 00:00:04,000
[music playing]

2
00:00:16,866 --> 00:00:20,866
- THIS IS REALLY A GREAT HONOR
TO INTRODUCE TODAY'S TALK.

3
00:00:22,600 --> 00:00:24,166
SOME OF YOU MIGHT HAVE NOTICED

4
00:00:24,166 --> 00:00:26,100
THERE'S BEEN A LOT
OF TALKS ABOUT--

5
00:00:26,100 --> 00:00:29,566
YOU KNOW, OTHER STAR SYSTEMS,
AND BIOLOGY, AND SO ON.

6
00:00:29,566 --> 00:00:33,000
THAT'S COMPLETELY DELIBERATE
ON THE PART OF JACOB COHEN'S...

7
00:00:33,000 --> 00:00:35,033
[laughs]

8
00:00:36,300 --> 00:00:38,533
YOU KNOW, BACKGROUND.

9
00:00:38,533 --> 00:00:42,300
BUT ALSO I THINK IT'S REALLY
WHERE THE FUTURE IS.

10
00:00:42,300 --> 00:00:44,366
AND AS NOTED BEFORE,

11
00:00:44,366 --> 00:00:48,866
THIS IS PART OF OUR
75th ANNIVERSARY CELEBRATION.

12

00:00:48,866 --> 00:00:50,500

THE COLLOQUIUM SERIES
THIS SUMMER

13

00:00:50,500 --> 00:00:52,833

IS IN HONOR OF OUR
75th ANNIVERSARY.

14

00:00:52,833 --> 00:00:57,100

BUT I AM PARTICULARLY PLEASED
TODAY TO HAVE DR. JILL TARTER.

15

00:00:57,100 --> 00:01:00,733

SHE HAS DEVOTED HER CAREER
SEARCHING FOR EVIDENCE

16

00:01:00,733 --> 00:01:03,600

FOR SENTIENT BEINGS
OFF EARTH.

17

00:01:03,600 --> 00:01:05,500

THERE ARE OTHERS
WHO HAVE SPENT THEIR WHOLE LIFE

18

00:01:05,500 --> 00:01:07,833

SEARCHING FOR THEM ON EARTH.

19

00:01:07,833 --> 00:01:10,300

MOST OF THEM FAILED.

20

00:01:10,300 --> 00:01:13,333

BUT IN ALL SERIOUSNESS,

21

00:01:13,333 --> 00:01:18,033

THAT SHE HAS CHANGED
OUR WAY OF THINKING ABOUT THIS.

22

00:01:18,033 --> 00:01:20,766

HER ASTRONOMICAL WORK

IS ILLUSTRATED

23

00:01:20,766 --> 00:01:23,300
IN CARL SAGAN'S NOVEL
"CONTACT"

24

00:01:23,300 --> 00:01:25,100
AND THE FILM VERSION
OF "CONTACT."

25

00:01:25,100 --> 00:01:27,666
AND WE UNDERSTAND
THAT JODI FOSTER'S CHARACTER

26

00:01:27,666 --> 00:01:28,933
WAS LARGELY INSPIRED
BY JILL.

27

00:01:28,933 --> 00:01:32,966
SO, THE--I THINK
SHE'S MUCH COOLER.

28

00:01:32,966 --> 00:01:34,100
JILL IS.

29

00:01:34,100 --> 00:01:35,533
[laughs]

30

00:01:35,533 --> 00:01:37,933
- [woman speaks indistinctly]
- YEAH, THAT'S RIGHT.

31

00:01:37,933 --> 00:01:42,400
ASTEROID 74824 TARTER
(1999 TJ16)

32

00:01:42,400 --> 00:01:43,933
HAS BEEN NAMED IN HER HONOR.

33

00:01:43,933 --> 00:01:45,666

NOW, I HAVE TO SAY
A STORY ABOUT IT.

34

00:01:45,666 --> 00:01:48,366

SOMEBODY WANTED TO NAME
AN ASTEROID AFTER ME.

35

00:01:48,366 --> 00:01:50,633

[laughs]

36

00:01:50,633 --> 00:01:52,566

AND THEY SUBMITTED IT.

37

00:01:52,566 --> 00:01:54,733

AND I WAS A GENERAL
IN THE AIR FORCE AT THE TIME.

38

00:01:54,733 --> 00:01:57,633

WELL, IT TURNS OUT THAT THE
INTERNATIONAL ASTRONOMICAL UNION

39

00:01:57,633 --> 00:02:00,966

WON'T ALLOW THINGS BEING NAMED
AFTER MILITARY FIGURES

40

00:02:00,966 --> 00:02:02,666

OR POLITICAL FIGURES.

41

00:02:02,666 --> 00:02:05,900

AND NOT BEING A POLITICAL FIGURE
THEY USED MILITARY FIGURE.

42

00:02:05,900 --> 00:02:08,200

SO THEY NAMED IT
AFTER MY WIFE.

43

00:02:08,200 --> 00:02:09,933

WHEN I TOLD HER ABOUT IT,
SHE SAID,

44

00:02:09,933 --> 00:02:11,933

"WELL, I'M SURE THAT'LL BE THE
ONE THAT DESTROYS THE EARTH."

45

00:02:11,933 --> 00:02:13,800

[laughter]

46

00:02:13,800 --> 00:02:17,600

BUT JILL HOLDS
THE BERNARD M. OLIVER CHAIR

47

00:02:17,600 --> 00:02:19,800

FOR SETI AT THE SETI
INSTITUTE IN MOUNTAIN VIEW,

48

00:02:19,800 --> 00:02:21,666

JUST DOWN THE ROAD HERE.

49

00:02:21,666 --> 00:02:24,200

AND SHE SERVES
ON THE BOARD OF TRUSTEES.

50

00:02:24,200 --> 00:02:27,366

WE COLLABORATE HERE AT AMES
VERY CLOSELY WITH SOFIA,

51

00:02:27,366 --> 00:02:29,900

AND THEY HAVE BEEN
THE PRINCIPLE PARTNER

52

00:02:29,900 --> 00:02:32,366

IN THE SCIENCE
AND ALL-SEASON TEAM

53

00:02:32,366 --> 00:02:34,600

FOR SOFIA AND KEPLER.

54

00:02:34,600 --> 00:02:37,033

SO REALLY, REALLY PROUD
OF HAVING THAT.

55

00:02:37,033 --> 00:02:40,033
IN 2004 "TIME" MAGAZINE
NAMED HER

56

00:02:40,033 --> 00:02:43,166
AS ONE OF THE 100 MOST
INFLUENTIAL PEOPLE IN THE WORLD.

57

00:02:43,166 --> 00:02:44,933
PRETTY COOL, HUH?

58

00:02:44,933 --> 00:02:46,933
AND IN 2012,
WAS ONE OF THE 25

59

00:02:46,933 --> 00:02:48,966
MOST INFLUENTIAL PEOPLE
IN SPACE.

60

00:02:48,966 --> 00:02:52,133
SHE HAS A BACHELOR OF
ENGINEERING DEGREE IN PHYSICS

61

00:02:52,133 --> 00:02:53,666
FROM CORNELL UNIVERSITY,

62

00:02:53,666 --> 00:02:55,200
AND I UNDERSTAND SHE WAS
THE ONLY WOMAN

63

00:02:55,200 --> 00:02:58,566
IN A CLASS OF 300 ENGINEERING
STUDENTS, SO CONGRATULATIONS.

64

00:02:58,566 --> 00:03:01,866
I HOPE THAT'S MUCH BETTER NOW.

65

00:03:01,866 --> 00:03:04,933

AND A PhD IN ASTRONOMY

66

00:03:04,933 --> 00:03:07,033

FROM THE UNIVERSITY
OF CALIFORNIA AT BERKELEY.

67

00:03:07,033 --> 00:03:09,600

HER TALK TODAY IS ENTITLED
"SEARCHING FOR E.T.:

68

00:03:09,600 --> 00:03:11,400

AN INVESTMENT
IN OUR LONG FUTURE."

69

00:03:11,400 --> 00:03:13,600

JILL? WELCOME BACK.

70

00:03:13,600 --> 00:03:15,600

[applause]

71

00:03:19,366 --> 00:03:22,033

- WELL, PETE, I THINK YOU KNOW
HOW MUCH OF A PLEASURE IT IS

72

00:03:22,033 --> 00:03:25,066

FOR ME TO BE BACK HERE,
SINCE THIS WAS MY FIRST JOB

73

00:03:25,066 --> 00:03:26,900

AS A POSTDOC,
WAS AT NASA AMES.

74

00:03:26,900 --> 00:03:29,766

AND WE WERE WORKING
ON BROWN DWARVES BACK THEN.

75

00:03:29,766 --> 00:03:31,600

THEY'VE BEEN FOUND.

- YUP.

76

00:03:31,600 --> 00:03:33,766

- E.T. HAS YET TO HAPPEN.

77

00:03:33,766 --> 00:03:36,366

SO I THINK MANY OF YOU
MAY THINK

78

00:03:36,366 --> 00:03:39,133

WHEN YOU HEAR
THE WORD "SETI,"

79

00:03:39,133 --> 00:03:41,433

YOU MAY THINK,
"OH, THAT'S FRINGE."

80

00:03:41,433 --> 00:03:44,433

OH, YOU'LL LAUGH TO YOURSELVES
ABOUT LITTLE GREEN MEN

81

00:03:44,433 --> 00:03:47,533

AND FLYING SAUCERS, UFOs.

82

00:03:47,533 --> 00:03:52,300

BUT IN FACT I'M GOING TO TRY
TODAY TO CONVINCING YOU

83

00:03:52,300 --> 00:03:56,100

THAT SETI, THE SEARCH,

84

00:03:56,100 --> 00:03:59,566

AND ALL THE WORK THAT GETS DONE
HERE AT AMES

85

00:03:59,566 --> 00:04:03,133

SEARCHING FOR OTHER
KINDS OF LIFE

86

00:04:03,133 --> 00:04:07,466
IS INCREDIBLY IMPORTANT
TO OUR FUTURE,

87

00:04:07,466 --> 00:04:12,466
BECAUSE THESE TOPICS
ALLOW US

88

00:04:12,466 --> 00:04:15,466
TO CHANGE PERSPECTIVE.

89

00:04:15,466 --> 00:04:18,633
THEY ALLOW US
TO THINK ABOUT THINGS

90

00:04:18,633 --> 00:04:21,733
AND TO SEE OURSELVES
IN A WAY

91

00:04:21,733 --> 00:04:26,533
THAT IS NOT OFTEN USED
BY THE GENERAL PUBLIC.

92

00:04:26,533 --> 00:04:29,766
BUT I THINK IT'S SOMETHING
THAT WE NEED TO SHARE WITH THEM,

93

00:04:29,766 --> 00:04:32,800
BECAUSE BEING ABLE
TO STEP BACK,

94

00:04:32,800 --> 00:04:37,600
TAKE THIS COSMIC
LARGER PICTURE VIEW

95

00:04:37,600 --> 00:04:41,533
IS WHAT WE NEED TO DO
IN ORDER TO SOLVE

96

00:04:41,533 --> 00:04:45,166

ALL OF THE CHALLENGES
THAT FACE THE PLANET

97

00:04:45,166 --> 00:04:47,200
AND ALL LIFE ON IT.

98

00:04:47,200 --> 00:04:51,666
AND SO I HOPE THAT I CAN CHANGE
YOUR POINT OF VIEW,

99

00:04:51,666 --> 00:04:53,833
AND I HOPE THAT YOU'LL GET
INTERESTED

100

00:04:53,833 --> 00:04:56,966
IN PARTICIPATING
IN THESE GRAND SEARCHES.

101

00:04:56,966 --> 00:05:01,800
SO, THIS WHOLE STORY--

102

00:05:01,800 --> 00:05:05,233
SORT OF YOUR STORY,
MY STORY, OUR STORY,

103

00:05:05,233 --> 00:05:08,200
BEGAN BILLIONS
OF YEARS AGO, RIGHT?

104

00:05:08,200 --> 00:05:10,766
THAT'S NO SECRET TO ANYONE

105

00:05:10,766 --> 00:05:13,266
WHO'S TAKEN A UNIVERSITY
ASTRONOMY COURSE,

106

00:05:13,266 --> 00:05:15,833
OR ANYONE WHO'S WORKED
AROUND THIS FACILITY.

107
00:05:17,766 --> 00:05:20,000
BUT IT...

108
00:05:20,000 --> 00:05:21,966
IT PROBABLY DOESN'T COME

109
00:05:21,966 --> 00:05:25,333
FIRST TO YOUR MIND
WHEN YOU WAKE UP IN THE MORNING.

110
00:05:25,333 --> 00:05:28,166
YOU NEED TO CHANGE THAT,
ALL RIGHT?

111
00:05:28,166 --> 00:05:32,200
SO, UM, OUR UNIVERSE BEGAN

112
00:05:32,200 --> 00:05:34,700
IN AN ENORMOUS EXPANSION

113
00:05:34,700 --> 00:05:37,166
ABOUT 3.8 BILLION
YEARS AGO.

114
00:05:37,166 --> 00:05:41,933
AND OUR MILKY WAY GALAXY WAS
BORN ABOUT 10 BILLION YEARS AGO.

115
00:05:43,700 --> 00:05:48,866
AND WE ARE INTIMATELY CONNECTED
WITH THESE FARAWAY TIMES

116
00:05:48,866 --> 00:05:51,033
AND FARAWAY PLACES,

117
00:05:51,033 --> 00:05:54,766
BECAUSE IT TAKES A COSMOS
TO MAKE A HUMAN.

118

00:05:54,766 --> 00:05:57,300

HUMANS CAN TRACE
THEIR LINEAGE

119

00:05:57,300 --> 00:06:00,866

NOT JUST BACK THROUGH THE
CENTURIES OF OUR OWN FAMILIES,

120

00:06:00,866 --> 00:06:05,600

NOT JUST BACK THROUGH THE
MILLENNIA OF OUR CIVILIZATIONS,

121

00:06:05,600 --> 00:06:10,333

WITH ITS BUILDINGS,
ITS ART AND ITS EXPERIMENTS

122

00:06:10,333 --> 00:06:13,366

WITH DIFFERENT FORMS
OF GOVERNANCE.

123

00:06:13,366 --> 00:06:17,733

WE TRACE OUR HERITAGE NOT JUST
BACK TO THE MILLIONS OF YEARS...

124

00:06:20,233 --> 00:06:24,866

SINCE WE EMERGED,
BRANCHED AWAY FROM THE APES.

125

00:06:24,866 --> 00:06:28,700

NOT JUST BACK
THE 2.4 BILLION YEARS

126

00:06:28,700 --> 00:06:33,200

DURING WHICH EARTH'S ATMOSPHERE
HAS BEEN PERFUSED WITH OXYGEN,

127

00:06:33,200 --> 00:06:39,166

THANKS TO THE CEASELESS EFFORTS
OF PHOTOSYNTHETIC CYANOBACTERIA.

128

00:06:39,166 --> 00:06:43,533

NOT JUST BACK TO THE FORMATION
OF THE SUN AND THE SOLAR SYSTEM,

129

00:06:43,533 --> 00:06:46,333

ABOUT 5 BILLION YEARS AGO.

130

00:06:46,333 --> 00:06:48,966

BUT ALL THE WAY BACK

131

00:06:48,966 --> 00:06:52,900

TO THE SUPERNOVA
EXPLOSION

132

00:06:52,900 --> 00:06:57,500

AND DEATH OF A MASSIVE STAR.

133

00:06:57,500 --> 00:07:02,066

THE IRON ATOMS IN THE HEMOGLOBIN
MOLECULES IN YOUR BLOOD,

134

00:07:02,066 --> 00:07:05,400

THE CALCIUM ATOMS
IN YOUR BONES,

135

00:07:05,400 --> 00:07:08,866

WERE FUSED DEEP WITHIN
A MASSIVE STAR

136

00:07:08,866 --> 00:07:12,900

THAT ENDED ITS LIFE
IN A CATASTROPHIC CONVULSION,

137

00:07:12,900 --> 00:07:14,400

LEAVING BEHIND REMNANTS,

138

00:07:14,400 --> 00:07:17,266

SUCH AS THIS MORE
MODERN EXAMPLE.

139

00:07:17,266 --> 00:07:21,033

REMNANTS THAT ARE NOW WAITING
TO BE INCORPORATED

140

00:07:21,033 --> 00:07:24,966

INTO FUTURE GENERATIONS
OF STARS AND PLANETS,

141

00:07:24,966 --> 00:07:28,333

AND PERHAPS LIFE.

142

00:07:28,333 --> 00:07:32,266

SO IT'S TAKEN MILLENNIA
FOR HUMANS TO PIECE TOGETHER

143

00:07:32,266 --> 00:07:36,133

THE STORY THUS FAR.

144

00:07:36,133 --> 00:07:39,933

AND WE'RE CONTINUING
ON THIS JOURNEY,

145

00:07:39,933 --> 00:07:42,766

DRIVEN BY OUR CURIOSITY

146

00:07:42,766 --> 00:07:46,566

AND OUR DESIRE
TO UNDERSTAND,

147

00:07:46,566 --> 00:07:51,333

TO KNOW OUR PLACE
IN THE UNIVERSE.

148

00:07:51,333 --> 00:07:55,166

WE WANT TO KNOW,
WHERE DO WE COME FROM?

149

00:07:55,166 --> 00:07:56,566

WHERE ARE WE GOING?

150

00:07:56,566 --> 00:07:59,200

WHAT IS? WHY IS?

151

00:07:59,200 --> 00:08:01,233

AND, OF COURSE,
WE'RE REALLY INTERESTED

152

00:08:01,233 --> 00:08:05,800

IN WHETHER OR NOT
THERE'S ANYONE ELSE OUT THERE.

153

00:08:07,233 --> 00:08:11,700

SO, SO FAR THE NUMBERS SUGGEST
A UNIVERSE OF POSSIBILITIES.

154

00:08:16,833 --> 00:08:19,500

WOW, THIS CLICKER IS A LITTLE
BIT JET-LAGGED.

155

00:08:19,500 --> 00:08:21,700

OKAY...

156

00:08:21,700 --> 00:08:23,966

SO LET'S DO IT THIS WAY.

157

00:08:23,966 --> 00:08:26,900

AND RIGHT NOW,

158

00:08:26,900 --> 00:08:31,133

WE'RE ABLE TO COMPREHEND
OURSELVES AS LIVING

159

00:08:31,133 --> 00:08:34,833

ON A VERY FRAGILE ISLAND
OF LIFE

160

00:08:34,833 --> 00:08:37,533

WITHIN THIS UNIVERSE
OF POSSIBILITIES.

161
00:08:39,700 --> 00:08:42,800
WE'RE JUST BEGINNING
TO APPRECIATE

162
00:08:42,800 --> 00:08:45,766
THE POSSIBILITIES
HERE ON EARTH,

163
00:08:45,766 --> 00:08:48,166
THE POSSIBILITIES
FOR OUR FUTURE.

164
00:08:48,166 --> 00:08:52,166
AND THOSE POSSIBILITIES
REQUIRE EMBRACING

165
00:08:52,166 --> 00:08:54,200
THIS COSMIC PERSPECTIVE.

166
00:08:54,200 --> 00:08:56,100
SO, EXTREMOPHILES,

167
00:08:56,100 --> 00:08:58,866
SOMETHING THAT MANY OF YOU HERE
ARE FAMILIAR WITH.

168
00:08:58,866 --> 00:09:01,266
IT'S LIFE THAT WE DIDN'T
EVEN KNOW ABOUT

169
00:09:01,266 --> 00:09:03,100
UNTIL A FEW DECADES AGO,

170
00:09:03,100 --> 00:09:05,300
THRIVING IN PLACES
THAT WE ONCE THOUGHT

171

00:09:05,300 --> 00:09:09,966

WERE COMPLETELY
INHOSPITABLE TO LIFE.

172

00:09:09,966 --> 00:09:13,933

AND THESE ORGANISMS
ARE NOW ILLUMINATING

173

00:09:13,933 --> 00:09:16,466

THE POTENTIAL FOR LIFE
ELSEWHERE.

174

00:09:16,466 --> 00:09:22,166

AND THE POSSIBILITY
FOR A LOT MORE HABITABLE

175

00:09:22,166 --> 00:09:26,100

COSMIC REAL ESTATE OUT THERE
THAN WE ONCE MIGHT HAVE THOUGHT.

176

00:09:28,166 --> 00:09:32,100

SO AN APPRECIATION
OF LIFE'S INCREDIBLE DIVERSITY

177

00:09:32,100 --> 00:09:36,100

AND ITS SCALE
IS REALLY THE FIRST STEP

178

00:09:36,100 --> 00:09:40,300

IN CONTEMPLATING THE UNIVERSE
BEYOND OUR OWN COSMIC DOORSTEP.

179

00:09:41,900 --> 00:09:45,866

IT'S IMPORTANT TO REMEMBER
THAT WE ARE NOT THE PINNACLE

180

00:09:45,866 --> 00:09:49,566

OR THE ULTIMATE DESIGN
OF EVOLUTION.

181
00:09:49,566 --> 00:09:55,233
WE'RE NOT THE INTENTIONAL
PRODUCT OF 4 BILLION YEARS

182
00:09:55,233 --> 00:09:58,100
OF PLOTTING AND PLANNING.

183
00:09:58,100 --> 00:10:03,766
WE'RE SIMPLY A PART
OF TODAY'S SNAPSHOT

184
00:10:03,766 --> 00:10:07,000
OF A PERPETUALLY
TRANSITIONAL FORM.

185
00:10:07,000 --> 00:10:11,133
SO AS WE PRY OPEN
THOSE COSMIC DOORS,

186
00:10:11,133 --> 00:10:14,766
WE'RE TESTING
THESE POSSIBILITIES.

187
00:10:14,766 --> 00:10:16,533
AND THIS AMAZING IMAGE--

188
00:10:16,533 --> 00:10:19,400
ABSOLUTELY MIND-BLOWING IMAGE

189
00:10:19,400 --> 00:10:24,166
IS THANKS TO THE CURIOSITY
SCIENCE LABORATORY ON MARS.

190
00:10:24,166 --> 00:10:27,700
CURIOSITY WASN'T DESIGNED
TO FIND LIFE.

191
00:10:27,700 --> 00:10:29,733
BUT IT'S SHOWING US

192

00:10:29,733 --> 00:10:33,100
THAT THE CONDITIONS
THAT WE THINK

193

00:10:33,100 --> 00:10:35,700
ARE NECESSARY FOR LIFE

194

00:10:35,700 --> 00:10:38,166
DID EXIST
ON THIS PLANET ONCE.

195

00:10:38,166 --> 00:10:41,766
AND PERHAPS THEY STILL
EXIST IN PLACES TODAY,

196

00:10:41,766 --> 00:10:45,200
BURIED BENEATH THE SURFACE
OF THIS FROZEN DESERT.

197

00:10:47,233 --> 00:10:51,800
ALTERNATELY, LIFE MAY BE FOUND
FARTHER OUT IN THE SOLAR SYSTEM.

198

00:10:53,766 --> 00:10:58,300
IN THE WATER OCEANS
BENEATH THE ICE OF EUROPA,

199

00:10:58,300 --> 00:11:00,133
CALLISTO, GANYMEDE,
RIGHT?

200

00:11:00,133 --> 00:11:02,200
THESE LARGE MOONS
OF JUPITER.

201

00:11:02,200 --> 00:11:04,233
OR MAYBE
IN THE ETHANE LAKES

202

00:11:04,233 --> 00:11:08,233

ON THE SURFACE OF SATURN'S
LARGE MOON, TITAN.

203

00:11:08,233 --> 00:11:13,033

OR EVEN, PERHAPS, ON A TINY
LITTLE MOON, ENCELADUS,

204

00:11:13,033 --> 00:11:17,033

WITH ITS AMAZING
CRYOVOLCANOES.

205

00:11:18,633 --> 00:11:21,700

AND THESE PLACES

206

00:11:21,700 --> 00:11:25,266

ARE PLACES THAT WE
OR OUR SURROGATES

207

00:11:25,266 --> 00:11:28,166

MAY VISIT IN THE FUTURE.

208

00:11:28,166 --> 00:11:31,400

AND MAY BE ABLE TO INTERROGATE,

209

00:11:31,400 --> 00:11:34,666

LOOKING FOR LIFE.

210

00:11:34,666 --> 00:11:37,266

BUT IT ALSO
MAY BE THE CASE

211

00:11:37,266 --> 00:11:41,666

THAT WE HAVE TO LOOK FARTHER,
BEYOND OUR OWN SOLAR SYSTEM.

212

00:11:43,633 --> 00:11:47,100

AND UNTIL 1995,

213

00:11:47,100 --> 00:11:51,233

WE ACTUALLY DIDN'T KNOW
WHETHER THERE WERE ANY PLANETS

214

00:11:51,233 --> 00:11:54,766

AROUND SOLAR-TYPE
NORMAL STARS.

215

00:11:54,766 --> 00:11:57,000

BUT SINCE MARCH OF 2009,

216

00:11:57,000 --> 00:11:58,566

THE KEPLER SPACECRAFT,

217

00:11:58,566 --> 00:12:02,500

WITH WHICH THIS FACILITY
IS SO HEAVILY INVOLVED

218

00:12:02,500 --> 00:12:06,233

AND SO RESPONSIBLE
FOR ITS SUCCESS,

219

00:12:06,233 --> 00:12:08,600

KEPLER'S BEEN FOLLOWING
BEHIND THE EARTH

220

00:12:08,600 --> 00:12:12,800

IN ITS ORBIT
AROUND THE SUN...

221

00:12:12,800 --> 00:12:16,700

AND ITS MISSION
IS TO TELL US

222

00:12:16,700 --> 00:12:21,500

HOW FREQUENTLY PLANETS
THE SIZE OF THE EARTH

223

00:12:21,500 --> 00:12:25,366

ACTUALLY FORM
AROUND OTHER STARS.

224
00:12:25,366 --> 00:12:28,533
SO KEPLER HAS
A 93-MEGAPIXEL CAMERA.

225
00:12:28,533 --> 00:12:30,366
C.C.D. CAMERA.

226
00:12:30,366 --> 00:12:33,833
REAL HIGH-END VERSION
OF WHAT YOU HAVE ON YOUR PHONES.

227
00:12:33,833 --> 00:12:39,566
AND IT STARES CONTINUOUSLY AT
100 SQUARE DEGREES ON THE SKY.

228
00:12:39,566 --> 00:12:42,966
AND IT'S IN THE DIRECTION
THAT'S JUST A BIT NORTH

229
00:12:42,966 --> 00:12:45,666
OF THE PLANE
OF THE MILKY WAY GALAXY,

230
00:12:45,666 --> 00:12:49,600
BECAUSE THERE ARE A LOT OF STARS
IN THAT DIRECTION.

231
00:12:49,600 --> 00:12:52,066
AND YET NOT TOO MANY,

232
00:12:52,066 --> 00:12:56,633
SO KEPLER'S INSTRUMENTATION
DOESN'T GET CONFUSED.

233
00:12:56,633 --> 00:12:59,433
SO KEPLER'S STARING
AT THAT PATCH OF SKY,

234

00:12:59,433 --> 00:13:02,800

WHICH IS LIKE THE SIZE
OF YOUR HAND.

235

00:13:02,800 --> 00:13:07,733

AND IT'S WAITING FOR SOME
OF THOSE 170,000 STARS

236

00:13:07,733 --> 00:13:10,200

THAT IT'S CONCENTRATING ON
TO BLINK.

237

00:13:10,200 --> 00:13:15,000

OR AT LEAST THAT'S WHAT IT DID
BETWEEN 2009 AND 2012.

238

00:13:15,000 --> 00:13:18,633

2013. MY MISTAKE.

239

00:13:18,633 --> 00:13:20,400

AND, AS IT TURNS OUT,

240

00:13:20,400 --> 00:13:22,500

MANY OF THEM DID BLINK.

241

00:13:22,500 --> 00:13:25,300

AND THIS TRANSIT METHOD,

242

00:13:25,300 --> 00:13:29,333

LOOKING FOR A PLANET TO PASS
IN FRONT OF A STAR

243

00:13:29,333 --> 00:13:32,400

AND DIM ITS LIGHTS
FOR A FEW HOURS--

244

00:13:32,400 --> 00:13:35,166

DIM ITS BRIGHTNESS

FOR A FEW HOURS--

245

00:13:35,166 --> 00:13:37,800
IS EXTRAORDINARILY
SUCCESSFUL.

246

00:13:37,800 --> 00:13:41,533
SO TODAY,
ON THE KEPLER-MAST SITE,

247

00:13:41,533 --> 00:13:43,300
I LOOKED UP,
AND THERE ARE

248

00:13:43,300 --> 00:13:47,500
4,234 CANDIDATE EXOPLANETS.

249

00:13:47,500 --> 00:13:50,433
THAT GOES UP, AND SOMETIMES
IT GOES DOWN A LITTLE.

250

00:13:50,433 --> 00:13:55,433
AND 978 OF THEM
HAVE BEEN CONFIRMED

251

00:13:55,433 --> 00:13:59,166
EITHER BY OTHER GROUND-BASED
OBSERVATORIES

252

00:13:59,166 --> 00:14:00,866
AND OTHER METHODOLOGY,

253

00:14:00,866 --> 00:14:05,633
OR STATISTICALLY, USING
THE KEPLER DATA THEMSELVES.

254

00:14:05,633 --> 00:14:07,833
AND IT TURNS OUT

255

00:14:07,833 --> 00:14:12,300
THAT BECAUSE WE HAVE
THIS CHAUVINISM

256
00:14:12,300 --> 00:14:14,366
IN OUR SEARCH FOR LIFE,

257
00:14:14,366 --> 00:14:18,300
WE THINK LIQUID WATER
IS REALLY IMPORTANT.

258
00:14:18,300 --> 00:14:22,600
THEN THERE ARE
A FEW OF THESE STARS

259
00:14:22,600 --> 00:14:28,400
THAT APPEAR TO HAVE PLANETS
IN ORBIT AROUND THEM

260
00:14:28,400 --> 00:14:30,800
AT JUST THE RIGHT DISTANCE,

261
00:14:30,800 --> 00:14:32,666
SO THAT IF THERE WERE
AN ATMOSPHERE

262
00:14:32,666 --> 00:14:34,400
SURROUNDING THAT PLANET,

263
00:14:34,400 --> 00:14:37,266
IT WOULD BE NOT TOO HOT,
NOT TOO COLD,

264
00:14:37,266 --> 00:14:41,433
AND MIGHT BE ABLE TO SUPPORT
LIQUID WATER ON ITS SURFACE.

265
00:14:41,433 --> 00:14:45,966
AND SO WE THINK A LOT
ABOUT THIS HABITABLE ZONE.

266

00:14:45,966 --> 00:14:47,566

AND I HEARD A REALLY NICE TALK
AT THE SETI INSTITUTE

267

00:14:47,566 --> 00:14:50,066

A COUPLE OF WEEKS AGO

268

00:14:50,066 --> 00:14:52,866

WHERE MY COLLEAGUE,
STEPHEN KANE,

269

00:14:52,866 --> 00:14:54,300

REMINDED US--

270

00:14:54,300 --> 00:14:56,566

I HAVE TO BE CAREFUL HERE.

271

00:14:56,566 --> 00:15:00,200

WE ASTRONOMERS ARE GOING
INTO HYPE LAND, RIGHT?

272

00:15:00,200 --> 00:15:03,533

WE ARE TALKING ABOUT
HABITABLE ZONES,

273

00:15:03,533 --> 00:15:07,900

THEN POTENTIALLY
HABITABLE PLANETS.