

1  
00:00:00,000 --> 00:00:03,330  
this was demon has been introduced by

2  
00:00:01,740 --> 00:00:05,028  
Daniel doesn't need a great deal of

3  
00:00:03,330 --> 00:00:08,669  
review but we will go through some of it

4  
00:00:05,028 --> 00:00:10,320  
is generally challenges to the second

5  
00:00:08,669 --> 00:00:12,269  
law through that Maxwell's demon has

6  
00:00:10,320 --> 00:00:14,759  
been microscopic on the atomic level

7  
00:00:12,269 --> 00:00:16,109  
like when other fellows just asking

8  
00:00:14,759 --> 00:00:19,618  
about there and on the atomic level

9  
00:00:16,109 --> 00:00:22,529  
things yeah largely are ignored because

10  
00:00:19,618 --> 00:00:28,439  
it's a reversible regime on the

11  
00:00:22,528 --> 00:00:30,390  
macroscopic scale it is not now the also

12  
00:00:28,439 --> 00:00:32,270  
has pointed out before the scientific

13  
00:00:30,390 --> 00:00:34,320  
discipline of thermodynamics is

14  
00:00:32,270 --> 00:00:36,630  
considered to be a close science that

15  
00:00:34,320 --> 00:00:38,730  
very little has changed to the

16  
00:00:36,630 --> 00:00:40,320  
fundamentals of it for over a hundred

17  
00:00:38,729 --> 00:00:43,109  
years and what has occurred in recent

18  
00:00:40,320 --> 00:00:45,420  
years is just simply advancements and

19  
00:00:43,109 --> 00:00:49,409  
materials and computational fluid

20  
00:00:45,420 --> 00:00:51,390  
dynamics such as gas turbine of five how

21  
00:00:49,409 --> 00:00:54,929  
do we keep the thing from from melting

22  
00:00:51,390 --> 00:00:56,969  
or fracturing and flying apart and how

23  
00:00:54,929 --> 00:01:01,140  
can we model it according to computers

24  
00:00:56,969 --> 00:01:02,698  
but it's still with the old concepts

25  
00:01:01,140 --> 00:01:06,710  
that were developed a hundred years ago

26  
00:01:02,698 --> 00:01:09,959  
or more and within the first of the

27  
00:01:06,709 --> 00:01:11,938  
within the discipline of thermodynamics

28  
00:01:09,959 --> 00:01:14,399  
it's largely directed by the first law

29

00:01:11,938 --> 00:01:15,989  
of conservation of energy and the second

30  
00:01:14,400 --> 00:01:17,990  
law of the concept of entropy that

31  
00:01:15,989 --> 00:01:21,688  
energy increases its randomness and

32  
00:01:17,989 --> 00:01:24,419  
describe definitively as the net change

33  
00:01:21,688 --> 00:01:28,769  
in a nice elated system so I entropy is

34  
00:01:24,420 --> 00:01:30,299  
0 or greater than zero can be stated

35  
00:01:28,769 --> 00:01:31,319  
number of different ways we'll just go

36  
00:01:30,299 --> 00:01:33,118  
through this quickly he flows

37  
00:01:31,319 --> 00:01:35,339  
spontaneously from mojado to a colder

38  
00:01:33,118 --> 00:01:37,140  
object but not vice versa when an

39  
00:01:35,340 --> 00:01:39,329  
isolated system undergoes change its

40  
00:01:37,140 --> 00:01:42,509  
change in entropy will be 0 or greater

41  
00:01:39,328 --> 00:01:45,389  
than zero the specific embodiment to

42  
00:01:42,509 --> 00:01:47,430  
this is Carnales theorem that a heat

43  
00:01:45,390 --> 00:01:48,959

engines efficiency is a function of its

44

00:01:47,430 --> 00:01:52,110  
maximum and minimum absolute

45

00:01:48,959 --> 00:01:55,469  
temperatures as a as a ratio like we see

46

00:01:52,109 --> 00:01:57,328  
right down here the second law of

47

00:01:55,469 --> 00:01:59,429  
thermodynamics is based upon the kinetic

48

00:01:57,328 --> 00:02:01,559  
theory of heat that thermal energy use

49

00:01:59,430 --> 00:02:04,140  
the random motion and vibration of atoms

50

00:02:01,560 --> 00:02:06,090  
and molecules collisions between these

51

00:02:04,140 --> 00:02:07,890  
atoms and molecules transfer thermal

52

00:02:06,090 --> 00:02:10,770  
energy preserving kinetic energy and

53

00:02:07,890 --> 00:02:12,479  
momentum statistical mechanics models

54

00:02:10,770 --> 00:02:12,890  
this a little bit further by saying well

55

00:02:12,479 --> 00:02:15,619  
these

56

00:02:12,889 --> 00:02:17,208  
these collisions are our particle pair

57

00:02:15,620 --> 00:02:18,740  
collisions just two of them coming

58

00:02:17,209 --> 00:02:21,319  
together and then they go off in

59

00:02:18,740 --> 00:02:23,719  
whatever direction they do preserving

60

00:02:21,318 --> 00:02:25,759  
the kinetic energy and the momentum now

61

00:02:23,719 --> 00:02:27,439  
in the atomic scale these seem to be

62

00:02:25,759 --> 00:02:29,090  
reversible collisions they will go all

63

00:02:27,439 --> 00:02:32,389  
over the place nothing's lost we say

64

00:02:29,090 --> 00:02:33,860  
it's there elastic collisions but when

65

00:02:32,389 --> 00:02:36,649  
let's look down a larger and larger

66

00:02:33,860 --> 00:02:39,730  
scale of all these particles together in

67

00:02:36,650 --> 00:02:43,129  
a larger group it all gets randomized

68

00:02:39,729 --> 00:02:45,500  
and that's the another question over

69

00:02:43,129 --> 00:02:47,810  
here how do we rewrite the second law it

70

00:02:45,500 --> 00:02:49,699  
will deal with the this nature of

71

00:02:47,810 --> 00:02:52,939  
randomness that is underlying all of

72  
00:02:49,699 --> 00:02:55,759  
this with any law you must understand

73  
00:02:52,939 --> 00:02:59,000  
the fundamental principles under which

74  
00:02:55,759 --> 00:03:00,889  
the law was identified and all laws of

75  
00:02:59,000 --> 00:03:03,229  
physics are nothing more than models of

76  
00:03:00,889 --> 00:03:06,529  
understanding and as our understanding

77  
00:03:03,229 --> 00:03:08,539  
changes so does the law Max Planck one

78  
00:03:06,530 --> 00:03:10,729  
of the fathers of quantum mechanics was

79  
00:03:08,539 --> 00:03:13,009  
quoted as saying we have no right to

80  
00:03:10,729 --> 00:03:15,109  
assume that any physical laws exist or

81  
00:03:13,009 --> 00:03:16,729  
if they have existed up to now that they

82  
00:03:15,110 --> 00:03:19,880  
will continue to exist in a similar

83  
00:03:16,729 --> 00:03:22,548  
manner all I meant was our awareness of

84  
00:03:19,879 --> 00:03:25,639  
them are understanding of them is what K

85  
00:03:22,549 --> 00:03:28,819  
is capable of changing now I were the

86

00:03:25,639 --> 00:03:31,039  
result of the 2l Te'o's we know it he

87  
00:03:28,819 --> 00:03:33,019  
cannot be completely converted into work

88  
00:03:31,039 --> 00:03:34,789  
and engines efficiently will always be

89  
00:03:33,019 --> 00:03:37,039  
less than one hundred percent it's

90  
00:03:34,789 --> 00:03:38,870  
assumed to be universal in sculpting is

91  
00:03:37,039 --> 00:03:40,310  
that kind of dangerous to operate

92  
00:03:38,870 --> 00:03:43,849  
something in science with an assumption

93  
00:03:40,310 --> 00:03:45,469  
but it's there it's never been nobody's

94  
00:03:43,849 --> 00:03:47,090  
ever had an opportunity to challenge it

95  
00:03:45,469 --> 00:03:49,430  
so it's been assumed all the way back

96  
00:03:47,090 --> 00:03:51,019  
from what Ruth Clausius he said

97  
00:03:49,430 --> 00:03:53,900  
something to the effect well from these

98  
00:03:51,019 --> 00:03:56,329  
observations it's just assume that the

99  
00:03:53,900 --> 00:03:59,930  
you know the second law is said is

100  
00:03:56,329 --> 00:04:02,060

precise and it's also thought to be

101

00:03:59,930 --> 00:04:04,340

absolute and manifestation such that

102

00:04:02,060 --> 00:04:06,739

there are no exceptions whatsoever it be

103

00:04:04,340 --> 00:04:09,950

like seeing our gravity is inviolable

104

00:04:06,739 --> 00:04:11,719

there are no there are no exceptions to

105

00:04:09,949 --> 00:04:13,339

it it is absolutely if that's the case I

106

00:04:11,719 --> 00:04:15,799

wouldn't be able to lift this up is this

107

00:04:13,340 --> 00:04:17,660

a violation of gravity but this is how

108

00:04:15,799 --> 00:04:19,959

absurd that the second law is being

109

00:04:17,660 --> 00:04:19,959

treated

110

00:04:21,089 --> 00:04:25,869

the second law is that's understood is

111

00:04:23,439 --> 00:04:29,829

based upon faulty logic and we rarely go

112

00:04:25,870 --> 00:04:33,129

back to understand where it came from as

113

00:04:29,829 --> 00:04:36,219

with anything in science or in the on or

114

00:04:33,129 --> 00:04:39,100

in the the discipline of logic through

115  
00:04:36,220 --> 00:04:41,740  
philosophy the conclusion is only true

116  
00:04:39,100 --> 00:04:43,780  
if its premises are true and a

117  
00:04:41,740 --> 00:04:46,120  
conclusion is limited if one or more if

118  
00:04:43,779 --> 00:04:47,529  
its premises is limited and what's

119  
00:04:46,120 --> 00:04:50,280  
behind the second law of thermodynamics

120  
00:04:47,529 --> 00:04:54,129  
is the understanding of randomness and

121  
00:04:50,279 --> 00:04:56,799  
things are not always random plus we

122  
00:04:54,129 --> 00:04:59,589  
also have the basic human understanding

123  
00:04:56,800 --> 00:05:01,509  
that you can get to that the absence of

124  
00:04:59,589 --> 00:05:04,899  
evidence is not evidence that it does

125  
00:05:01,509 --> 00:05:06,879  
not exist plus natural law has always

126  
00:05:04,899 --> 00:05:11,079  
affect each other recruiting absolute

127  
00:05:06,879 --> 00:05:13,180  
manifestation and this is why laboratory

128  
00:05:11,079 --> 00:05:15,219  
protocols are so difficult to do and do

129

00:05:13,180 --> 00:05:17,800

it well so that it really identifies

130

00:05:15,220 --> 00:05:19,440

that a concept in question because we're

131

00:05:17,800 --> 00:05:21,730

all these are interferences from other

132

00:05:19,439 --> 00:05:25,060

effects and you want to get those out of

133

00:05:21,730 --> 00:05:28,830

the way so the the effect in question is

134

00:05:25,060 --> 00:05:32,829

all that's left to be identified by the

135

00:05:28,829 --> 00:05:34,870

experiment so what this comes down to is

136

00:05:32,829 --> 00:05:36,279

that these laws are competing with each

137

00:05:34,870 --> 00:05:38,439

other to outdo each other all the time

138

00:05:36,279 --> 00:05:40,839

and a good example of this I ran into it

139

00:05:38,439 --> 00:05:42,339

with a civil engineer number of years

140

00:05:40,839 --> 00:05:44,889

ago set only we're talking about a

141

00:05:42,339 --> 00:05:46,810

municipal water tower being able to

142

00:05:44,889 --> 00:05:50,310

measure the pressure on this water tower

143

00:05:46,810 --> 00:05:52,509  
says all its or by Pascal's principle of

144  
00:05:50,310 --> 00:05:54,579  
Equalization the fire fluid pressure on

145  
00:05:52,509 --> 00:05:56,709  
a municipal reservoir if you close the

146  
00:05:54,579 --> 00:05:59,079  
vent on top it's same pressure top and

147  
00:05:56,709 --> 00:06:00,939  
bottom said no it is not there's also

148  
00:05:59,079 --> 00:06:02,829  
the effect of gravity that affects it

149  
00:06:00,939 --> 00:06:04,689  
and it's going to be a lower pressure up

150  
00:06:02,829 --> 00:06:07,060  
at the top then what you would measure

151  
00:06:04,689 --> 00:06:09,339  
down at the bottom of the standpipe in

152  
00:06:07,060 --> 00:06:11,649  
the municipal water tank but this is

153  
00:06:09,339 --> 00:06:13,239  
where people think they don't we have

154  
00:06:11,649 --> 00:06:15,849  
simplistic models that we study in

155  
00:06:13,240 --> 00:06:17,829  
school but these models do not reflect

156  
00:06:15,850 --> 00:06:20,140  
the real world that we are in and the

157  
00:06:17,829 --> 00:06:21,609

second law is also here that comes to

158

00:06:20,139 --> 00:06:25,089

pinning one law against the other the

159

00:06:21,610 --> 00:06:27,550

only one that I would bet on I'm winning

160

00:06:25,089 --> 00:06:29,079

in any of these competitive play offices

161

00:06:27,550 --> 00:06:30,850

that the conservation of energy would

162

00:06:29,079 --> 00:06:33,159

would win if it was pitted against the

163

00:06:30,850 --> 00:06:34,660

second law and remember other things

164

00:06:33,160 --> 00:06:36,820

that the second one pitted

165

00:06:34,660 --> 00:06:40,930

so everyone's well that other one loses

166

00:06:36,819 --> 00:06:42,610

at the expense of the second law now I

167

00:06:40,930 --> 00:06:46,769

want to go to some historical

168

00:06:42,610 --> 00:06:50,400

perspective here read you a quote from

169

00:06:46,769 --> 00:06:54,519

James Clerk Maxwell about the second law

170

00:06:50,399 --> 00:06:57,009

and has taken from the texts that quoted

171

00:06:54,519 --> 00:06:58,659

here it is probably impossible to reduce

172  
00:06:57,009 --> 00:07:01,019  
the second law of thermodynamics to a

173  
00:06:58,660 --> 00:07:03,220  
form as axiomatic as that of the first

174  
00:07:01,019 --> 00:07:06,039  
four we have reason to believe that

175  
00:07:03,220 --> 00:07:08,620  
though true its truth is not the same

176  
00:07:06,040 --> 00:07:10,420  
order as that of the first law the first

177  
00:07:08,620 --> 00:07:12,490  
law is an extension to the theory of

178  
00:07:10,420 --> 00:07:14,379  
heat of the principle of conservation of

179  
00:07:12,490 --> 00:07:16,060  
energy which can be proved

180  
00:07:14,379 --> 00:07:18,240  
mathematically true if real bodies

181  
00:07:16,060 --> 00:07:22,000  
consist of matter as per definition

182  
00:07:18,240 --> 00:07:23,949  
acted on by forces having potentials the

183  
00:07:22,000 --> 00:07:25,899  
second layer you log relates to that

184  
00:07:23,949 --> 00:07:28,300  
kind of communication of energy which we

185  
00:07:25,899 --> 00:07:30,189  
call work according to the molecular

186  
00:07:28,300 --> 00:07:32,920  
theory the only difference between these

187  
00:07:30,189 --> 00:07:34,629  
two kinds of communications of energy is

188  
00:07:32,920 --> 00:07:36,189  
that the motions and displacements which

189  
00:07:34,629 --> 00:07:38,649  
are concerned in the communication of

190  
00:07:36,189 --> 00:07:41,889  
heat are those of molecules and are some

191  
00:07:38,649 --> 00:07:44,229  
rumors so small individually and so

192  
00:07:41,889 --> 00:07:46,000  
irregular in their distribution that

193  
00:07:44,230 --> 00:07:50,350  
they quite escape all our methods of

194  
00:07:46,000 --> 00:07:52,480  
observation whereas when the motions and

195  
00:07:50,350 --> 00:07:54,010  
displacements are those of physical

196  
00:07:52,480 --> 00:07:56,200  
bodies consisting of great numbers

197  
00:07:54,009 --> 00:07:58,319  
molecules moving all together the

198  
00:07:56,199 --> 00:08:01,060  
communication of energy is called work

199  
00:07:58,319 --> 00:08:02,740  
hence we have only to suppose our senses

200

00:08:01,060 --> 00:08:05,560  
sharpen to such a degree that we could

201  
00:08:02,740 --> 00:08:07,509  
trace the motions molecules as easily as

202  
00:08:05,560 --> 00:08:09,579  
we now trace those of large bodies and

203  
00:08:07,509 --> 00:08:11,649  
the distinction between work and heat

204  
00:08:09,579 --> 00:08:13,389  
would vanish for the communication of

205  
00:08:11,649 --> 00:08:15,759  
heat would be seen to be a communication

206  
00:08:13,389 --> 00:08:18,129  
of energy of the same kind as that which

207  
00:08:15,759 --> 00:08:20,230  
we call work the second law must either

208  
00:08:18,129 --> 00:08:22,360  
be founded on our actual experience in

209  
00:08:20,230 --> 00:08:24,490  
dealing with real bodies around the

210  
00:08:22,360 --> 00:08:27,100  
hypothesis that the behavior of body is

211  
00:08:24,490 --> 00:08:28,509  
consisting of millions of molecules may

212  
00:08:27,100 --> 00:08:32,050  
be deduced from the theory of the

213  
00:08:28,509 --> 00:08:33,580  
encounters of Paris molecules by

214  
00:08:32,049 --> 00:08:35,409

supposing the relative frequency of

215

00:08:33,580 --> 00:08:37,270

different different kinds of encounters

216

00:08:35,409 --> 00:08:40,059

to be distributed according to the laws

217

00:08:37,269 --> 00:08:42,429

of probability the truth of the second

218

00:08:40,059 --> 00:08:45,009

law is therefore a statistical not a

219

00:08:42,429 --> 00:08:46,989

mathematical truth for it depends on the

220

00:08:45,009 --> 00:08:48,009

fact that these bodies we deal with

221

00:08:46,990 --> 00:08:49,960

consistent millions

222

00:08:48,009 --> 00:08:54,819

molecules and that we can never get a

223

00:08:49,960 --> 00:08:59,350

hold of a single single molecules let me

224

00:08:54,820 --> 00:09:02,379

quote from James Joule known to codify

225

00:08:59,350 --> 00:09:04,090

the conservation of energy but the most

226

00:09:02,379 --> 00:09:05,919

convincing proof of the conversion of

227

00:09:04,090 --> 00:09:09,370

heat into living force which he called

228

00:09:05,919 --> 00:09:11,139

his word for her phrase for work has

229  
00:09:09,370 --> 00:09:13,480  
been derived from my experiments with

230  
00:09:11,139 --> 00:09:15,669  
the electromagnetic engine a machine

231  
00:09:13,480 --> 00:09:18,190  
composed magnets and bios of item set in

232  
00:09:15,669 --> 00:09:19,990  
motion by an electrical battery I have

233  
00:09:18,190 --> 00:09:21,820  
proved by actual experiment that in

234  
00:09:19,990 --> 00:09:24,549  
exact proportion to the force with which

235  
00:09:21,820 --> 00:09:26,740  
this machine works heat is abstracted

236  
00:09:24,549 --> 00:09:28,419  
from the electrical battery you see

237  
00:09:26,740 --> 00:09:30,879  
therefore that living force may be

238  
00:09:28,419 --> 00:09:32,439  
converted into heat and that heat may be

239  
00:09:30,879 --> 00:09:34,120  
converted into living force or its

240  
00:09:32,440 --> 00:09:37,090  
equivalent attraction through space all

241  
00:09:34,120 --> 00:09:39,009  
three therefore namely heat living force

242  
00:09:37,090 --> 00:09:40,690  
an attraction through space to which I

243  
00:09:39,009 --> 00:09:42,159  
could also add light were consistent

244  
00:09:40,690 --> 00:09:44,740  
with the scope of this president vent

245  
00:09:42,159 --> 00:09:47,949  
this lecture are mutually convertible

246  
00:09:44,740 --> 00:09:51,580  
into one another in these conversions

247  
00:09:47,950 --> 00:09:53,920  
nothing is ever lost historically jewel

248  
00:09:51,580 --> 00:09:56,110  
has been thought of as referring to the

249  
00:09:53,919 --> 00:09:58,779  
conservation of energy but I point out

250  
00:09:56,110 --> 00:10:00,399  
in this in this quote that as he starts

251  
00:09:58,779 --> 00:10:04,179  
off with right here at the at the

252  
00:10:00,399 --> 00:10:06,100  
beginning most convincing proof of the

253  
00:10:04,179 --> 00:10:08,319  
conversion of heat into living force was

254  
00:10:06,100 --> 00:10:11,170  
the operation of an electric motor from

255  
00:10:08,320 --> 00:10:12,460  
an electrochemical battery that was the

256  
00:10:11,169 --> 00:10:14,589  
most convincing why wasn't this a

257

00:10:12,460 --> 00:10:16,660  
paddlewheel water experiment of

258  
00:10:14,590 --> 00:10:19,540  
converting a mechanical energy into

259  
00:10:16,659 --> 00:10:21,909  
thermal energy of the water more

260  
00:10:19,539 --> 00:10:24,819  
convincing what he was seeing here was

261  
00:10:21,909 --> 00:10:26,949  
that the the electrical nature of the

262  
00:10:24,820 --> 00:10:28,900  
battery by this equation down here at

263  
00:10:26,950 --> 00:10:30,790  
the bottom Gibbs free energy equation

264  
00:10:28,899 --> 00:10:32,829  
here  $\Delta G$  equals  $\Delta H$  minus  $T$

265  
00:10:30,789 --> 00:10:36,699  
 $\Delta H$  is what determined

266  
00:10:32,830 --> 00:10:40,090  
spontaneity and in a battery the release

267  
00:10:36,700 --> 00:10:43,740  
of energy the  $\Delta G$  value which ones

268  
00:10:40,090 --> 00:10:46,030  
that the battery actually in trains

269  
00:10:43,740 --> 00:10:47,710  
ambient environment in the battery

270  
00:10:46,029 --> 00:10:53,519  
itself run out of its plates and

271  
00:10:47,710 --> 00:10:56,230

electrolyte it is and it is an

272

00:10:53,519 --> 00:10:59,778

endothermic reaction and the battery

273

00:10:56,230 --> 00:11:02,959

does get cold perspective of

274

00:10:59,778 --> 00:11:05,539

resistive losses and this is what he was

275

00:11:02,958 --> 00:11:07,399

talking about in this system heat was

276

00:11:05,539 --> 00:11:10,240

going right into the electrical system

277

00:11:07,399 --> 00:11:12,740

and going into work in the in the

278

00:11:10,240 --> 00:11:14,149

electric motor and nothing else happened

279

00:11:12,740 --> 00:11:16,850

to the heat that is complete conversion

280

00:11:14,149 --> 00:11:18,528

of heat into electricity now there are

281

00:11:16,850 --> 00:11:20,480

lots of arguments to the country of this

282

00:11:18,528 --> 00:11:21,860

it's not a cycle and all that and this

283

00:11:20,480 --> 00:11:23,300

is not the time to get into these

284

00:11:21,860 --> 00:11:25,610

details but I'm just giving you an

285

00:11:23,299 --> 00:11:28,278

introduction that there might be a basis

286  
00:11:25,610 --> 00:11:30,709  
for the second law not being limitation

287  
00:11:28,278 --> 00:11:33,799  
that we all think it is now here's

288  
00:11:30,708 --> 00:11:36,109  
another presentation of Maxwell's demon

289  
00:11:33,799 --> 00:11:39,068  
by the way it was called a demon because

290  
00:11:36,110 --> 00:11:41,899  
said well a parallel werner heisenberg

291  
00:11:39,068 --> 00:11:44,088  
really hated Paul tow-rax work and

292  
00:11:41,899 --> 00:11:47,419  
called the Dirac equation learn it trash

293  
00:11:44,089 --> 00:11:50,480  
a similar dynamic of haida curtain in

294  
00:11:47,419 --> 00:11:52,188  
here with Lord Kelvin can't couldn't

295  
00:11:50,480 --> 00:11:54,319  
stand this thought experiment and called

296  
00:11:52,188 --> 00:11:58,248  
this intelligent being to do the sorting

297  
00:11:54,318 --> 00:12:01,128  
of the of the trapdoor here a demon but

298  
00:11:58,249 --> 00:12:03,409  
here's what happens fast and slow

299  
00:12:01,129 --> 00:12:07,579  
particle is indicated by the the length

300  
00:12:03,409 --> 00:12:10,429  
of the arrows here we can open the door

301  
00:12:07,578 --> 00:12:12,799  
and the highlighted particle be allowed

302  
00:12:10,429 --> 00:12:15,469  
through to the other side and conversely

303  
00:12:12,799 --> 00:12:17,318  
a slow particle is allowed to pass

304  
00:12:15,470 --> 00:12:22,129  
through in the other direction but now

305  
00:12:17,318 --> 00:12:24,289  
what's up let's look at a slow moving

306  
00:12:22,129 --> 00:12:25,789  
particle is deflected back in on the

307  
00:12:24,289 --> 00:12:27,948  
same side and also from the other side

308  
00:12:25,789 --> 00:12:30,019  
of fast particle is kept so you keep

309  
00:12:27,948 --> 00:12:32,479  
doing this out infinitum for a while you

310  
00:12:30,019 --> 00:12:34,399  
end up with this result a collection of

311  
00:12:32,480 --> 00:12:36,620  
cold particles on one are slow-moving

312  
00:12:34,399 --> 00:12:38,208  
particles on one side and fast-moving

313  
00:12:36,620 --> 00:12:41,058  
particles on the other and by the theory

314

00:12:38,208 --> 00:12:44,239  
of the kinetic theory of heat end up

315  
00:12:41,058 --> 00:12:46,519  
with a zone of cold and hot with no work

316  
00:12:44,240 --> 00:12:49,308  
done on the system because the demon

317  
00:12:46,519 --> 00:12:52,009  
that operated the trapdoor was said was

318  
00:12:49,308 --> 00:12:54,139  
doing this on a it's a by the principle

319  
00:12:52,009 --> 00:12:55,938  
of reversibility often using

320  
00:12:54,139 --> 00:12:57,919  
thermodynamics to understand models that

321  
00:12:55,938 --> 00:12:59,659  
the trapdoor was frictionless massless

322  
00:12:57,919 --> 00:13:02,808  
and so could be moved without any energy

323  
00:12:59,659 --> 00:13:05,448  
but then the there's another case now

324  
00:13:02,808 --> 00:13:08,058  
that the information needed to do the

325  
00:13:05,448 --> 00:13:09,139  
sorting can be totally circumvented and

326  
00:13:08,058 --> 00:13:13,188  
that's where the pole

327  
00:13:09,139 --> 00:13:16,100  
comes in perfect is the correct analysis

328  
00:13:13,188 --> 00:13:17,868

of the non-homogeneous constant volume

329

00:13:16,100 --> 00:13:20,749

process with displacement and

330

00:13:17,869 --> 00:13:22,459

regeneration this is the classical

331

00:13:20,749 --> 00:13:24,558

analysis of the constant volume process

332

00:13:22,458 --> 00:13:27,488

which appears by the way in the Stirling

333

00:13:24,558 --> 00:13:30,078

cycle the only standard well known

334

00:13:27,489 --> 00:13:32,778

thermodynamic engine cycle that people

335

00:13:30,078 --> 00:13:36,438

would be familiar with it's just a

336

00:13:32,778 --> 00:13:38,958

sealed volume of gas volume does not

337

00:13:36,438 --> 00:13:42,078

change heat goes in and out and the

338

00:13:38,958 --> 00:13:44,178

temperature and pressure of the of the

339

00:13:42,078 --> 00:13:46,758

gas changes and this is the way it is

340

00:13:44,178 --> 00:13:49,789

represented entirely I've never found an

341

00:13:46,759 --> 00:13:51,889

exception to this the heat  $Q$  equals the

342

00:13:49,789 --> 00:13:54,318

mass and times the specific heat

343  
00:13:51,889 --> 00:13:56,899  
capacity  $C$  sub  $V$  times the temperature

344  
00:13:54,318 --> 00:14:01,488  
difference equals  $\Delta u$  the internal

345  
00:13:56,899 --> 00:14:03,078  
energy change the gas Wayne pole was the

346  
00:14:01,489 --> 00:14:04,790  
first person to correctly identify the

347  
00:14:03,078 --> 00:14:07,399  
complex energy flows that take place

348  
00:14:04,789 --> 00:14:09,678  
within the constant volume process with

349  
00:14:07,399 --> 00:14:11,989  
displacement and regeneration and this

350  
00:14:09,678 --> 00:14:14,600  
is the text from which I first became

351  
00:14:11,989 --> 00:14:16,610  
familiar with it talked with him and

352  
00:14:14,600 --> 00:14:19,339  
said he'd ever done any experiments with

353  
00:14:16,610 --> 00:14:22,188  
no woman retirement I don't have my lab

354  
00:14:19,339 --> 00:14:27,529  
at Standard Oil anymore he was a chemist

355  
00:14:22,188 --> 00:14:29,118  
and so he said I did some work based on

356  
00:14:27,528 --> 00:14:31,039  
the book the stuff he did in the book

357  
00:14:29,119 --> 00:14:33,769  
and experimentally verified what he did

358  
00:14:31,039 --> 00:14:35,778  
now this is a graphic depiction of what

359  
00:14:33,769 --> 00:14:37,519  
the pole effect is like in two forms the

360  
00:14:35,778 --> 00:14:39,470  
self refrigeration effect where we start

361  
00:14:37,519 --> 00:14:41,959  
off with initial conditions the

362  
00:14:39,470 --> 00:14:45,100  
displacer can find gas regenerated with

363  
00:14:41,958 --> 00:14:47,418  
a distributed thermal gradient on it and

364  
00:14:45,100 --> 00:14:50,119  
effects let's say air in this argument

365  
00:14:47,418 --> 00:14:51,879  
here 50 degrees C is displaced by the

366  
00:14:50,119 --> 00:14:54,230  
displacer through the regenerate

367  
00:14:51,879 --> 00:14:56,749  
regenerative to the cold side what we

368  
00:14:54,230 --> 00:14:58,938  
end up with down here is the bulk gas

369  
00:14:56,749 --> 00:15:00,589  
temperature is below the ambient

370  
00:14:58,938 --> 00:15:04,219  
temperature that we started off with in

371

00:15:00,589 --> 00:15:06,709  
the system 20 degrees C conversely the

372  
00:15:04,220 --> 00:15:09,379  
self heating process where we start off

373  
00:15:06,708 --> 00:15:12,078  
with gas in the cold side and displace

374  
00:15:09,379 --> 00:15:13,548  
it to the high side we end up with a gas

375  
00:15:12,078 --> 00:15:17,168  
temperature that's higher than the

376  
00:15:13,548 --> 00:15:17,168  
maximum temperature of the regenerator

377  
00:15:17,679 --> 00:15:23,169  
compression and expansion work take

378  
00:15:20,080 --> 00:15:25,660  
place in the in the system here in order

379  
00:15:23,169 --> 00:15:29,079  
for this to take place as gases

380  
00:15:25,659 --> 00:15:31,539  
displaced let's go back go back to to

381  
00:15:29,080 --> 00:15:33,970  
here hot stuff is displaced through the

382  
00:15:31,539 --> 00:15:35,860  
regenerator cooled off the specific

383  
00:15:33,970 --> 00:15:38,230  
volume of the gas decreases but this is

384  
00:15:35,860 --> 00:15:42,100  
a constant volume environment therefore

385  
00:15:38,230 --> 00:15:44,560

the the gas on both sides of the

386

00:15:42,100 --> 00:15:47,110

displacer must expand to compensate and

387

00:15:44,559 --> 00:15:49,689

that's pressure-volume work that is is

388

00:15:47,110 --> 00:15:53,169

sourced out here and put into the

389

00:15:49,690 --> 00:15:55,240

regenerator as extra heat and what we

390

00:15:53,169 --> 00:15:57,360

end up with is the change in internal

391

00:15:55,240 --> 00:15:59,649

energy of the gas you Plus this work

392

00:15:57,360 --> 00:16:02,500

equates to the mass times the heat

393

00:15:59,649 --> 00:16:04,360

capacity of constant pressure times the

394

00:16:02,500 --> 00:16:07,179

temperature which is equivalent of the

395

00:16:04,360 --> 00:16:09,909

enthalpy change  $\Delta H$  all sorts of

396

00:16:07,179 --> 00:16:12,669

things open up here and this the ratio

397

00:16:09,909 --> 00:16:14,980

of CP to cv is the heat capacity ratio

398

00:16:12,669 --> 00:16:16,449

of the gas which is substantial and

399

00:16:14,980 --> 00:16:18,278

there can be considerable amount of

400  
00:16:16,450 --> 00:16:19,778  
power in here the implications are

401  
00:16:18,278 --> 00:16:23,439  
profound the second law can be

402  
00:16:19,778 --> 00:16:25,419  
circumvented and pearl effect does this

403  
00:16:23,440 --> 00:16:27,339  
without sorting any particles all

404  
00:16:25,419 --> 00:16:32,289  
particles undergo this energy

405  
00:16:27,339 --> 00:16:33,820  
transformation now the second law does

406  
00:16:32,289 --> 00:16:35,500  
not apply when he can transfer

407  
00:16:33,820 --> 00:16:38,200  
elastically according to the kinetic

408  
00:16:35,500 --> 00:16:40,179  
theory of heat cost greater distances

409  
00:16:38,200 --> 00:16:42,520  
between particles than statistically

410  
00:16:40,179 --> 00:16:45,009  
allowed for single particle collisions

411  
00:16:42,519 --> 00:16:47,230  
when the vectored heat transfer via work

412  
00:16:45,009 --> 00:16:50,039  
occurs over distances greater than the

413  
00:16:47,230 --> 00:16:52,209  
mean free path of the gas the randomness

414  
00:16:50,039 --> 00:16:54,730  
requirement to the second law is gone

415  
00:16:52,208 --> 00:16:57,639  
and this is how the second law is

416  
00:16:54,730 --> 00:17:00,278  
violated so to speak we've put a limit

417  
00:16:57,639 --> 00:17:04,869  
on Singh it's no longer applies like the

418  
00:17:00,278 --> 00:17:07,179  
limits on Newtonian mechanics use a

419  
00:17:04,869 --> 00:17:09,250  
graphic depiction of transfer of work

420  
00:17:07,179 --> 00:17:12,459  
over an area greater than the mean free

421  
00:17:09,250 --> 00:17:15,279  
path from from cloak particles to hot

422  
00:17:12,459 --> 00:17:17,350  
particles sending heat and look the

423  
00:17:15,279 --> 00:17:19,660  
reverse direction which is neg entropic

424  
00:17:17,349 --> 00:17:20,980  
and here's a device which is on display

425  
00:17:19,660 --> 00:17:23,199  
in the back and I'll have a chance to

426  
00:17:20,980 --> 00:17:24,490  
demonstrate it to anyone who's once see

427  
00:17:23,199 --> 00:17:27,759  
it with which loss left of the

428

00:17:24,490 --> 00:17:29,720  
conference schematic view of what's here

429  
00:17:27,759 --> 00:17:32,298  
for displacer inside of

430  
00:17:29,720 --> 00:17:34,579  
a tube and this is the way it was built

431  
00:17:32,298 --> 00:17:36,950  
with steel wool inside of an acrylic

432  
00:17:34,579 --> 00:17:39,730  
cylinder and a bar magnet on top for

433  
00:17:36,950 --> 00:17:42,740  
coupling through the medic seal a

434  
00:17:39,730 --> 00:17:44,538  
thermocouple for sensing 50 gauge one

435  
00:17:42,740 --> 00:17:48,950  
one thousandth of an inch in diameter

436  
00:17:44,538 --> 00:17:51,650  
social fast response ambient conditions

437  
00:17:48,950 --> 00:17:54,080  
thermal equilibrium stroking of the

438  
00:17:51,650 --> 00:17:56,059  
device and see what little changes occur

439  
00:17:54,079 --> 00:17:58,519  
in the change in temperature with the

440  
00:17:56,058 --> 00:18:00,918  
thermocouples this is what occurs when

441  
00:17:58,519 --> 00:18:02,808  
the volume is closed often it's no

442  
00:18:00,919 --> 00:18:05,900

longer under constant pressure and I've

443

00:18:02,808 --> 00:18:07,730

lifted up stroking it to the carb the

444

00:18:05,900 --> 00:18:10,038

cold side we get a self refrigeration

445

00:18:07,730 --> 00:18:13,429

spike I drop it back down self heating

446

00:18:10,038 --> 00:18:16,429

and we get this over here increase it to

447

00:18:13,429 --> 00:18:19,190

from air to argon and then from down to

448

00:18:16,429 --> 00:18:22,490

try time at gas carbon dioxide and it

449

00:18:19,190 --> 00:18:24,250

follows the predictions you'll see this

450

00:18:22,490 --> 00:18:26,240

in the back room and I've did some other

451

00:18:24,250 --> 00:18:28,700

embodiments of the tester and with

452

00:18:26,240 --> 00:18:30,259

numerous thermocouples I know have US

453

00:18:28,700 --> 00:18:31,880

patent issued on a perpetual motion

454

00:18:30,259 --> 00:18:33,319

machine I told my lawyer have fun

455

00:18:31,880 --> 00:18:35,150

storming the castle and we got it

456

00:18:33,319 --> 00:18:38,329

through because they believed I gave

457  
00:18:35,150 --> 00:18:41,330  
them the science and it's there okay

458  
00:18:38,329 --> 00:18:43,849  
their number of engine cycles have been

459  
00:18:41,329 --> 00:18:45,019  
developed out of this and I want to show

460  
00:18:43,849 --> 00:18:46,969  
you some pictures before my time runs

461  
00:18:45,019 --> 00:18:49,308  
out their mathematical proofs on this

462  
00:18:46,970 --> 00:18:50,990  
I'd love to show this to anyone and see

463  
00:18:49,308 --> 00:18:53,178  
what they can try to shoot it down with

464  
00:18:50,990 --> 00:18:55,579  
and this is what a cycle can look like

465  
00:18:53,179 --> 00:18:57,860  
and we'll talk about this afterwards for

466  
00:18:55,579 --> 00:19:00,019  
anyone who's interested prototype was

467  
00:18:57,859 --> 00:19:02,359  
built in 2001 actually a couple versions

468  
00:19:00,019 --> 00:19:06,079  
of them a sterling like pissing and

469  
00:19:02,359 --> 00:19:07,609  
displacer mechanism and I don't have

470  
00:19:06,079 --> 00:19:10,029  
time to talk about it right now but i'll

471  
00:19:07,609 --> 00:19:12,589  
just give you some eye candy here a

472  
00:19:10,029 --> 00:19:14,720  
year's worth of experimentation and I

473  
00:19:12,589 --> 00:19:18,230  
ran into mechanical engineering problems

474  
00:19:14,720 --> 00:19:20,740  
of imperfect piston seals too much

475  
00:19:18,230 --> 00:19:23,200  
friction in the mechanical linkage and

476  
00:19:20,740 --> 00:19:25,759  
design issues with further regenerator

477  
00:19:23,200 --> 00:19:28,190  
use liquid nitrogen to generate the

478  
00:19:25,759 --> 00:19:30,980  
initial lab temperature gradient on it

479  
00:19:28,190 --> 00:19:34,220  
and here's some frost in the Dewar flask

480  
00:19:30,980 --> 00:19:35,990  
at the bottom instrumented the living

481  
00:19:34,220 --> 00:19:38,500  
daylights out of it so I have lots of

482  
00:19:35,990 --> 00:19:41,450  
documentation of it and this is key

483  
00:19:38,500 --> 00:19:42,118  
pressure center of the cycle starting

484  
00:19:41,450 --> 00:19:44,699  
from thermal

485

00:19:42,118 --> 00:19:47,668  
equilibrium or mechanical equilibrium

486  
00:19:44,699 --> 00:19:49,889  
over here and then the baseline drift

487  
00:19:47,669 --> 00:19:52,739  
shows that the piston leaked but

488  
00:19:49,888 --> 00:19:55,198  
expanding this out I have the constant

489  
00:19:52,739 --> 00:19:58,649  
pressure process the constant volume

490  
00:19:55,199 --> 00:20:01,048  
cooling and constant entropy compression

491  
00:19:58,648 --> 00:20:03,268  
showing up in here it is working it just

492  
00:20:01,048 --> 00:20:04,918  
did not have enough energy generated

493  
00:20:03,269 --> 00:20:09,929  
overcome its internal frictions and

494  
00:20:04,919 --> 00:20:12,809  
losses engineering drawing of profile

495  
00:20:09,929 --> 00:20:15,149  
view semi x-ray through it and view that

496  
00:20:12,808 --> 00:20:23,969  
the flywheel and I'm not a time but we

497  
00:20:15,148 --> 00:20:26,718  
can talk later we do have a few moments

498  
00:20:23,969 --> 00:20:26,719  
for questions

499  
00:20:35,750 --> 00:20:41,359

did you ever measure the effect of

500

00:20:37,819 --> 00:20:43,909

intention on your experiments no it will

501

00:20:41,359 --> 00:20:46,069

happen if you did i don't know i don't

502

00:20:43,910 --> 00:20:49,160

expect there to be any influence there i

503

00:20:46,069 --> 00:20:51,799

don't think this is a an area of science

504

00:20:49,160 --> 00:20:55,000

outside of what we've normally seen that

505

00:20:51,799 --> 00:20:58,250

requires any consciousness intervention

506

00:20:55,000 --> 00:20:59,809

in detail the science is there and if

507

00:20:58,250 --> 00:21:01,309

you don't see it yet we can talk more

508

00:20:59,809 --> 00:21:03,559

about it later and it should just be

509

00:21:01,309 --> 00:21:06,559

self-evident that it's it's a known it's

510

00:21:03,559 --> 00:21:09,470

a natural spontaneous reorganization

511

00:21:06,559 --> 00:21:12,200

process it's it's Kwazii it's not truly

512

00:21:09,470 --> 00:21:14,089

spontaneous it's Kwazii spontaneous that

513

00:21:12,200 --> 00:21:16,309

a perturbation of the system must be put

514  
00:21:14,089 --> 00:21:20,269  
in and that energy actual energy input

515  
00:21:16,309 --> 00:21:22,279  
is heading towards the natural

516  
00:21:20,269 --> 00:21:25,930  
expression of the second law but it's

517  
00:21:22,279 --> 00:21:28,309  
less than carnal if it's done right um

518  
00:21:25,930 --> 00:21:30,019  
we don't have time to go into detail

519  
00:21:28,309 --> 00:21:31,279  
here but I just want to stand up as a

520  
00:21:30,019 --> 00:21:33,710  
defender of the second law of

521  
00:21:31,279 --> 00:21:36,519  
thermodynamics all right I can talk

522  
00:21:33,710 --> 00:21:41,000  
later it just because its statistical

523  
00:21:36,519 --> 00:21:42,349  
doesn't mean that we can throw it out in

524  
00:21:41,000 --> 00:21:45,859  
other words just because it's not

525  
00:21:42,349 --> 00:21:48,799  
mathematically provable it still can be

526  
00:21:45,859 --> 00:21:52,189  
very solid for example if you take a box

527  
00:21:48,799 --> 00:21:54,619  
of marbles and you put some black

528  
00:21:52,190 --> 00:21:56,480  
marbles on one side of shoe box and

529  
00:21:54,619 --> 00:21:58,279  
white marbles on the other side you

530  
00:21:56,480 --> 00:22:00,680  
shake the thing the marbles will be

531  
00:21:58,279 --> 00:22:02,869  
distributed that's right that's just

532  
00:22:00,680 --> 00:22:04,820  
statistical but they really will be

533  
00:22:02,869 --> 00:22:06,409  
distributed and if you end up doing it

534  
00:22:04,819 --> 00:22:08,539  
with a million marbles they're going to

535  
00:22:06,410 --> 00:22:13,180  
be very very well distributed that's

536  
00:22:08,539 --> 00:22:18,559  
right and that concept of mixing is

537  
00:22:13,180 --> 00:22:20,330  
behind the the justification for the

538  
00:22:18,559 --> 00:22:23,629  
second law of thermodynamics and i

539  
00:22:20,329 --> 00:22:26,689  
believe it is solid again I'm not saying

540  
00:22:23,630 --> 00:22:28,550  
enough to argue with right here we will

541  
00:22:26,690 --> 00:22:31,240  
have a discussion tonight there's going

542

00:22:28,549 --> 00:22:33,649  
to be a panel discussion on energy and

543  
00:22:31,240 --> 00:22:36,829  
I'm hoping that we'll get into some of

544  
00:22:33,650 --> 00:22:38,480  
these issues and it looks like I'm going

545  
00:22:36,829 --> 00:22:39,970  
to be the conservative member on the on

546  
00:22:38,480 --> 00:22:43,429  
the panel

547  
00:22:39,970 --> 00:22:45,620  
so I'm not sure what will happen with

548  
00:22:43,429 --> 00:22:47,840  
Daniel and and several of us this

549  
00:22:45,619 --> 00:22:49,579  
evening at half past Rachel debate is

550  
00:22:47,839 --> 00:22:51,289  
welcome and actually that's what science

551  
00:22:49,579 --> 00:22:54,740  
needs more of because it's been closed

552  
00:22:51,289 --> 00:23:03,349  
all I can say to that is science is done

553  
00:22:54,740 --> 00:23:04,819  
in the details examine the details oh I

554  
00:23:03,349 --> 00:23:09,548  
guess I wasn't clear if you're talking

555  
00:23:04,819 --> 00:23:12,889  
about potential potential motion machine

556  
00:23:09,548 --> 00:23:16,359

perpetual motion machine how long have

557

00:23:12,890 --> 00:23:20,509

you run any experiment with a net energy

558

00:23:16,359 --> 00:23:22,629

output I do not have anything with a net

559

00:23:20,509 --> 00:23:26,089

energy output at this point it is only a

560

00:23:22,630 --> 00:23:28,640

tabletop physics experiment of the only

561

00:23:26,089 --> 00:23:31,339

questionable process in the cycle that

562

00:23:28,640 --> 00:23:35,150

is not classically understood exactly as

563

00:23:31,339 --> 00:23:37,339

the understanding is this these

564

00:23:35,150 --> 00:23:41,120

photographs you saw here were up from

565

00:23:37,339 --> 00:23:43,009

2001 when I had a contract with an

566

00:23:41,119 --> 00:23:45,668

investor from France where we formed a

567

00:23:43,009 --> 00:23:47,690

company called cool engines incorporated

568

00:23:45,669 --> 00:23:49,040

contract called for a million dollars

569

00:23:47,690 --> 00:23:51,350

and in the course of a year to be

570

00:23:49,039 --> 00:23:53,359

invested in it and an infusion of

571  
00:23:51,349 --> 00:23:56,119  
\$50,000 was given midway through the

572  
00:23:53,359 --> 00:23:58,579  
year and when we were ready for a second

573  
00:23:56,119 --> 00:24:00,319  
stage of investment 911 happened and the

574  
00:23:58,579 --> 00:24:02,720  
investor lots twenty percent of his net

575  
00:24:00,319 --> 00:24:04,279  
worth in two days and unfortunately I

576  
00:24:02,720 --> 00:24:06,769  
was funded by his play money and I never

577  
00:24:04,279 --> 00:24:08,298  
got any more that's why it never went

578  
00:24:06,769 --> 00:24:10,579  
any further but I learned a lot with

579  
00:24:08,298 --> 00:24:16,220  
that the first two prototypes you saw

580  
00:24:10,579 --> 00:24:19,599  
photographs up next yes you say that at

581  
00:24:16,220 --> 00:24:22,460  
the molecular level things are

582  
00:24:19,599 --> 00:24:23,839  
reversible that's right okay and so and

583  
00:24:22,460 --> 00:24:25,730  
we're thinking of the second law then it

584  
00:24:23,839 --> 00:24:28,490  
doesn't apply at the molecular level

585  
00:24:25,730 --> 00:24:30,919  
that's right and yet you made it you may

586  
00:24:28,490 --> 00:24:33,769  
not see a separation on the atomic level

587  
00:24:30,919 --> 00:24:36,049  
but tiny tiny little ones in space and

588  
00:24:33,769 --> 00:24:38,269  
time have been reported okay just go

589  
00:24:36,048 --> 00:24:41,480  
away if you go to the macroscopic level

590  
00:24:38,269 --> 00:24:43,668  
then the second law applies yes isn't

591  
00:24:41,480 --> 00:24:45,169  
there any consistency what happens you

592  
00:24:43,669 --> 00:24:47,630  
know there's some transition point where

593  
00:24:45,169 --> 00:24:49,149  
it doesn't work and words does worse

594  
00:24:47,630 --> 00:24:52,649  
that's going on is base

595  
00:24:49,148 --> 00:24:55,449  
upon random collisions and departures of

596  
00:24:52,648 --> 00:24:57,428  
trajectories that only conserve their

597  
00:24:55,450 --> 00:25:00,190  
kinetic energy and their momentum from

598  
00:24:57,429 --> 00:25:01,839  
the collision but that on a larger scale

599

00:25:00,190 --> 00:25:03,729  
as many of them are colliding ends up

600  
00:25:01,838 --> 00:25:07,749  
being a statistical randomness that's

601  
00:25:03,729 --> 00:25:09,548  
just overwhelmingly impossible that from

602  
00:25:07,749 --> 00:25:11,048  
a practical point of view to get to like

603  
00:25:09,548 --> 00:25:13,690  
the box of marbles you can have five

604  
00:25:11,048 --> 00:25:16,239  
black and five red marbles and juggle

605  
00:25:13,690 --> 00:25:18,338  
them around and if you do you have for 4

606  
00:25:16,239 --> 00:25:20,019  
30 hours you might guess a look they're

607  
00:25:18,338 --> 00:25:21,788  
separated again and then they're back

608  
00:25:20,019 --> 00:25:23,469  
again the more the numbers go up the

609  
00:25:21,788 --> 00:25:27,009  
probability of that coming back to the

610  
00:25:23,469 --> 00:25:30,338  
original state just falls through the

611  
00:25:27,009 --> 00:25:32,348  
floor abysmally but in this case as I'm

612  
00:25:30,338 --> 00:25:34,388  
saying there is no sorting of Maxwell's

613  
00:25:32,348 --> 00:25:36,069

demon going on and everything goes

614

00:25:34,388 --> 00:25:38,788

through there and it can ratchet up hill

615

00:25:36,069 --> 00:25:42,249

and you can and you can capture it I

616

00:25:38,788 --> 00:25:45,548

have four I have four compact discs here

617

00:25:42,249 --> 00:25:47,639

with publicly available computer files

618

00:25:45,548 --> 00:25:49,838

including two mathematical proofs

619

00:25:47,638 --> 00:25:53,199

encourage any of you to take this and

620

00:25:49,838 --> 00:25:55,148

study it and for the skeptics find the

621

00:25:53,200 --> 00:25:58,359

flaws in the mathematical proof it's too

622

00:25:55,148 --> 00:26:03,579

traceable state variables or publish

623

00:25:58,358 --> 00:26:05,968

gases point out the flaws there's Kenan

624

00:26:03,579 --> 00:26:08,558

thanks for thanks for your nice talk i

625

00:26:05,969 --> 00:26:11,048

sensing that in the general scientific

626

00:26:08,558 --> 00:26:12,219

community maybe you do too but there

627

00:26:11,048 --> 00:26:14,440

seems to be a feeling that what is ever

628  
00:26:12,219 --> 00:26:16,509  
whatever is true for the ideal gas must

629  
00:26:14,440 --> 00:26:19,479  
be true for everything else and it

630  
00:26:16,509 --> 00:26:22,088  
simply is not that way well yes now I I

631  
00:26:19,479 --> 00:26:24,489  
don't argue about the ideal gas and the

632  
00:26:22,088 --> 00:26:26,678  
ideal gas line not reflecting that I see

633  
00:26:24,489 --> 00:26:28,989  
that this kind of process can work with

634  
00:26:26,679 --> 00:26:31,119  
ideal gases or kwasi ideal gases or

635  
00:26:28,989 --> 00:26:35,528  
things are very far off you know close

636  
00:26:31,118 --> 00:26:39,749  
to the the critical point of gas we're

637  
00:26:35,528 --> 00:26:39,749  
all bets are off on the modeling of