The Proell Effect

- *The Second Law does not apply when heat can transfer elastically according to the Kinetic Theory of Heat across greater distances between particles than statistically allowed for single particle pair collisions.*
- *When the vectored heat transfer (via work) occurs over distances greater than the mean free path of the gas, the randomness of the Second Law is circumvented.*

1
00:00:03,320 --> 00:00:01,730
this was demon has been introduced by

2
00:00:05,019 --> 00:00:03,330
Daniel doesn't need a great deal of

3
00:00:08,660 --> 00:00:05,029
review but we will go through some of it

4
00:00:10,310 --> 00:00:08,670
is generally challenges to the second

5
00:00:12,259 --> 00:00:10,320
law through that Maxwell's demon has

6
00:00:14,749 --> 00:00:12,269
been microscopic on the atomic level

7
00:00:16,099 --> 00:00:14,759
like when other fellows just asking

8
00:00:19,609 --> 00:00:16,109
about there and on the atomic level

9
00:00:22,519 --> 00:00:19,619
things yeah largely are ignored because

10
00:00:28,429 --> 00:00:22,529
it's a reversible regime on the

11
00:00:30,380 --> 00:00:28,439
macroscopic scale it is not now the also

12
00:00:32,260 --> 00:00:30,390
has pointed out before the scientific

13
00:00:34,310 --> 00:00:32,270

discipline of thermodynamics is

14
00:00:36,620 --> 00:00:34,320
considered to be a close science that

15
00:00:38,720 --> 00:00:36,630
very little has changed to the

16
00:00:40,310 --> 00:00:38,730
fundamentals of it for over a hundred

17
00:00:43,100 --> 00:00:40,320
years and what has occurred in recent

18
00:00:45,410 --> 00:00:43,110
years is just simply advancements and

19
00:00:49,400 --> 00:00:45,420
materials and computational fluid

20
00:00:51,380 --> 00:00:49,410
dynamics such as gas turbine of five how

21
00:00:54,920 --> 00:00:51,390
do we keep the thing from from melting

22
00:00:56,959 --> 00:00:54,930
or fracturing and flying apart and how

23
00:01:01,130 --> 00:00:56,969
can we model it according to computers

24
00:01:02,689 --> 00:01:01,140
but it's still with the old concepts

25
00:01:06,700 --> 00:01:02,699
that were developed a hundred years ago

26
00:01:09,950 --> 00:01:06,710
or more and within the first of the

27
00:01:11,929 --> 00:01:09,960
within the discipline of thermodynamics

28
00:01:14,390 --> 00:01:11,939
it's largely directed by the first law

29
00:01:15,980 --> 00:01:14,400
of conservation of energy and the second

30
00:01:17,980 --> 00:01:15,990
law of the concept of entropy that

31
00:01:21,679 --> 00:01:17,990
energy increases its randomness and

32
00:01:24,410 --> 00:01:21,689
describe definitively as the net change

33
00:01:28,760 --> 00:01:24,420
in a nice elated system so I entropy is

34
00:01:30,289 --> 00:01:28,770
0 or greater than zero can be stated

35
00:01:31,310 --> 00:01:30,299
number of different ways we'll just go

36
00:01:33,109 --> 00:01:31,320
through this quickly he flows

37
00:01:35,330 --> 00:01:33,119
spontaneously from mojado to a colder

38
00:01:37,130 --> 00:01:35,340

object but not vice versa when an

39
00:01:39,319 --> 00:01:37,140
isolated system undergoes change its

40
00:01:42,499 --> 00:01:39,329
change in entropy will be 0 or greater

41
00:01:45,380 --> 00:01:42,509
than zero the specific embodiment to

42
00:01:47,420 --> 00:01:45,390
this is Carnales theorem that a heat

43
00:01:48,950 --> 00:01:47,430
engines efficiency is a function of its

44
00:01:52,100 --> 00:01:48,960
maximum and minimum absolute

45
00:01:55,460 --> 00:01:52,110
temperatures as a as a ratio like we see

46
00:01:57,319 --> 00:01:55,470
right down here the second law of

47
00:01:59,420 --> 00:01:57,329
thermodynamics is based upon the kinetic

48
00:02:01,550 --> 00:01:59,430
theory of heat that thermal energy use

49
00:02:04,130 --> 00:02:01,560
the random motion and vibration of atoms

50
00:02:06,080 --> 00:02:04,140
and molecules collisions between these

51
00:02:07,880 --> 00:02:06,090
atoms and molecules transfer thermal

52
00:02:10,760 --> 00:02:07,890
energy preserving kinetic energy and

53
00:02:12,470 --> 00:02:10,770
momentum statistical mechanics models

54
00:02:12,880 --> 00:02:12,480
this a little bit further by saying well

55
00:02:17,199 --> 00:02:12,890
these

56
00:02:18,730 --> 00:02:17,209
collisions just two of them coming

57
00:02:21,309 --> 00:02:18,740
together and then they go off in

58
00:02:23,710 --> 00:02:21,319
whatever direction they do preserving

59
00:02:25,750 --> 00:02:23,720
the kinetic energy and the momentum now

60
00:02:27,430 --> 00:02:25,760
in the atomic scale these seem to be

61
00:02:29,080 --> 00:02:27,440
reversible collisions they will go all

62
00:02:32,380 --> 00:02:29,090
over the place nothing's lost we say

63
00:02:33,850 --> 00:02:32,390

it's there elastic collisions but when

64
00:02:36,640 --> 00:02:33,860
let's look down a larger and larger

65
00:02:39,720 --> 00:02:36,650
scale of all these particles together in

66
00:02:43,120 --> 00:02:39,730
a larger group it all gets randomized

67
00:02:45,490 --> 00:02:43,130
and that's the another question over

68
00:02:47,800 --> 00:02:45,500
here how do we rewrite the second law it

69
00:02:49,690 --> 00:02:47,810
will deal with the this nature of

70
00:02:52,930 --> 00:02:49,700
randomness that is underlying all of

71
00:02:55,750 --> 00:02:52,940
this with any law you must understand

72
00:02:58,990 --> 00:02:55,760
the fundamental principles under which

73
00:03:00,880 --> 00:02:59,000
the law was identified and all laws of

74
00:03:03,220 --> 00:03:00,890
physics are nothing more than models of

75
00:03:06,520 --> 00:03:03,230
understanding and as our understanding

76
00:03:08,530 --> 00:03:06,530
changes so does the law Max Planck one

77
00:03:10,720 --> 00:03:08,540
of the fathers of quantum mechanics was

78
00:03:13,000 --> 00:03:10,730
quoted as saying we have no right to

79
00:03:15,100 --> 00:03:13,010
assume that any physical laws exist or

80
00:03:16,720 --> 00:03:15,110
if they have existed up to now that they

81
00:03:19,870 --> 00:03:16,730
will continue to exist in a similar

82
00:03:22,539 --> 00:03:19,880
manner all I meant was our awareness of

83
00:03:25,630 --> 00:03:22,549
them are understanding of them is what K

84
00:03:28,810 --> 00:03:25,640
is capable of changing now I were the

85
00:03:31,030 --> 00:03:28,820
result of the 2l Te'o's we know it he

86
00:03:33,009 --> 00:03:31,040
cannot be completely converted into work

87
00:03:34,780 --> 00:03:33,019
and engines efficiently will always be

88
00:03:37,030 --> 00:03:34,790

less than one hundred percent it's

89
00:03:38,860 --> 00:03:37,040
assumed to be universal in sculpting is

90
00:03:40,300 --> 00:03:38,870
that kind of dangerous to operate

91
00:03:43,840 --> 00:03:40,310
something in science with an assumption

92
00:03:45,460 --> 00:03:43,850
but it's there it's never been nobody's

93
00:03:47,080 --> 00:03:45,470
ever had an opportunity to challenge it

94
00:03:49,420 --> 00:03:47,090
so it's been assumed all the way back

95
00:03:51,009 --> 00:03:49,430
from what Ruth Clausius he said

96
00:03:53,890 --> 00:03:51,019
something to the effect well from these

97
00:03:56,319 --> 00:03:53,900
observations it's just assume that the

98
00:03:59,920 --> 00:03:56,329
you know the second law is said is

99
00:04:02,050 --> 00:03:59,930
precise and it's also thought to be

100
00:04:04,330 --> 00:04:02,060
absolute and manifestation such that

101
00:04:06,729 --> 00:04:04,340
there are no exceptions whatsoever it be

102
00:04:09,940 --> 00:04:06,739
like seeing our gravity is inviolable

103
00:04:11,710 --> 00:04:09,950
there are no there are no exceptions to

104
00:04:13,330 --> 00:04:11,720
it it is absolutely if that's the case I

105
00:04:15,789 --> 00:04:13,340
wouldn't be able to lift this up is this

106
00:04:17,650 --> 00:04:15,799
a violation of gravity but this is how

107
00:04:21,080 --> 00:04:17,660
absurd that the second law is being

108
00:04:25,860 --> 00:04:23,430
the second law is that's understood is

109
00:04:29,820 --> 00:04:25,870
based upon faulty logic and we rarely go

110
00:04:33,120 --> 00:04:29,830
back to understand where it came from as

111
00:04:36,210 --> 00:04:33,130
with anything in science or in the on or

112
00:04:39,090 --> 00:04:36,220
in the the discipline of logic through

113
00:04:41,730 --> 00:04:39,100

philosophy the conclusion is only true

114
00:04:43,770 --> 00:04:41,740
if its premises are true and a

115
00:04:46,110 --> 00:04:43,780
conclusion is limited if one or more if

116
00:04:47,520 --> 00:04:46,120
its premises is limited and what's

117
00:04:50,270 --> 00:04:47,530
behind the second law of thermodynamics

118
00:04:54,120 --> 00:04:50,280
is the understanding of randomness and

119
00:04:56,790 --> 00:04:54,130
things are not always random plus we

120
00:04:59,580 --> 00:04:56,800
also have the basic human understanding

121
00:05:01,500 --> 00:04:59,590
that you can get to that the absence of

122
00:05:04,890 --> 00:05:01,510
evidence is not evidence that it does

123
00:05:06,870 --> 00:05:04,900
not exist plus natural law has always

124
00:05:11,070 --> 00:05:06,880
affect each other recruiting absolute

125
00:05:13,170 --> 00:05:11,080
manifestation and this is why laboratory

126
00:05:15,210 --> 00:05:13,180
protocols are so difficult to do and do

127
00:05:17,790 --> 00:05:15,220
it well so that it really identifies

128
00:05:19,430 --> 00:05:17,800
that a concept in question because we're

129
00:05:21,720 --> 00:05:19,440
all these are interferences from other

130
00:05:25,050 --> 00:05:21,730
effects and you want to get those out of

131
00:05:28,820 --> 00:05:25,060
the way so the the effect in question is

132
00:05:32,820 --> 00:05:28,830
all that's left to be identified by the

133
00:05:34,860 --> 00:05:32,830
experiment so what this comes down to is

134
00:05:36,270 --> 00:05:34,870
that these laws are competing with each

135
00:05:38,430 --> 00:05:36,280
other to outdo each other all the time

136
00:05:40,830 --> 00:05:38,440
and a good example of this I ran into it

137
00:05:42,330 --> 00:05:40,840
with a civil engineer number of years

138
00:05:44,880 --> 00:05:42,340

ago set only we're talking about a

139
00:05:46,800 --> 00:05:44,890
municipal water tower being able to

140
00:05:50,300 --> 00:05:46,810
measure the pressure on this water tower

141
00:05:52,500 --> 00:05:50,310
says all its or by Pascal's principle of

142
00:05:54,570 --> 00:05:52,510
Equalization the fire fluid pressure on

143
00:05:56,700 --> 00:05:54,580
a municipal reservoir if you close the

144
00:05:59,070 --> 00:05:56,710
vent on top it's same pressure top and

145
00:06:00,930 --> 00:05:59,080
bottom said no it is not there's also

146
00:06:02,820 --> 00:06:00,940
the effect of gravity that affects it

147
00:06:04,680 --> 00:06:02,830
and it's going to be a lower pressure up

148
00:06:07,050 --> 00:06:04,690
at the top then what you would measure

149
00:06:09,330 --> 00:06:07,060
down at the bottom of the standpipe in

150
00:06:11,640 --> 00:06:09,340
the municipal water tank but this is

151
00:06:13,230 --> 00:06:11,650
where people think they don't we have

152
00:06:15,840 --> 00:06:13,240
simplistic models that we study in

153
00:06:17,820 --> 00:06:15,850
school but these models do not reflect

154
00:06:20,130 --> 00:06:17,830
the real world that we are in and the

155
00:06:21,600 --> 00:06:20,140
second law is also here that comes to

156
00:06:25,080 --> 00:06:21,610
pinning one law against the other the

157
00:06:27,540 --> 00:06:25,090
only one that I would bet on I'm winning

158
00:06:29,070 --> 00:06:27,550
in any of these competitive play offices

159
00:06:30,840 --> 00:06:29,080
that the conservation of energy would

160
00:06:33,150 --> 00:06:30,850
would win if it was pitted against the

161
00:06:34,650 --> 00:06:33,160
second law and remember other things

162
00:06:36,810 --> 00:06:34,660
that the second one pitted

163
00:06:40,920 --> 00:06:36,820

so everyone's well that other one loses

164
00:06:42,600 --> 00:06:40,930
at the expense of the second law now I

165
00:06:46,760 --> 00:06:42,610
want to go to some historical

166
00:06:50,390 --> 00:06:46,770
perspective here read you a quote from

167
00:06:54,510 --> 00:06:50,400
James Clerk Maxwell about the second law

168
00:06:57,000 --> 00:06:54,520
and has taken from the texts that quoted

169
00:06:58,650 --> 00:06:57,010
here it is probably impossible to reduce

170
00:07:01,010 --> 00:06:58,660
the second law of thermodynamics to a

171
00:07:03,210 --> 00:07:01,020
form as axiomatic as that of the first

172
00:07:06,030 --> 00:07:03,220
four we have reason to believe that

173
00:07:08,610 --> 00:07:06,040
though true its truth is not the same

174
00:07:10,410 --> 00:07:08,620
order as that of the first law the first

175
00:07:12,480 --> 00:07:10,420
law is an extension to the theory of

176
00:07:14,370 --> 00:07:12,490
heat of the principle of conservation of

177
00:07:16,050 --> 00:07:14,380
energy which can be proved

178
00:07:18,230 --> 00:07:16,060
mathematically true if real bodies

179
00:07:21,990 --> 00:07:18,240
consist of matter as per definition

180
00:07:23,940 --> 00:07:22,000
acted on by forces having potentials the

181
00:07:25,890 --> 00:07:23,950
second layer you log relates to that

182
00:07:28,290 --> 00:07:25,900
kind of communication of energy which we

183
00:07:30,180 --> 00:07:28,300
call work according to the molecular

184
00:07:32,910 --> 00:07:30,190
theory the only difference between these

185
00:07:34,620 --> 00:07:32,920
two kinds of communications of energy is

186
00:07:36,180 --> 00:07:34,630
that the motions and displacements which

187
00:07:38,640 --> 00:07:36,190
are concerned in the communication of

188
00:07:41,880 --> 00:07:38,650

heat are those of molecules and are some

189
00:07:44,220 --> 00:07:41,890
rumors so small individually and so

190
00:07:45,990 --> 00:07:44,230
irregular in their distribution that

191
00:07:50,340 --> 00:07:46,000
they quite escape all our methods of

192
00:07:52,470 --> 00:07:50,350
observation whereas when the motions and

193
00:07:54,000 --> 00:07:52,480
displacements are those of physical

194
00:07:56,190 --> 00:07:54,010
bodies consisting of great numbers

195
00:07:58,310 --> 00:07:56,200
molecules moving all together the

196
00:08:01,050 --> 00:07:58,320
communication of energy is called work

197
00:08:02,730 --> 00:08:01,060
hence we have only to suppose our senses

198
00:08:05,550 --> 00:08:02,740
sharpen to such a degree that we could

199
00:08:07,500 --> 00:08:05,560
trace the motions molecules as easily as

200
00:08:09,570 --> 00:08:07,510
we now trace those of large bodies and

201
00:08:11,640 --> 00:08:09,580
the distinction between work and heat

202
00:08:13,380 --> 00:08:11,650
would vanish for the communication of

203
00:08:15,750 --> 00:08:13,390
heat would be seen to be a communication

204
00:08:18,120 --> 00:08:15,760
of energy of the same kind as that which

205
00:08:20,220 --> 00:08:18,130
we call work the second law must either

206
00:08:22,350 --> 00:08:20,230
be founded on our actual experience in

207
00:08:24,480 --> 00:08:22,360
dealing with real bodies around the

208
00:08:27,090 --> 00:08:24,490
hypothesis that the behavior of body is

209
00:08:28,500 --> 00:08:27,100
consisting of millions of molecules may

210
00:08:32,040 --> 00:08:28,510
be deduced from the theory of the

211
00:08:33,570 --> 00:08:32,050
encounters of Paris molecules by

212
00:08:35,400 --> 00:08:33,580
supposing the relative frequency of

213
00:08:37,260 --> 00:08:35,410

different different kinds of encounters

214
00:08:40,050 --> 00:08:37,270
to be distributed according to the laws

215
00:08:42,420 --> 00:08:40,060
of probability the truth of the second

216
00:08:45,000 --> 00:08:42,430
law is therefore a statistical not a

217
00:08:46,980 --> 00:08:45,010
mathematical truth for it depends on the

218
00:08:48,000 --> 00:08:46,990
fact that these bodies we deal with

219
00:08:49,950 --> 00:08:48,010
consistent millions

220
00:08:54,810 --> 00:08:49,960
molecules and that we can never get a

221
00:08:59,340 --> 00:08:54,820
hold of a single single molecules let me

222
00:09:02,370 --> 00:08:59,350
quote from James Joule known to codify

223
00:09:04,080 --> 00:09:02,380
the conservation of energy but the most

224
00:09:05,910 --> 00:09:04,090
convincing proof of the conversion of

225
00:09:09,360 --> 00:09:05,920
heat into living force which he called

226
00:09:11,130 --> 00:09:09,370
his word for her phrase for work has

227
00:09:13,470 --> 00:09:11,140
been derived from my experiments with

228
00:09:15,660 --> 00:09:13,480
the electromagnetic engine a machine

229
00:09:18,180 --> 00:09:15,670
composed magnets and bios of item set in

230
00:09:19,980 --> 00:09:18,190
motion by an electrical battery I have

231
00:09:21,810 --> 00:09:19,990
proved by actual experiment that in

232
00:09:24,540 --> 00:09:21,820
exact proportion to the force with which

233
00:09:26,730 --> 00:09:24,550
this machine works heat is abstracted

234
00:09:28,410 --> 00:09:26,740
from the electrical battery you see

235
00:09:30,870 --> 00:09:28,420
therefore that living force may be

236
00:09:32,430 --> 00:09:30,880
converted into heat and that heat may be

237
00:09:34,110 --> 00:09:32,440
converted into living force or its

238
00:09:37,080 --> 00:09:34,120

equivalent attraction through space all

239
00:09:39,000 --> 00:09:37,090
three therefore namely heat living force

240
00:09:40,680 --> 00:09:39,010
an attraction through space to which I

241
00:09:42,150 --> 00:09:40,690
could also add light were consistent

242
00:09:44,730 --> 00:09:42,160
with the scope of this president vent

243
00:09:47,940 --> 00:09:44,740
this lecture are mutually convertible

244
00:09:51,570 --> 00:09:47,950
into one another in these conversions

245
00:09:53,910 --> 00:09:51,580
nothing is ever lost historically jewel

246
00:09:56,100 --> 00:09:53,920
has been thought of as referring to the

247
00:09:58,770 --> 00:09:56,110
conservation of energy but I point out

248
00:10:00,390 --> 00:09:58,780
in this in this quote that as he starts

249
00:10:04,170 --> 00:10:00,400
off with right here at the at the

250
00:10:06,090 --> 00:10:04,180
beginning most convincing proof of the

251
00:10:08,310 --> 00:10:06,100
conversion of heat into living force was

252
00:10:11,160 --> 00:10:08,320
the operation of an electric motor from

253
00:10:12,450 --> 00:10:11,170
an electrochemical battery that was the

254
00:10:14,580 --> 00:10:12,460
most convincing why wasn't this a

255
00:10:16,650 --> 00:10:14,590
paddlewheel water experiment of

256
00:10:19,530 --> 00:10:16,660
converting a mechanical energy into

257
00:10:21,900 --> 00:10:19,540
thermal energy of the water more

258
00:10:24,810 --> 00:10:21,910
convincing what he was seeing here was

259
00:10:26,940 --> 00:10:24,820
that the the electrical nature of the

260
00:10:28,890 --> 00:10:26,950
battery by this equation down here at

261
00:10:30,780 --> 00:10:28,900
the bottom Gibbs free energy equation

262
00:10:32,820 --> 00:10:30,790
here Delta G equals Delta H minus T

263
00:10:36,690 --> 00:10:32,830

Delta house is what determined

264
00:10:40,080 --> 00:10:36,700
spontaneity and in a battery the release

265
00:10:43,730 --> 00:10:40,090
of energy the Delta G value which ones

266
00:10:46,020 --> 00:10:43,740
that the battery actually in trains

267
00:10:47,700 --> 00:10:46,030
ambient environment in the battery

268
00:10:53,510 --> 00:10:47,710
itself run out of its plates and

269
00:10:56,220 --> 00:10:53,520
electrolyte it is and it is an

270
00:10:59,769 --> 00:10:56,230
endothermic reaction and the battery

271
00:11:02,949 --> 00:10:59,779
does get cold perspective of

272
00:11:05,530 --> 00:11:02,959
resistive losses and this is what he was

273
00:11:07,389 --> 00:11:05,540
talking about in this system heat was

274
00:11:10,230 --> 00:11:07,399
going right into the electrical system

275
00:11:12,730 --> 00:11:10,240
and going into work in the in the

276
00:11:14,139 --> 00:11:12,740
electric motor and nothing else happened

277
00:11:16,840 --> 00:11:14,149
to the heat that is complete conversion

278
00:11:18,519 --> 00:11:16,850
of heat into electricity now there are

279
00:11:20,470 --> 00:11:18,529
lots of arguments to the country of this

280
00:11:21,850 --> 00:11:20,480
it's not a cycle and all that and this

281
00:11:23,290 --> 00:11:21,860
is not the time to get into these

282
00:11:25,600 --> 00:11:23,300
details but I'm just giving you an

283
00:11:28,269 --> 00:11:25,610
introduction that there might be a basis

284
00:11:30,699 --> 00:11:28,279
for the second law not being limitation

285
00:11:33,790 --> 00:11:30,709
that we all think it is now here's

286
00:11:36,100 --> 00:11:33,800
another presentation of Maxwell's demon

287
00:11:39,059 --> 00:11:36,110
by the way it was called a demon because

288
00:11:41,889 --> 00:11:39,069

said well a parallel werner heisenberg

289
00:11:44,079 --> 00:11:41,899
really hated Paul tow-rax work and

290
00:11:47,410 --> 00:11:44,089
called the Dirac equation learn it trash

291
00:11:50,470 --> 00:11:47,420
a similar dynamic of haida curtain in

292
00:11:52,179 --> 00:11:50,480
here with Lord Kelvin can't couldn't

293
00:11:54,309 --> 00:11:52,189
stand this thought experiment and called

294
00:11:58,239 --> 00:11:54,319
this intelligent being to do the sorting

295
00:12:01,119 --> 00:11:58,249
of the of the trapdoor here a demon but

296
00:12:03,400 --> 00:12:01,129
here's what happens fast and slow

297
00:12:07,569 --> 00:12:03,410
particle is indicated by the the length

298
00:12:10,420 --> 00:12:07,579
of the arrows here we can open the door

299
00:12:12,790 --> 00:12:10,430
and the highlighted particle be allowed

300
00:12:15,460 --> 00:12:12,800
through to the other side and conversely

301
00:12:17,309 --> 00:12:15,470
a slow particle is allowed to pass

302
00:12:22,119 --> 00:12:17,319
through in the other direction but now

303
00:12:24,280 --> 00:12:22,129
what's up let's look at a slow moving

304
00:12:25,780 --> 00:12:24,290
particle is deflected back in on the

305
00:12:27,939 --> 00:12:25,790
same side and also from the other side

306
00:12:30,009 --> 00:12:27,949
of fast particle is kept so you keep

307
00:12:32,470 --> 00:12:30,019
doing this out infinitum for a while you

308
00:12:34,389 --> 00:12:32,480
end up with this result a collection of

309
00:12:36,610 --> 00:12:34,399
cold particles on one are slow-moving

310
00:12:38,199 --> 00:12:36,620
particles on one side and fast-moving

311
00:12:41,049 --> 00:12:38,209
particles on the other and by the theory

312
00:12:44,230 --> 00:12:41,059
of the kinetic theory of heat end up

313
00:12:46,509 --> 00:12:44,240

with a zone of cold and hot with no work

314
00:12:49,299 --> 00:12:46,519
done on the system because the demon

315
00:12:51,999 --> 00:12:49,309
that operated the trapdoor was said was

316
00:12:54,129 --> 00:12:52,009
doing this on a it's a by the principle

317
00:12:55,929 --> 00:12:54,139
of reversibility often using

318
00:12:57,910 --> 00:12:55,939
thermodynamics to understand models that

319
00:12:59,650 --> 00:12:57,920
the trapdoor was frictionless massless

320
00:13:02,799 --> 00:12:59,660
and so could be moved without any energy

321
00:13:05,439 --> 00:13:02,809
but then the there's another case now

322
00:13:08,049 --> 00:13:05,449
that the information needed to do the

323
00:13:09,129 --> 00:13:08,059
sorting can be totally circumvented and

324
00:13:13,179 --> 00:13:09,139
that's where the pole

325
00:13:16,090 --> 00:13:13,189
comes in perfect is the correct analysis

326
00:13:17,859 --> 00:13:16,100
of the non-homogeneous constant volume

327
00:13:20,739 --> 00:13:17,869
process with displacement and

328
00:13:22,449 --> 00:13:20,749
regeneration this is the classical

329
00:13:24,549 --> 00:13:22,459
analysis of the constant volume process

330
00:13:27,479 --> 00:13:24,559
which appears by the way in the Stirling

331
00:13:30,069 --> 00:13:27,489
cycle the only standard well known

332
00:13:32,769 --> 00:13:30,079
thermodynamic engine cycle that people

333
00:13:36,429 --> 00:13:32,779
would be familiar with it's just a

334
00:13:38,949 --> 00:13:36,439
sealed volume of gas volume does not

335
00:13:42,069 --> 00:13:38,959
change heat goes in and out and the

336
00:13:44,169 --> 00:13:42,079
temperature and pressure of the of the

337
00:13:46,749 --> 00:13:44,179
gas changes and this is the way it is

338
00:13:49,780 --> 00:13:46,759

represented entirely I've never found an

339
00:13:51,879 --> 00:13:49,790
exception to this the heat Q equals the

340
00:13:54,309 --> 00:13:51,889
mass and times the specific heat

341
00:13:56,889 --> 00:13:54,319
capacity C sub V times the temperature

342
00:14:01,479 --> 00:13:56,899
difference equals Delta u the internal

343
00:14:03,069 --> 00:14:01,489
energy change the gas Wayne pole was the

344
00:14:04,780 --> 00:14:03,079
first person to correctly identify the

345
00:14:07,389 --> 00:14:04,790
complex energy flows that take place

346
00:14:09,669 --> 00:14:07,399
within the constant volume process with

347
00:14:11,979 --> 00:14:09,679
displacement and regeneration and this

348
00:14:14,590 --> 00:14:11,989
is the text from which I first became

349
00:14:16,600 --> 00:14:14,600
familiar with it talked with him and

350
00:14:19,329 --> 00:14:16,610
said he'd ever done any experiments with

351
00:14:22,179 --> 00:14:19,339
no woman retirement I don't have my lab

352
00:14:27,519 --> 00:14:22,189
at Standard Oil anymore he was a chemist

353
00:14:29,109 --> 00:14:27,529
and so he said I did some work based on

354
00:14:31,030 --> 00:14:29,119
the book the stuff he did in the book

355
00:14:33,759 --> 00:14:31,040
and experimentally verified what he did

356
00:14:35,769 --> 00:14:33,769
now this is a graphic depiction of what

357
00:14:37,509 --> 00:14:35,779
the pole effect is like in two forms the

358
00:14:39,460 --> 00:14:37,519
self refrigeration effect where we start

359
00:14:41,949 --> 00:14:39,470
off with initial conditions the

360
00:14:45,090 --> 00:14:41,959
displacer can find gas regenerated with

361
00:14:47,409 --> 00:14:45,100
a distributed thermal gradient on it and

362
00:14:50,109 --> 00:14:47,419
effects let's say air in this argument

363
00:14:51,869 --> 00:14:50,119

here 50 degrees C is displaced by the

364
00:14:54,220 --> 00:14:51,879
displacer through the regenerate

365
00:14:56,739 --> 00:14:54,230
regenerative to the cold side what we

366
00:14:58,929 --> 00:14:56,749
end up with down here is the bulk gas

367
00:15:00,579 --> 00:14:58,939
temperature is below the ambient

368
00:15:04,210 --> 00:15:00,589
temperature that we started off with in

369
00:15:06,699 --> 00:15:04,220
the system 20 degrees C conversely the

370
00:15:09,369 --> 00:15:06,709
self heating process where we start off

371
00:15:12,069 --> 00:15:09,379
with gas in the cold side and displace

372
00:15:13,539 --> 00:15:12,079
it to the high side we end up with a gas

373
00:15:17,670 --> 00:15:13,549
temperature that's higher than the

374
00:15:23,160 --> 00:15:20,070
compression and expansion work take

375
00:15:25,650 --> 00:15:23,170
place in the in the system here in order

376
00:15:29,070 --> 00:15:25,660
for this to take place as gases

377
00:15:31,530 --> 00:15:29,080
displaced let's go back go back to to

378
00:15:33,960 --> 00:15:31,540
here hot stuff is displaced through the

379
00:15:35,850 --> 00:15:33,970
regenerator cooled off the specific

380
00:15:38,220 --> 00:15:35,860
volume of the gas decreases but this is

381
00:15:42,090 --> 00:15:38,230
a constant volume environment therefore

382
00:15:44,550 --> 00:15:42,100
the the gas on both sides of the

383
00:15:47,100 --> 00:15:44,560
displacer must expand to compensate and

384
00:15:49,680 --> 00:15:47,110
that's pressure-volume work that is is

385
00:15:53,160 --> 00:15:49,690
sourced out here and put into the

386
00:15:55,230 --> 00:15:53,170
regenerator as extra heat and what we

387
00:15:57,350 --> 00:15:55,240
end up with is the change in internal

388
00:15:59,639 --> 00:15:57,360

energy of the gas you Plus this work

389
00:16:02,490 --> 00:15:59,649
equates to the mass times the heat

390
00:16:04,350 --> 00:16:02,500
capacity of constant pressure times the

391
00:16:07,170 --> 00:16:04,360
temperature which is equivalent of the

392
00:16:09,900 --> 00:16:07,180
enthalpy change Delta H all sorts of

393
00:16:12,660 --> 00:16:09,910
things open up here and this the ratio

394
00:16:14,970 --> 00:16:12,670
of CP to cv is the heat capacity ratio

395
00:16:16,440 --> 00:16:14,980
of the gas which is substantial and

396
00:16:18,269 --> 00:16:16,450
there can be considerable amount of

397
00:16:19,769 --> 00:16:18,279
power in here the implications are

398
00:16:23,430 --> 00:16:19,779
profound the second law can be

399
00:16:25,410 --> 00:16:23,440
circumvented and pearl effect does this

400
00:16:27,329 --> 00:16:25,420
without sorting any particles all

401
00:16:32,280 --> 00:16:27,339
particles undergo this energy

402
00:16:33,810 --> 00:16:32,290
transformation now the second law does

403
00:16:35,490 --> 00:16:33,820
not apply when he can transfer

404
00:16:38,190 --> 00:16:35,500
elastically according to the kinetic

405
00:16:40,170 --> 00:16:38,200
theory of heat cost greater distances

406
00:16:42,510 --> 00:16:40,180
between particles than statistically

407
00:16:45,000 --> 00:16:42,520
allowed for single particle collisions

408
00:16:47,220 --> 00:16:45,010
when the vectored heat transfer via work

409
00:16:50,030 --> 00:16:47,230
occurs over distances greater than the

410
00:16:52,199 --> 00:16:50,040
mean free path of the gas the randomness

411
00:16:54,720 --> 00:16:52,209
requirement to the second law is gone

412
00:16:57,630 --> 00:16:54,730
and this is how the second law is

413
00:17:00,269 --> 00:16:57,640

violated so to speak we've put a limit

414
00:17:04,860 --> 00:17:00,279
on Singh it's no longer applies like the

415
00:17:07,169 --> 00:17:04,870
limits on Newtonian mechanics use a

416
00:17:09,240 --> 00:17:07,179
graphic depiction of transfer of work

417
00:17:12,449 --> 00:17:09,250
over an area greater than the mean free

418
00:17:15,270 --> 00:17:12,459
path from from cloak particles to hot

419
00:17:17,340 --> 00:17:15,280
particles sending heat and look the

420
00:17:19,650 --> 00:17:17,350
reverse direction which is neg entropic

421
00:17:20,970 --> 00:17:19,660
and here's a device which is on display

422
00:17:23,189 --> 00:17:20,980
in the back and I'll have a chance to

423
00:17:24,480 --> 00:17:23,199
demonstrate it to anyone who's once see

424
00:17:27,750 --> 00:17:24,490
it with which loss left of the

425
00:17:29,710 --> 00:17:27,760
conference schematic view of what's here

426
00:17:32,289 --> 00:17:29,720
for displacer inside of

427
00:17:34,570 --> 00:17:32,299
a tube and this is the way it was built

428
00:17:36,940 --> 00:17:34,580
with steel wool inside of an acrylic

429
00:17:39,720 --> 00:17:36,950
cylinder and a bar magnet on top for

430
00:17:42,730 --> 00:17:39,730
coupling through the medic seal a

431
00:17:44,529 --> 00:17:42,740
thermocouple for sensing 50 gauge one

432
00:17:48,940 --> 00:17:44,539
one thousandth of an inch in diameter

433
00:17:51,640 --> 00:17:48,950
social fast response ambient conditions

434
00:17:54,070 --> 00:17:51,650
thermal equilibrium stroking of the

435
00:17:56,049 --> 00:17:54,080
device and see what little changes occur

436
00:17:58,510 --> 00:17:56,059
in the change in temperature with the

437
00:18:00,909 --> 00:17:58,520
thermocouples this is what occurs when

438
00:18:02,799 --> 00:18:00,919

the volume is closed often it's no

439
00:18:05,890 --> 00:18:02,809
longer under constant pressure and I've

440
00:18:07,720 --> 00:18:05,900
lifted up stroking it to the carb the

441
00:18:10,029 --> 00:18:07,730
cold side we get a self refrigeration

442
00:18:13,419 --> 00:18:10,039
spike I drop it back down self heating

443
00:18:16,419 --> 00:18:13,429
and we get this over here increase it to

444
00:18:19,180 --> 00:18:16,429
from air to argon and then from down to

445
00:18:22,480 --> 00:18:19,190
try time at gas carbon dioxide and it

446
00:18:24,240 --> 00:18:22,490
follows the predictions you'll see this

447
00:18:26,230 --> 00:18:24,250
in the back room and I've did some other

448
00:18:28,690 --> 00:18:26,240
embodiments of the tester and with

449
00:18:30,250 --> 00:18:28,700
numerous thermocouples I know have US

450
00:18:31,870 --> 00:18:30,260
patent issued on a perpetual motion

451
00:18:33,310 --> 00:18:31,880
machine I told my lawyer have fun

452
00:18:35,140 --> 00:18:33,320
storming the castle and we got it

453
00:18:38,320 --> 00:18:35,150
through because they believed I gave

454
00:18:41,320 --> 00:18:38,330
them the science and it's there okay

455
00:18:43,840 --> 00:18:41,330
their number of engine cycles have been

456
00:18:45,010 --> 00:18:43,850
developed out of this and I want to show

457
00:18:46,960 --> 00:18:45,020
you some pictures before my time runs

458
00:18:49,299 --> 00:18:46,970
out their mathematical proofs on this

459
00:18:50,980 --> 00:18:49,309
I'd love to show this to anyone and see

460
00:18:53,169 --> 00:18:50,990
what they can try to shoot it down with

461
00:18:55,570 --> 00:18:53,179
and this is what a cycle can look like

462
00:18:57,850 --> 00:18:55,580
and we'll talk about this afterwards for

463
00:19:00,010 --> 00:18:57,860

anyone who's interested prototype was

464
00:19:02,350 --> 00:19:00,020
built in 2001 actually a couple versions

465
00:19:06,070 --> 00:19:02,360
of them a sterling like pissing and

466
00:19:07,600 --> 00:19:06,080
displacer mechanism and I don't have

467
00:19:10,020 --> 00:19:07,610
time to talk about it right now but i'll

468
00:19:12,580 --> 00:19:10,030
just give you some eye candy here a

469
00:19:14,710 --> 00:19:12,590
year's worth of experimentation and I

470
00:19:18,220 --> 00:19:14,720
ran into mechanical engineering problems

471
00:19:20,730 --> 00:19:18,230
of imperfect piston seals too much

472
00:19:23,190 --> 00:19:20,740
friction in the mechanical linkage and

473
00:19:25,750 --> 00:19:23,200
design issues with further regenerator

474
00:19:28,180 --> 00:19:25,760
use liquid nitrogen to generate the

475
00:19:30,970 --> 00:19:28,190
initial lab temperature gradient on it

476
00:19:34,210 --> 00:19:30,980
and here's some frost in the Dewar flask

477
00:19:35,980 --> 00:19:34,220
at the bottom instrumented the living

478
00:19:38,490 --> 00:19:35,990
daylights out of it so I have lots of

479
00:19:41,440 --> 00:19:38,500
documentation of it and this is key

480
00:19:42,109 --> 00:19:41,450
pressure center of the cycle starting

481
00:19:44,689 --> 00:19:42,119
from thermal

482
00:19:47,659 --> 00:19:44,699
equilibrium or mechanical equilibrium

483
00:19:49,879 --> 00:19:47,669
over here and then the baseline drift

484
00:19:52,729 --> 00:19:49,889
shows that the piston leaked but

485
00:19:55,189 --> 00:19:52,739
expanding this out I have the constant

486
00:19:58,639 --> 00:19:55,199
pressure process the constant volume

487
00:20:01,039 --> 00:19:58,649
cooling and constant entropy compression

488
00:20:03,259 --> 00:20:01,049

showing up in here it is working it just

489
00:20:04,909 --> 00:20:03,269
did not have enough energy generated

490
00:20:09,919 --> 00:20:04,919
overcome its internal frictions and

491
00:20:12,799 --> 00:20:09,929
losses engineering drawing of profile

492
00:20:15,139 --> 00:20:12,809
view semi x-ray through it and view that

493
00:20:23,959 --> 00:20:15,149
the flywheel and I'm not a time but we

494
00:20:35,740 --> 00:20:23,969
can talk later we do have a few moments

495
00:20:41,350 --> 00:20:37,810
did you ever measure the effect of

496
00:20:43,900 --> 00:20:41,360
intention on your experiments no it will

497
00:20:46,060 --> 00:20:43,910
happen if you did i don't know i don't

498
00:20:49,150 --> 00:20:46,070
expect there to be any influence there i

499
00:20:51,790 --> 00:20:49,160
don't think this is a an area of science

500
00:20:54,990 --> 00:20:51,800
outside of what we've normally seen that

501
00:20:58,240 --> 00:20:55,000
requires any consciousness intervention

502
00:20:59,800 --> 00:20:58,250
in detail the science is there and if

503
00:21:01,300 --> 00:20:59,810
you don't see it yet we can talk more

504
00:21:03,550 --> 00:21:01,310
about it later and it should just be

505
00:21:06,550 --> 00:21:03,560
self-evident that it's it's a known it's

506
00:21:09,460 --> 00:21:06,560
a natural spontaneous reorganization

507
00:21:12,190 --> 00:21:09,470
process it's it's Kwazii it's not truly

508
00:21:14,080 --> 00:21:12,200
spontaneous it's Kwazii spontaneous that

509
00:21:16,300 --> 00:21:14,090
a perturbation of the system must be put

510
00:21:20,260 --> 00:21:16,310
in and that energy actual energy input

511
00:21:22,270 --> 00:21:20,270
is heading towards the natural

512
00:21:25,920 --> 00:21:22,280
expression of the second law but it's

513
00:21:28,300 --> 00:21:25,930

less than carnal if it's done right um

514
00:21:30,010 --> 00:21:28,310
we don't have time to go into detail

515
00:21:31,270 --> 00:21:30,020
here but I just want to stand up as a

516
00:21:33,700 --> 00:21:31,280
defender of the second law of

517
00:21:36,510 --> 00:21:33,710
thermodynamics all right I can talk

518
00:21:40,990 --> 00:21:36,520
later it just because its statistical

519
00:21:42,340 --> 00:21:41,000
doesn't mean that we can throw it out in

520
00:21:45,850 --> 00:21:42,350
other words just because it's not

521
00:21:48,790 --> 00:21:45,860
mathematically provable it still can be

522
00:21:52,180 --> 00:21:48,800
very solid for example if you take a box

523
00:21:54,610 --> 00:21:52,190
of marbles and you put some black

524
00:21:56,470 --> 00:21:54,620
marbles on one side of shoe box and

525
00:21:58,270 --> 00:21:56,480
white marbles on the other side you

526
00:22:00,670 --> 00:21:58,280
shake the thing the marbles will be

527
00:22:02,860 --> 00:22:00,680
distributed that's right that's just

528
00:22:04,810 --> 00:22:02,870
statistical but they really will be

529
00:22:06,400 --> 00:22:04,820
distributed and if you end up doing it

530
00:22:08,530 --> 00:22:06,410
with a million marbles they're going to

531
00:22:13,170 --> 00:22:08,540
be very very well distributed that's

532
00:22:18,550 --> 00:22:13,180
right and that concept of mixing is

533
00:22:20,320 --> 00:22:18,560
behind the the justification for the

534
00:22:23,620 --> 00:22:20,330
second law of thermodynamics and i

535
00:22:26,680 --> 00:22:23,630
believe it is solid again I'm not saying

536
00:22:28,540 --> 00:22:26,690
enough to argue with right here we will

537
00:22:31,230 --> 00:22:28,550
have a discussion tonight there's going

538
00:22:33,640 --> 00:22:31,240

to be a panel discussion on energy and

539
00:22:36,820 --> 00:22:33,650
I'm hoping that we'll get into some of

540
00:22:38,470 --> 00:22:36,830
these issues and it looks like I'm going

541
00:22:39,960 --> 00:22:38,480
to be the conservative member on the on

542
00:22:43,419 --> 00:22:39,970
the panel

543
00:22:45,610 --> 00:22:43,429
so I'm not sure what will happen with

544
00:22:47,830 --> 00:22:45,620
Daniel and and several of us this

545
00:22:49,570 --> 00:22:47,840
evening at half past Rachel debate is

546
00:22:51,280 --> 00:22:49,580
welcome and actually that's what science

547
00:22:54,730 --> 00:22:51,290
needs more of because it's been closed

548
00:23:03,340 --> 00:22:54,740
all I can say to that is science is done

549
00:23:04,810 --> 00:23:03,350
in the details examine the details oh I

550
00:23:09,539 --> 00:23:04,820
guess I wasn't clear if you're talking

551
00:23:12,880 --> 00:23:09,549
about potential potential motion machine

552
00:23:16,350 --> 00:23:12,890
perpetual motion machine how long have

553
00:23:20,500 --> 00:23:16,360
you run any experiment with a net energy

554
00:23:22,620 --> 00:23:20,510
output I do not have anything with a net

555
00:23:26,080 --> 00:23:22,630
energy output at this point it is only a

556
00:23:28,630 --> 00:23:26,090
tabletop physics experiment of the only

557
00:23:31,330 --> 00:23:28,640
questionable process in the cycle that

558
00:23:35,140 --> 00:23:31,340
is not classically understood exactly as

559
00:23:37,330 --> 00:23:35,150
the understanding is this these

560
00:23:41,110 --> 00:23:37,340
photographs you saw here were up from

561
00:23:43,000 --> 00:23:41,120
2001 when I had a contract with an

562
00:23:45,659 --> 00:23:43,010
investor from France where we formed a

563
00:23:47,680 --> 00:23:45,669

company called cool engines incorporated

564
00:23:49,030 --> 00:23:47,690
contract called for a million dollars

565
00:23:51,340 --> 00:23:49,040
and in the course of a year to be

566
00:23:53,350 --> 00:23:51,350
invested in it and an infusion of

567
00:23:56,110 --> 00:23:53,360
$50,000 was given midway through the

568
00:23:58,570 --> 00:23:56,120
year and when we were ready for a second

569
00:24:00,310 --> 00:23:58,580
stage of investment 911 happened and the

570
00:24:02,710 --> 00:24:00,320
investor lots twenty percent of his net

571
00:24:04,270 --> 00:24:02,720
worth in two days and unfortunately I

572
00:24:06,760 --> 00:24:04,280
was funded by his play money and I never

573
00:24:08,289 --> 00:24:06,770
got any more that's why it never went

574
00:24:10,570 --> 00:24:08,299
any further but I learned a lot with

575
00:24:16,210 --> 00:24:10,580
that the first two prototypes you saw

576
00:24:19,590 --> 00:24:16,220
photographs up next yes you say that at

577
00:24:22,450 --> 00:24:19,600
the molecular level things are

578
00:24:23,830 --> 00:24:22,460
reversible that's right okay and so and

579
00:24:25,720 --> 00:24:23,840
we're thinking of the second law then it

580
00:24:28,480 --> 00:24:25,730
doesn't apply at the molecular level

581
00:24:30,909 --> 00:24:28,490
that's right and yet you made it you may

582
00:24:33,760 --> 00:24:30,919
not see a separation on the atomic level

583
00:24:36,039 --> 00:24:33,770
but tiny tiny little ones in space and

584
00:24:38,260 --> 00:24:36,049
time have been reported okay just go

585
00:24:41,470 --> 00:24:38,270
away if you go to the macroscopic level

586
00:24:43,659 --> 00:24:41,480
then the second law applies yes isn't

587
00:24:45,159 --> 00:24:43,669
there any consistency what happens you

588
00:24:47,620 --> 00:24:45,169

know there's some transition point where

589
00:24:49,139 --> 00:24:47,630
it doesn't work and words does worse

590
00:24:52,639 --> 00:24:49,149
that's going on is base

591
00:24:55,440 --> 00:24:52,649
upon random collisions and departures of

592
00:24:57,419 --> 00:24:55,450
trajectories that only conserve their

593
00:25:00,180 --> 00:24:57,429
kinetic energy and their momentum from

594
00:25:01,829 --> 00:25:00,190
the collision but that on a larger scale

595
00:25:03,719 --> 00:25:01,839
as many of them are colliding ends up

596
00:25:07,739 --> 00:25:03,729
being a statistical randomness that's

597
00:25:09,539 --> 00:25:07,749
just overwhelmingly impossible that from

598
00:25:11,039 --> 00:25:09,549
a practical point of view to get to like

599
00:25:13,680 --> 00:25:11,049
the box of marbles you can have five

600
00:25:16,229 --> 00:25:13,690
black and five red marbles and juggle

601
00:25:18,329 --> 00:25:16,239
them around and if you do you have for 4

602
00:25:20,009 --> 00:25:18,339
30 hours you might guess a look they're

603
00:25:21,779 --> 00:25:20,019
separated again and then they're back

604
00:25:23,459 --> 00:25:21,789
again the more the numbers go up the

605
00:25:26,999 --> 00:25:23,469
probability of that coming back to the

606
00:25:30,329 --> 00:25:27,009
original state just falls through the

607
00:25:32,339 --> 00:25:30,339
floor abysmally but in this case as I'm

608
00:25:34,379 --> 00:25:32,349
saying there is no sorting of Maxwell's

609
00:25:36,060 --> 00:25:34,389
demon going on and everything goes

610
00:25:38,779 --> 00:25:36,070
through there and it can ratchet up hill

611
00:25:42,239 --> 00:25:38,789
and you can and you can capture it I

612
00:25:45,539 --> 00:25:42,249
have four I have four compact discs here

613
00:25:47,629 --> 00:25:45,549

with publicly available computer files

614
00:25:49,829 --> 00:25:47,639
including two mathematical proofs

615
00:25:53,190 --> 00:25:49,839
encourage any of you to take this and

616
00:25:55,139 --> 00:25:53,200
study it and for the skeptics find the

617
00:25:58,349 --> 00:25:55,149
flaws in the mathematical proof it's too

618
00:26:03,570 --> 00:25:58,359
traceable state variables or publish

619
00:26:05,959 --> 00:26:03,580
gases point out the flaws there's Kenan

620
00:26:08,549 --> 00:26:05,969
thanks for thanks for your nice talk i

621
00:26:11,039 --> 00:26:08,559
sensing that in the general scientific

622
00:26:12,209 --> 00:26:11,049
community maybe you do too but there

623
00:26:14,430 --> 00:26:12,219
seems to be a feeling that what is ever

624
00:26:16,499 --> 00:26:14,440
whatever is true for the ideal gas must

625
00:26:19,469 --> 00:26:16,509
be true for everything else and it

626
00:26:22,079 --> 00:26:19,479
simply is not that way well yes now I I

627
00:26:24,479 --> 00:26:22,089
don't argue about the ideal gas and the

628
00:26:26,669 --> 00:26:24,489
ideal gas line not reflecting that I see

629
00:26:28,979 --> 00:26:26,679
that this kind of process can work with

630
00:26:31,109 --> 00:26:28,989
ideal gases or kwasi ideal gases or

631
00:26:35,519 --> 00:26:31,119
things are very far off you know close