1	01:00:04:15	01:00:07:27	Annenberg Media
2	01:00:07:29	01:00:59:01	§
3	01:00:59:03	01:01:01:16	*EVEN AFTER 3,500 YEARS,*
4	01:01:01:18	01:01:04:15	*THE HIEROGLYPHICS ON THIS ANCIENT EGYPTIAN OBELISK*
5	01:01:04:17	01:01:07:14	*STAND OUT WITH IMPRESSIVE CLARITY.*
6	01:01:10:29	01:01:14:18	*BUT THIS OBELISK, KNOWN AS CLEOPATRA'S NEEDLE,*
7	01:01:14:20	01:01:17:03	*IS IN FAR LESS PRISTINE CONDITION.*
8	01:01:17:05	01:01:21:01	*AFTER LYING HALF-BURIED IN MUD FOR YEARS,*
9	01:01:21:03	01:01:23:01	*IT WAS SHIPPED FROM EGYPT*
10	01:01:23:03	01:01:26:00	*TO THE UNITED STATES IN THE LATE 1800s*
11	01:01:26:02	01:01:28:28	*AND PLACED IN THE VERY HUMID ATMOSPHERE*
12	01:01:29:00	01:01:30:17	*OF NEW YORK CITY.*
13	01:01:32:04	01:01:35:14	*HERE, THE DAMP AIR REACTED WITH NATURAL SALTS*
14	01:01:35:16	01:01:37:14	*ABSORBED FROM EGYPTIAN MUD*
15	01:01:37:16	01:01:41:18	*TO CAUSE A GREAT DEAL OF DAMAGE TO ITS SURFACE.*
16	01:01:41:20	01:01:43:26	*THE REASON FOR THE CONTRAST*
17	01:01:43:28	01:01:45:09	*BETWEEN THE TWO MONUMENTS*
18	01:01:45:11	01:01:47:26	*CAN BE SUMMED UP IN ONE WORD--*
19	01:01:47:28	01:01:49:00	*WEATHERING.*
20	01:01:54:16	01:01:57:13	*LIKE THE GRANITIC ROCKS OF THE EGYPTIAN MONUMENTS,*
21	01:01:57:15	01:01:59:28	*ALL THE ROCKS ON THE EARTH'S SURFACE*
22	01:02:00:00	01:02:01:14	*ARE AFFECTED BY WEATHERING,*
23	01:02:01:16	01:02:04:05	*WHICH IS REALLY THE WAY ROCKS ADAPT THEMSELVES*
24	01:02:04:07	01:02:06:19	*TO THE ENVIRONMENT OF EARTH'S SURFACE.*
25	01:02:13:14	01:02:14:27	MOST ROCKS ARE FORMED
26	01:02:14:29	01:02:16:13	DEEP BENEATH THE EARTH'S SURFACE
27	01:02:16:15	01:02:18:11	OR ON THE OCEAN FLOOR.
28	01:02:18:13	01:02:20:14	TECTONIC ACTIVITY SUCH AS UPLIFT,
29	01:02:20:16	01:02:22:29	MOUNTAIN BUILDING, OR FALLING SEA LEVEL
30	01:02:23:01	01:02:24:14	BRINGS THESE ROCKS
31	01:02:24:16	01:02:26:14	FROM THEIR ENVIRONMENT OF FORMATION
32	01:02:26:16	01:02:28:13	UP TO THE EARTH'S SURFACE.
33	01:02:28:15	01:02:30:27	THERE THE ROCKS ARE CHANGED INTO A FORM
34	01:02:30:29	01:02:33:12	THAT IS STABLE UNDER THESE NEW CONDITIONS

35 01:02:33:14 01:02:35:02 BY A PROCESS CALLED
WEATHERING.
36 01:02:35:04 01:02:37:01 WEATHERING OCCURS
EVERYWHERE ON EARTH,
37 01:02:37:03 01:02:39:15 BE IT A COLD,
DRY POLAR REGION
38 01:02:39:17 01:02:41:08 OR THE HOT, HUMID TROPICS.
39 01:02:41:10 01:02:43:26 THIS PARTICULAR OUTCROP
IS MADE OF GRANITE.
40 01:02:43:28 01:02:45:12 NOW, GRANITE IN ITS FRESH,
41 01:02:45:14 01:02:47:11 UNWEATHERED STATE
IS QUITE HARD
42 01:02:47:13 01:02:49:11 BECAUSE THE INDIVIDUAL
MINERAL GRAINS
43 01:02:49:13 01:02:50:26 ARE TIGHTLY
INTERLOCKING TOGETHER.
44 01:02:50:28 01:02:54:02 THIS GRANITE, HOWEVER,
IS HEAVILY WEATHERED.
45 01:02:57:02 01:02:58:23 IT'S QUITE SOFT,
46 01:02:58:25 01:02:59:28 CRUMBLES EASILY
47 01:03:00:02 01:03:02:06 BECAUSE THE GRAINS
ARE FALLING APART,
48 01:03:02:08 01:03:04:18 AND THEY'RE ALSO
DECOMPOSING CHEMICALLY.
49 01:03:04:20 01:03:05:25 WEATHERING OCCURS
50 01:03:05:27 01:03:08:09 IN TWO FUNDAMENTALLY
DIFFERENT WAYS.
51 01:03:08:11 01:03:09:24 THE FIRST OF THESE
52 01:03:09:26 01:03:12:20 INVOLVES THE BREAKING
OF ROCK INTO FRAGMENTS
53 01:03:12:22 01:03:13:23 AND INDIVIDUAL
MINERAL CRYSTALS.
54 01:03:16:08 01:03:18:05 *THE PHYSICAL*
FRAGMENTATION OF ROCK
55 01:03:18:07 01:03:20:16 *IS KNOWN AS*
MECHANICAL WEATHERING.
56 01:03:24:19 01:03:26:08 *THE ROCKS WE SEE*
57 01:03:26:10 01:03:28:24 *ARE USUALLY CRACKED*
TO START WITH
58 01:03:28:26 01:03:30:00 *BECAUSE OF TECTONIC*
ACTIVITY.
59 01:03:32:21 01:03:35:03 *SYSTEMS OF NATURAL*
CRACKS IN ROCKS
60 01:03:35:05 01:03:36:18 *ARE CALLED JOINTS.*
61 01:03:36:20 01:03:39:02 *ONE COMMON KIND*
OF JOINT RESULTS
62 01:03:39:04 01:03:42:03 *FROM A PROCESS KNOWN*
AS PRESSURE RELEASE.
63 01:03:44:01 01:03:46:29 *THE ROCK FORMING*
THIS GREAT GRANITIC DOME
64 01:03:47:01 01:03:48:14 *IN YOSEMITE NATIONAL PARK*
65 01:03:48:16 01:03:49:28 *WAS ORIGINALLY BURIED*
66 01:03:50:00 01:03:52:05 *KILOMETERS BENEATH*
THE SURFACE.
67 01:03:54:12 01:03:56:24 *WHILE A ROCK*
IS BELOW THE SURFACE,

68 01:03:56:26 01:03:59:09 *THE LAYERS OF EARTH'S CRUST ABOVE*
69 01:03:59:11 01:04:01:09 *PRESS DOWN ON IT.*
70 01:04:01:11 01:04:02:24 *WITH TECTONIC UPLIFT,*
71 01:04:02:26 01:04:04:09 *SURFACE EROSION REDUCES*
72 01:04:04:11 01:04:07:20 *THE THICKNESS OF THE OVERLYING ROCK.*
73 01:04:07:22 01:04:09:19 *THE DOWNWARD PRESSURE IS REDUCED,*
74 01:04:09:21 01:04:11:04 *AND THE ROCK EXPANDS*
75 01:04:11:06 01:04:13:24 *PRIMARILY IN AN UPWARD DIRECTION.*
76 01:04:16:08 01:04:18:21 *AT SHALLOW DEPTH, THE EXPANSION CAUSES*
77 01:04:18:23 01:04:21:05 *THE ROCK TO CRACK INTO SHEETS*
78 01:04:21:07 01:04:22:20 *SEPARATED BY JOINTS*
79 01:04:22:22 01:04:24:23 *PARALLEL TO THE OVERLYING SURFACE.*
80 01:04:26:00 01:04:27:17 *EXPOSED BY EROSION,*
81 01:04:27:19 01:04:31:00 *PLATES OF JOINTED GRANITE THEN DETACH THEMSELVES*
82 01:04:31:02 01:04:32:15 *AND SLIDE DOWN,*
83 01:04:32:17 01:04:36:01 *SLOWLY UNPEELING THE FACE OF THE ROCK*
84 01:04:36:03 01:04:37:16 *LAYER BY LAYER,*
85 01:04:37:18 01:04:40:16 *LIKE THE STRIPPING OF SKINS FROM AN ONION.*
86 01:04:43:09 01:04:45:07 *THIS IS KNOWN AS EXFOLIATION--*
87 01:04:45:09 01:04:48:15 *LITERALLY, THE STRIPPING AWAY OF LEAVES.*
88 01:04:48:17 01:04:50:00 *THIS OPENS THE WAY*
89 01:04:50:02 01:04:52:15 *FOR OTHER TYPES OF MECHANICAL WEATHERING,*
90 01:04:52:17 01:04:55:10 *FOR EXAMPLE, ICE WEDGING.*
91 01:04:58:05 01:04:59:17 *WHEN WATER FREEZES,*
92 01:04:59:19 01:05:03:00 *ITS VOLUME EXPANDS AS MUCH AS 9%.*
93 01:05:04:19 01:05:07:21 *THIS EXPANSION EXERTS ENORMOUS PRESSURE,*
94 01:05:07:23 01:05:09:05 *AS THOSE ACQUAINTED*
95 01:05:09:07 01:05:12:10 *WITH BURST WATER PIPES IN WINTER WELL KNOW.*
96 01:05:15:06 01:05:17:21 *WE ALSO SEE THE EFFECT OF THIS PRESSURE*
97 01:05:17:23 01:05:20:14 *ON ROADS IN COLD CLIMATES.*
98 01:05:20:16 01:05:22:06 *AFTER A PARTICULARLY FRIGID WINTER,*
99 01:05:22:08 01:05:24:29 *THE WATER THAT HAS SEEPED UNDER THE PAVEMENT*
100 01:05:25:01 01:05:26:15 *FREEZES AND EXPANDS,*
101 01:05:26:17 01:05:28:18 *HEAVING UP THE ROAD SURFACE.*
102 01:05:31:25 01:05:34:25 *THE SAME THING*

HAPPENS TO ROCKS.

103 01:05:34:27 01:05:38:21 *WHEN WATER GETS INTO*
THE CRACKS AND FREEZES,

104 01:05:38:23 01:05:41:05 *IT EXPANDS,*
WEDGING THE ROCK APART,

105 01:05:41:07 01:05:42:20 *EXTENDING THE CRACK,*

106 01:05:42:22 01:05:45:21 *AND EVEN BREAKING*
THE ROCK INTO PIECES,

107 01:05:45:23 01:05:47:07 *WHICH IS WHAT HAPPENED*

108 01:05:47:09 01:05:50:10 *TO FORM THESE JAGGED*
SPIRES OF GRANITE.

109 01:05:57:24 01:05:59:04 *THE TERM*
MECHANICAL WEATHERING,

110 01:05:59:06 01:06:01:18 *OR DISINTEGRATION,*

111 01:06:01:20 01:06:03:17 *DESCRIBES*
THE NATURAL BREAKUP

112 01:06:03:19 01:06:06:17 *OR FRAGMENTATION OF ROCK*
AT THE EARTH'S SURFACE.

113 01:06:08:10 01:06:10:08 *A CHUNK OF GRANITE,*
FOR EXAMPLE,

114 01:06:10:10 01:06:12:24 *MAY BE BROKEN UP*
INTO SMALLER PIECES

115 01:06:12:26 01:06:15:19 *BY ICE WEDGING*
OR TECTONIC ACTIVITY,

116 01:06:15:21 01:06:17:03 *BUT THIS DOESN'T CHANGE*

117 01:06:17:05 01:06:19:00 *THE COMPOSITION*
OF THE ROCK.

118 01:06:19:02 01:06:20:15 *IT'S STILL GRANITE.*

119 01:06:20:17 01:06:23:01 *IT STILL CONSISTS*
OF ITS ORIGINAL CRYSTALS

120 01:06:23:03 01:06:27:02 *OF QUARTZ, FELDSPAR, AND*
FERROMAGNESIAN MINERALS.

121 01:06:30:06 01:06:34:17 *CONTRAST THIS WITH THE OTHER*
MAIN FORM OF WEATHERING--

122 01:06:34:19 01:06:36:03 *CHEMICAL WEATHERING,*

123 01:06:36:05 01:06:39:02 *WHICH HAS A MUCH MORE*
DRASTIC EFFECT ON ROCK,

124 01:06:39:04 01:06:40:18 *ALTHOUGH THE TWO TYPES*

125 01:06:40:20 01:06:42:04 *OF WEATHERING*
ARE INTERRELATED.

126 01:06:45:10 01:06:47:24 *BY BREAKING ROCKS*
INTO SMALLER PIECES,

127 01:06:47:26 01:06:49:09 *MECHANICAL WEATHERING*

128 01:06:49:11 01:06:52:11 *INCREASES THE AMOUNT*
OF EXPOSED SURFACE.

129 01:06:52:13 01:06:54:11 *THIS HASTENS*
THE CHEMICAL WEATHERING

130 01:06:54:13 01:06:56:14 *OF THE ENTIRE ROCK.*

131 01:06:59:05 01:07:01:16 *THE PRINCIPAL AGENTS*
OF CHEMICAL WEATHERING

132 01:07:01:18 01:07:03:04 *ARE WATER IN THE GROUND*

133 01:07:03:06 01:07:05:25 *AND MOISTURE*
IN THE AIR.

134 01:07:05:27 01:07:08:09 *USUALLY THESE SOLUTIONS*
ARE WEAKLY ACIDIC

135 01:07:08:11 01:07:10:08 *AND ARE CAPABLE*

OF CAUSING

136 01:07:10:10 01:07:12:06 *THE SLOW*
CHEMICAL DECOMPOSITION

137 01:07:12:08 01:07:14:21 *OF MOST ROCK-MAKING*
MINERALS.

138 01:07:16:02 01:07:18:15 *AS RAIN FALLS,*
FOR EXAMPLE,

139 01:07:18:17 01:07:20:16 *IT DISSOLVES*
SMALL QUANTITIES

140 01:07:20:18 01:07:22:28 *OF CARBON DIOXIDE*
IN THE ATMOSPHERE,

141 01:07:23:00 01:07:25:10 *PRODUCING WEAK*
CARBONIC ACID.

142 01:07:27:09 01:07:28:22 *AS THIS SOLUTION*
PERCOLATES

143 01:07:28:24 01:07:31:12 *THROUGH DECAYING*
VEGETATION AND SOIL,

144 01:07:31:14 01:07:33:11 *IT PICKS UP MORE ACIDS,*

145 01:07:33:13 01:07:35:12 *AND THUS BECOMES*
MORE EFFECTIVE

146 01:07:35:14 01:07:37:12 *IN DECOMPOSING*
UNDERLYING ROCKS,

147 01:07:37:14 01:07:39:03 *ESPECIALLY LIMESTONE.*

148 01:07:40:15 01:07:41:29 *THIS TIME-LAPSE SEQUENCE*

149 01:07:42:01 01:07:43:15 *SHOWS HOW RAINFALL*

150 01:07:43:17 01:07:45:29 *GRADUALLY*
DISSOLVES LIMESTONE.

151 01:07:46:01 01:07:47:24 *THUS, UNLIKE*
MECHANICAL WEATHERING,

152 01:07:47:26 01:07:51:11 *CHEMICAL WEATHERING*
ACTUALLY DESTROYS

153 01:07:51:13 01:07:54:11 *OR CHANGES THE COMPOSITION*
OF THE ROCK.

154 01:07:54:13 01:07:57:24 *THE RUSTING OF METAL*
IS A GOOD EXAMPLE.

155 01:07:57:26 01:07:59:23 *THE RED RUST*
ON THIS NAIL

156 01:07:59:25 01:08:01:03 *IS A DIFFERENT SUBSTANCE*

157 01:08:01:05 01:08:03:13 *FROM THE METALLIC IRON*
AT ITS CORE.

158 01:08:03:15 01:08:05:28 *ONE SUBSTANCE*
HAS CHANGED INTO ANOTHER.

159 01:08:09:12 01:08:10:25 *THE IRON OF THE NAIL*

160 01:08:10:27 01:08:13:10 *HAS COMBINED WITH OXYGEN*
FROM THE ATMOSPHERE

161 01:08:13:12 01:08:15:21 *TO FORM RUST,*
IRON OXIDES,

162 01:08:15:23 01:08:19:27 *THE MINERALS LIMONITE*
AND GOETHITE, OR HEMATITE.

163 01:08:24:21 01:08:26:19 *BECAUSE WATER*
IS AN IMPORTANT AGENT

164 01:08:26:21 01:08:28:03 *IN CHEMICAL WEATHERING,*

165 01:08:28:05 01:08:29:19 *THE DEGREE OF WEATHERING*

166 01:08:29:21 01:08:32:18 *IS RELATED TO THE AMOUNT*
OF WATER EXISTING

167 01:08:32:20 01:08:34:17 *IN THE NATURAL*

ENVIRONMENT.

168 01:08:34:19 01:08:36:24 THE RATE A ROCK
WILL WEATHER

169 01:08:36:26 01:08:38:24 IS PRIMARILY CONTROLLED
BY THE CLIMATE.

170 01:08:38:26 01:08:41:25 IF YOU HAVE A VERY WET,
MOIST CLIMATE,

171 01:08:41:27 01:08:44:25 YOU HAVE A LOT MORE
CHEMICAL WEATHERING.

172 01:08:44:27 01:08:46:17 THE ROCKS WILL
LITERALLY DECOMPOSE

173 01:08:46:19 01:08:47:16 AT AN ACCELERATED RATE.

174 01:08:47:18 01:08:49:01 IF IT'S A DRY CLIMATE,

175 01:08:49:03 01:08:51:16 ONLY MECHANICAL WEATHERING
WILL BE ABLE TO OPERATE,

176 01:08:51:18 01:08:54:12 AND THAT'S A MUCH SLOWER
PROCESS TO CREATE SOILS.

177 01:08:56:28 01:08:59:10 *IN ADDITION TO WATER,*
TEMPERATURE IS IMPORTANT

178 01:08:59:12 01:09:01:08 *BECAUSE WARMER*
TEMPERATURES

179 01:09:01:10 01:09:03:22 *MEAN FASTER*
CHEMICAL REACTIONS.

180 01:09:03:24 01:09:05:05 *AS A RESULT,*

181 01:09:05:07 01:09:08:00 *WEATHERING IN THE TROPICS*
IS VERY RAPID.

182 01:09:08:02 01:09:11:03 *MOST DESERTS ARE*
ALSO WARM PLACES.

183 01:09:11:05 01:09:13:12 *BUT HERE,*
THE ABSENCE OF WATER

184 01:09:13:14 01:09:15:17 *SLOWS CHEMICAL WEATHERING.*

185 01:09:17:29 01:09:20:00 *EVENTUALLY MOST*
TYPES OF MINERALS

186 01:09:20:02 01:09:21:15 *CHEMICALLY WEATHER*
OR DECOMPOSE

187 01:09:21:17 01:09:25:03 *WHEN THEY ARE AT OR*
NEAR EARTH'S SURFACE.

188 01:09:28:04 01:09:30:02 ONLY A FEW MINERALS
ARE REALLY STABLE

189 01:09:30:04 01:09:31:08 AT THE EARTH'S SURFACE,

190 01:09:31:10 01:09:33:07 THE MINERAL QUARTZ,
FOR EXAMPLE.

191 01:09:33:09 01:09:35:07 HEMATITE, IRON OXIDE
IS STABLE--

192 01:09:35:09 01:09:38:25 THAT'S RUST. IT'S STABLE
AT THE EARTH'S SURFACE,

193 01:09:38:27 01:09:40:15 BUT MOST MINERALS
ARE NOT.

194 01:09:40:17 01:09:42:00 MOST MINERALS FORM
AT TEMPERATURES

195 01:09:42:02 01:09:44:00 VERY DIFFERENT THAN
25 DEGREES CENTIGRADE

196 01:09:44:02 01:09:45:18 IN ONE ATMOSPHERE
OF PRESSURE.

197 01:09:45:20 01:09:48:07 THE MINERALS MOST UNSTABLE
AT THE EARTH'S SURFACE,

198 01:09:48:09 01:09:49:28 THOSE THAT WEATHER
THE FASTEST,
199 01:09:50:00 01:09:51:28 ARE THOSE THAT FORMED AT
THE HIGHEST TEMPERATURES.
200 01:09:52:00 01:09:53:28 MINERALS THAT ARE
THE MOST STABLE
201 01:09:54:00 01:09:55:12 AND WEATHER THE LEAST
202 01:09:55:14 01:09:56:28 ARE THOSE THAT FORMED,
INITIALLY,
203 01:09:57:00 01:09:58:05 AT THE LOWEST TEMPERATURES.
204 01:09:59:18 01:10:02:08 *GRANITE IS COMPOSED*
OF VARIOUS MINERALS
205 01:10:02:10 01:10:04:22 *FORMED OVER A RANGE*
OF TEMPERATURES.
206 01:10:04:24 01:10:06:06 *EACH MINERAL TYPE*
207 01:10:06:08 01:10:08:28 *RESPONDS TO WEATHERING*
DIFFERENTLY.
208 01:10:09:00 01:10:11:13 HERE'S AN EXAMPLE
OF A GRANITE THAT'S FRESH,
209 01:10:11:15 01:10:12:13 IT'S UNWEATHERED,
210 01:10:12:15 01:10:13:27 AND TRY AS I MIGHT,
211 01:10:13:29 01:10:16:01 I CAN'T BREAK
THIS ROCK APART.
212 01:10:16:03 01:10:19:01 WE CAN SEE
THE DARK GRAY QUARTZ
213 01:10:19:03 01:10:21:27 AND THE PINK
ORTHOCLASE FELDSPAR.
214 01:10:21:29 01:10:24:13 THEY'RE IN THE ROCK,
BUT THEY HAVEN'T WEATHERED.
215 01:10:24:15 01:10:26:13 WE'LL NOW TURN
TO ANOTHER GRANITE
216 01:10:26:15 01:10:28:21 THAT HAS ALREADY BEGUN
CHEMICAL WEATHERING.
217 01:10:28:23 01:10:30:10 IT'S STARTING
TO FALL APART.
218 01:10:30:12 01:10:31:25 THE DIFFERENT MINERALS
219 01:10:31:27 01:10:33:03 ARE PROCEEDING
DIFFERENTLY.
220 01:10:33:05 01:10:35:02 PLAGIOCLASE IS WEATHERING
THE FASTEST
221 01:10:35:04 01:10:36:27 AND HAS ALREADY
TURNED TO CLAY.
222 01:10:36:29 01:10:39:13 ORTHOCLASE FELDSPAR IS
STARTING TO WEATHER AS WELL,
223 01:10:39:15 01:10:41:28 BUT THE QUARTZ HAS NOT
WEATHERED AT ALL.
224 01:10:42:00 01:10:43:24 BUT THE BASIC
FRAMEWORK OF THE ROCK
225 01:10:43:26 01:10:45:14 IS BEGINNING
TO FALL APART.
226 01:10:45:16 01:10:46:29 AND NOW THIS ROCK.
227 01:10:47:01 01:10:50:17 I CAN BEGIN TO BREAK THIS
ROCK APART WITH MY HANDS--
228 01:10:50:19 01:10:52:27 IT IS STARTING
TO DECOMPOSE.
229 01:10:52:29 01:10:54:28 THIS IS HOW

A ROCK CHANGES

230 01:10:55:00 01:10:56:13 TO BECOME SEDIMENT.

231 01:10:56:15 01:10:58:13 THE GRAINS
ARE BREAKING APART.

232 01:10:58:15 01:10:59:28 THEY'RE GOING TO DISLODGE

233 01:11:00:00 01:11:02:13 AND NOW WILL FALL INTO
THE SEDIMENTARY SYSTEM.

234 01:11:02:15 01:11:06:27 *THESE GRAINS ACCUMULATE*
IN PILES CALLED GROUPS.

235 01:11:06:29 01:11:10:22 *AS SEDIMENT IS WASHED*
AWAY BY RIVERS AND STREAMS,

236 01:11:10:24 01:11:13:22 *SAND-SIZED MINERAL GRAINS*
MAY BE SORTED OUT,

237 01:11:13:24 01:11:15:26 *DEPOSITED, AND CEMENTED*

238 01:11:15:28 01:11:18:17 *TO EVENTUALLY FORM*
SANDSTONE.

239 01:11:18:19 01:11:21:07 *AND THE SILT MAY*
ACCUMULATE SEPARATELY

240 01:11:21:09 01:11:23:23 *AND HARDEN AS SILT STONE.*

241 01:11:29:19 01:11:32:29 WEATHERING IS ESSENTIALLY
A PROCESS OF DESTRUCTION,

242 01:11:33:01 01:11:35:15 INVOLVING THE PHYSICAL
AND CHEMICAL BREAKDOWN

243 01:11:35:17 01:11:36:18 OF THE PARENT ROCK.

244 01:11:36:20 01:11:38:03 BUT IT'S A NATURAL PROCESS,

245 01:11:38:05 01:11:40:25 ONE THAT'S BEEN ACTIVE
THROUGHOUT GEOLOGIC TIME.

246 01:11:40:27 01:11:43:10 WITH THE ADVENT
OF THE INDUSTRIAL AGE,

247 01:11:43:12 01:11:45:09 MAN HAS UPSET
THIS NATURAL BALANCE

248 01:11:45:11 01:11:46:26 BY ACCELERATING
THE WEATHERING PROCESS.

249 01:11:46:28 01:11:49:11 THE BILLIONS OF TONS
OF CARBON DIOXIDE,

250 01:11:49:13 01:11:51:11 NITROGEN OXIDES,
AND SULFUR DIOXIDE

251 01:11:51:13 01:11:53:25 THAT WE ADD
TO THE AIR EACH YEAR

252 01:11:53:27 01:11:56:10 FROM THE BURNING OF FOSSIL
FUELS AND FORESTS

253 01:11:56:12 01:11:58:24 CREATES FAR MORE PROBLEMS
FOR THE ATMOSPHERE

254 01:11:58:26 01:12:00:17 THAN SOMETIMES
TURNING IT BROWN

255 01:12:00:19 01:12:02:17 AND MAKING IT
UNPLEASANT TO BREATHE.

256 01:12:02:19 01:12:03:21 THESE GASES
COMBINE CHEMICALLY

257 01:12:03:23 01:12:05:05 WITH RAIN WATER,

258 01:12:05:07 01:12:06:20 IN SOME CASES
CREATING SOLUTIONS

259 01:12:06:22 01:12:09:04 THAT ARE HUNDREDS
OF TIMES MORE ACIDIC

260 01:12:09:06 01:12:10:27 THAN NATURAL RAIN ALONE.

261 01:12:10:29 01:12:12:23 THE EFFECT OF THIS

CAUSTIC PRECIPITATION

262 01:12:12:25 01:12:14:08 FALLING ON
THE EARTH'S SURFACE

263 01:12:14:10 01:12:15:23 CREATES A SERIOUS,

264 01:12:15:25 01:12:17:07 GLOBAL-SCALE
ENVIRONMENTAL PROBLEM

265 01:12:17:09 01:12:19:23 COMMONLY KNOWN
AS ACID RAIN.

266 01:12:19:25 01:12:22:27 *THE MOST IMPORTANT*
SOURCE OF ACID RAIN

267 01:12:22:29 01:12:25:27 *IS THE SULFUR DIOXIDE*
EMITTED BY AUTOMOBILES

268 01:12:25:29 01:12:28:26 *AND FACTORIES BURNING*
HIGH-SULFUR COAL.

269 01:12:31:09 01:12:32:15 *THIS COMBINES*

270 01:12:32:17 01:12:33:24 *WITH MOISTURE*
IN THE ATMOSPHERE

271 01:12:33:26 01:12:35:27 *TO FORM SULFURIC ACID.*

272 01:12:38:28 01:12:40:11 *ADDITIONAL*
ACIDS CAN FORM

273 01:12:40:13 01:12:41:25 *FROM CARBON DIOXIDE,*

274 01:12:41:27 01:12:43:08 *CARBON MONOXIDE,*

275 01:12:43:10 01:12:46:16 *AND NITROGEN OXIDES*
FROM AUTO EXHAUSTS

276 01:12:46:18 01:12:49:16 *AND FROM BURNING*
OF ALMOST ALL KINDS.

277 01:12:50:29 01:12:52:27 *THE EXCESS ACIDS*
IN RAINFALL

278 01:12:52:29 01:12:54:26 *ACCELERATE CHEMICAL*
WEATHERING OF MASONRY

279 01:12:54:28 01:12:57:05 *AND STONE DOWNWIND*

280 01:12:57:07 01:12:58:20 *AND CAN WREAK HAVOC*

281 01:12:58:22 01:13:01:28 *ON THE LEAVES*
OF PLANTS AND TREES.

282 01:13:03:03 01:13:05:14 *A STRIKING EFFECT*
OF ACID RAIN

283 01:13:05:16 01:13:06:21 *IS THE HISTORICAL*
DETERIORATION

284 01:13:06:23 01:13:09:06 *OF SOME*
FORESTS AND LAKES.

285 01:13:09:08 01:13:12:06 *OVER THE LAST*
40 OR 50 YEARS

286 01:13:12:08 01:13:13:28 *THE WOODLANDS*
OF CENTRAL EUROPE

287 01:13:14:00 01:13:15:18 *AND EASTERN*
NORTH AMERICA

288 01:13:15:20 01:13:16:24 *HAVE BEEN*
NOTICEABLY AFFECTED

289 01:13:16:26 01:13:18:28 *BY ACID PRECIPITATION*

290 01:13:19:00 01:13:20:27 *AND RELATED*
DRY POLLUTANTS.

291 01:13:23:23 01:13:26:06 *AND WITH CONTINUED*
INDUSTRIAL POLLUTION,

292 01:13:26:08 01:13:29:03 *THE PROCESS COMPOUNDS*
YEAR BY YEAR.

293 01:13:31:20 01:13:32:29 ALTHOUGH WEATHERING

294 01:13:33:01 01:13:35:11 IS FUNDAMENTALLY
A PROCESS OF DESTRUCTION,
295 01:13:35:13 01:13:36:25 IT HAS
THE BENEFICIAL EFFECT
296 01:13:36:27 01:13:38:27 OF BREAKING ROCKS
DOWN INTO SOIL,
297 01:13:38:29 01:13:41:06 WHICH IS ESSENTIAL
TO ALL LAND-BASED LIFE.
298 01:13:41:08 01:13:42:21 HUMANS COULD
PROBABLY LIVE
299 01:13:42:23 01:13:45:17 WITHOUT OIL OR COAL
OR WOOD TO BURN,
300 01:13:45:19 01:13:47:26 BUT WE WOULDN'T SURVIVE
WITHOUT SOIL.
301 01:13:47:28 01:13:49:11 SOIL HAS MANY FUNCTIONS.
302 01:13:49:13 01:13:51:28 IT'S THE HABITAT
FOR LAND PLANTS,
303 01:13:52:00 01:13:54:13 IT HARBORS BACTERIA
WHICH PRODUCE NUTRIENTS
304 01:13:54:15 01:13:55:28 ESSENTIAL
TO THESE PLANTS,
305 01:13:56:00 01:13:57:13 AND IT'S A STOREHOUSE
306 01:13:57:15 01:13:59:15 FOR WATER AND
FOR TRACE ELEMENTS,
307 01:13:59:17 01:14:00:29 WHICH, BY THE WAY,
308 01:14:01:01 01:14:02:21 ARE ALSO PRODUCED
BY CHEMICAL WEATHERING.
309 01:14:02:23 01:14:04:22 IN FACT, SOIL
IS THE FOUNDATION
310 01:14:04:24 01:14:05:27 UPON WHICH THE ENTIRE
311 01:14:05:29 01:14:07:25 TERRESTRIAL
FOOD CHAIN DEPENDS.
312 01:14:09:25 01:14:11:09 *CONSIDER, FOR EXAMPLE,*
313 01:14:11:11 01:14:12:21 *CALCIUM AND PHOSPHORUS,*
314 01:14:12:23 01:14:15:22 *TWO OF THE ESSENTIAL*
ELEMENTS IN BONE.
315 01:14:17:29 01:14:21:02 *CALCIUM IS ABUNDANT*
THROUGHOUT NATURE,
316 01:14:21:04 01:14:22:18 *BUT ANIMALS OBTAIN*
PHOSPHORUS
317 01:14:22:20 01:14:25:01 *PRIMARILY*
BY EATING PLANTS,
318 01:14:25:03 01:14:26:17 *WHICH ABSORB*
THE PHOSPHORUS
319 01:14:26:19 01:14:29:16 *FROM THE SOIL*
IN WHICH THEY GROW.
320 01:14:30:29 01:14:33:04 *THE MOST IMPORTANT*
ORIGINAL SOURCE
321 01:14:33:06 01:14:35:07 *OF THE PHOSPHATE*
IN SOILS,
322 01:14:35:09 01:14:38:08 *IS THE RELATIVELY*
RARE MINERAL APATITE.
323 01:14:39:17 01:14:42:04 *THE APATITE*
IN A CHUNK OF GRANITE
324 01:14:42:06 01:14:43:28 *THE SIZE OF A FIST*
325 01:14:44:00 01:14:47:03 *WOULD PROBABLY FIT*

ONTO THE HEAD OF A PIN.

326 01:14:47:05 01:14:50:01 *BUT WHEN GRANITE*
IS WEATHERED INTO SOIL,

327 01:14:50:03 01:14:52:19 *THE TINY APATITE*
GRAINS DECOMPOSE,

328 01:14:52:21 01:14:54:18 *RELEASING SOLUBLE*
PHOSPHATE...

329 01:14:56:07 01:14:59:09 *WHICH IS SUBSEQUENTLY*
TAKEN UP BY PLANTS...

330 01:15:01:13 01:15:04:06 *AND THEN THROUGH*
THE FOOD CHAIN...

331 01:15:04:08 01:15:06:17 *BY PEOPLE.*

332 01:15:09:10 01:15:12:16 *APATITE IS FOUND IN MANY*
VARIETIES OF ROCKS,

333 01:15:12:18 01:15:15:12 *THOUGH USUALLY*
ONLY IN MINUTE TRACES.

334 01:15:15:14 01:15:17:27 *STILL, IT IS*
THE MAJOR SOURCE

335 01:15:17:29 01:15:20:14 *OF ALL THE PHOSPHATES*
SO VITAL TO LIFE.

336 01:15:20:16 01:15:23:03 *IF IT WERE NOT RELEASED*
BY WEATHERING,

337 01:15:23:05 01:15:26:03 *NO VERTEBRATE LAND*
ANIMALS WOULD EXIST.

338 01:15:31:07 01:15:33:20 *SOILS ARE FORMED*
AS A RESULT

339 01:15:33:22 01:15:35:04 *OF THE MECHANICAL*

340 01:15:35:06 01:15:36:28 *AND CHEMICAL*
BREAKDOWN OF ROCK.

341 01:15:37:00 01:15:38:09 *THEY ARE ENRICHED*

342 01:15:38:11 01:15:40:02 *BY THE DECOMPOSITION*
OF PLANT LIFE,

343 01:15:40:04 01:15:42:17 *WHICH PRODUCES THE RICH*
ORGANIC MATTER

344 01:15:42:19 01:15:44:01 *KNOWN AS HUMUS.*

345 01:15:45:05 01:15:46:17 *IT'S THIS COMBINATION*

346 01:15:46:19 01:15:49:03 *OF WEATHERED FRAGMENTS*
OF ROCK AND HUMUS

347 01:15:49:05 01:15:51:26 *THAT CREATES*
THE MOST FERTILE SOILS.

348 01:15:56:14 01:15:57:26 *IN ESSENCE,*

349 01:15:57:28 01:16:00:15 *SOIL IS A THIN LAYER*
THAT RESTS ON BEDROCK

350 01:16:00:17 01:16:03:09 *LIKE A COATING OF RUST*
ON IRON.

351 01:16:03:11 01:16:04:26 *AS THE SOIL MATURES,*

352 01:16:04:28 01:16:07:14 *IT FORMS INTO*
SEVERAL DIFFERENT LAYERS

353 01:16:07:16 01:16:09:03 *OR HORIZONS.*

354 01:16:09:05 01:16:10:23 *THE "A" HORIZON*

355 01:16:10:25 01:16:13:23 *IS THE LOAMY TOPSOIL*
GARDENERS KNOW SO WELL.

356 01:16:13:25 01:16:17:21 *THIS IS WHERE MOST*
PLANT HUMUS IS DERIVED.

357 01:16:17:23 01:16:20:20 *RAIN WATER SEEPS DOWN*
THROUGH THIS LAYER

358 01:16:20:22 01:16:24:01 *AND WASHES, OR LEACHES,*
SOME OF THE SOIL MATERIALS
359 01:16:24:03 01:16:26:01 *DOWN TO*
THE "B" HORIZON,
360 01:16:26:03 01:16:27:16 *THE NEXT LAYER,*
361 01:16:27:18 01:16:29:10 *WHERE THE LEACHED MATERIALS*
ACCUMULATE.
362 01:16:29:12 01:16:31:25 *THE "C" HORIZON,*
THE BOTTOMMOST LAYER,
363 01:16:31:27 01:16:34:21 *IS THE ZONE WHERE*
THE UNDERLYING BEDROCK
364 01:16:34:23 01:16:37:00 *IS PARTIALLY DISINTEGRATED*
AND DECOMPOSED,
365 01:16:37:02 01:16:39:14 *BUT STILL RECOGNIZABLE.*
366 01:16:39:16 01:16:42:16 *THE NATURE OF A SOIL*
IS DETERMINED PARTLY
367 01:16:42:18 01:16:45:25 *BY WHAT SORT OF PARENT ROCK*
IT DEVELOPS FROM,
368 01:16:45:27 01:16:48:07 *BECAUSE THIS*
IS ITS PRIME MATERIAL.
369 01:16:52:02 01:16:54:15 *IF THE PARENT ROCK*
IS GRANITE,
370 01:16:54:17 01:16:57:01 *IT DECOMPOSES*
INTO A SANDY SOIL
371 01:16:57:03 01:16:59:16 *MADE UP*
OF QUARTZ GRAINS.
372 01:16:59:18 01:17:00:29 *CLAY IN THE SOIL*
373 01:17:01:01 01:17:03:03 *COMES FROM THE WEATHERING*
OF FELDSPARS.
374 01:17:03:05 01:17:05:21 *SUCH SOIL*
IS USUALLY PERMEABLE
375 01:17:05:23 01:17:07:29 *AND CAN EASILY*
NOURISH VEGETATION.
376 01:17:10:00 01:17:12:22 *A FINE-GRAINED ROCK*
SUCH AS BASALT
377 01:17:12:24 01:17:14:09 *DECOMPOSES*
MORE RAPIDLY
378 01:17:14:11 01:17:16:29 *TO CLAY MINERALS*
AND IRON COMPOUNDS.
379 01:17:17:01 01:17:20:14 *BASALT FORMS SOIL*
THAT IS GENERALLY DARKER
380 01:17:20:16 01:17:22:22 *AND LESS PERMEABLE*
THAN GRANITIC SOIL,
381 01:17:22:24 01:17:24:06 *BUT STILL FERTILE.*
382 01:17:27:00 01:17:30:13 *CLIMATE AND TIME*
ALSO PLAY IMPORTANT ROLES
383 01:17:30:15 01:17:32:13 *IN THE EVOLUTION OF SOIL.*
384 01:17:32:15 01:17:35:08 *AS TIME PASSES*
AND THE SOIL MATURES,
385 01:17:35:10 01:17:37:03 *IT PROGRESSIVELY*
LOSES THE SIGNATURE
386 01:17:37:05 01:17:39:28 *OF THE ROCK*
IT WAS FORMED FROM
387 01:17:40:00 01:17:41:08 *AND TAKES ON*
CHARACTERISTICS
388 01:17:41:10 01:17:42:22 *DETERMINED*

BY THE CLIMATE.

389 01:17:46:20 01:17:49:29 *FERTILE SOIL DOESN'T COME INTO EXISTENCE QUICKLY.*

390 01:17:50:01 01:17:52:17 *IT TOOK ABOUT 15,000 YEARS*

391 01:17:52:19 01:17:54:28 *FOR THIS LAYER OF TRANSPORTED SOIL,*

392 01:17:55:00 01:17:56:28 *LESS THAN A METER THICK,*

393 01:17:57:00 01:17:59:11 *TO DEVELOP IN THE AMERICAN MIDWEST.*

394 01:18:03:08 01:18:06:01 *SOILS IN THE TROPICS CAN DEVELOP FASTER,*

395 01:18:06:03 01:18:08:00 *IN A FEW THOUSAND YEARS.*

396 01:18:11:29 01:18:14:19 *THESE MILLENNIA OF SOIL EVOLUTION*

397 01:18:14:21 01:18:17:11 *CAN BE DESTROYED IN A FEW SHORT YEARS*

398 01:18:17:13 01:18:19:20 *WHEN CERTAIN TYPES OF HUMAN ACTIVITY*

399 01:18:19:22 01:18:21:06 *DISTURB THE SURFACE.*

400 01:18:22:18 01:18:25:25 *FOR EXAMPLE, SOIL CAN BE DESTROYED*

401 01:18:25:27 01:18:27:12 *BY POOR SOIL MANAGEMENT,*

402 01:18:27:14 01:18:30:00 *SUCH AS OVERGRAZING*

403 01:18:30:02 01:18:32:09 *OR OVERWORKING THE LAND...*

404 01:18:32:11 01:18:35:24 *OR SIMPLY CUTTING DOWN TOO MANY TREES.*

405 01:18:39:27 01:18:43:01 *ONE REGION THAT HAS BEEN ADVERSELY AFFECTED BY THIS*

406 01:18:43:03 01:18:44:18 *IS THE TROPICS,*

407 01:18:44:20 01:18:47:12 *WHERE THE JUNGLE FLOOR WOULD SEEM TO BE*

408 01:18:47:14 01:18:49:13 *THE MOST FERTILE ENVIRONMENT POSSIBLE.*

409 01:18:53:03 01:18:55:26 *CLEARING THE LAND FOR AGRICULTURE*

410 01:18:55:28 01:18:58:27 *HAS IN MANY PLACES BEEN A DISASTROUS WASTE*

411 01:18:58:29 01:19:01:29 *BECAUSE THE FLOOR OF THE RAIN FOREST*

412 01:19:02:01 01:19:04:09 *IS ACTUALLY A RATHER UNPRODUCTIVE SOIL.*

413 01:19:04:11 01:19:05:25 *WHERE, THEN,*

414 01:19:05:27 01:19:08:19 *DOES ALL THE LUXURIANT VEGETATION COME FROM?*

415 01:19:10:11 01:19:11:28 *THE FACT IS*

416 01:19:12:00 01:19:14:27 *THE TROPICAL RAIN FOREST CREATES ITS OWN NUTRIENTS*

417 01:19:14:29 01:19:16:26 *IN THE FORM OF HUMUS,*

418 01:19:16:28 01:19:19:26 *A THICK LAYER OF DECAYING TREES AND PLANTS.*

419 01:19:22:21 01:19:24:27 *BUT BECAUSE OF THE INTENSE RAINFALL*

420 01:19:24:29 01:19:26:24 *IN THE TROPICAL JUNGLES,*

421 01:19:26:26 01:19:28:15 *NUTRIENTS IN THE SOIL*

422 01:19:28:17 01:19:31:29 *ARE QUICKLY LEACHED*

AND DRAINED AWAY,

423 01:19:32:01 01:19:34:20 *SO WHEN A FOREST*
IS CUT DOWN,

424 01:19:34:22 01:19:37:01 *THE HUMUS*
IS EXPOSED TO EROSION.

425 01:19:37:03 01:19:39:03 *THE LOSS*
OF THIS NUTRIENT SOURCE

426 01:19:39:05 01:19:42:19 *ULTIMATELY RESULTS*
IN A BARREN WASTELAND.

427 01:19:42:21 01:19:46:00 *SOIL EROSION IS NOT LIMITED*
TO TROPICAL RAIN FORESTS.

428 01:19:46:02 01:19:49:03 *IT IS, IN FACT,*
A WORLDWIDE PROBLEM

429 01:19:49:05 01:19:51:18 *THAT CAN TAKE*
MANY DIFFERENT FORMS.

430 01:19:53:12 01:19:55:04 *IN THE 1930s,*

431 01:19:55:06 01:19:57:24 *THE AMERICAN MIDWEST*
EXPERIENCED A CATASTROPHE

432 01:19:57:26 01:19:59:08 *OF MAJOR PROPORTIONS--*

433 01:19:59:10 01:20:01:03 *THE DUST BOWL.*

434 01:20:01:05 01:20:04:20 *DROUGHT CONDITIONS*
COMBINED WITH HIGH WINDS

435 01:20:04:22 01:20:06:15 *TO BLOW*
THE REGION'S SOIL

436 01:20:06:17 01:20:10:15 *INTO MASSIVE*
SWIRLING CLOUDS OF DUST.

437 01:20:10:17 01:20:13:03 THE FAMOUS DUST BOWL
OF THE AMERICAN MIDWEST

438 01:20:13:05 01:20:15:23 OCCURRED BETWEEN
1934 AND 1938,

439 01:20:15:25 01:20:17:07 AND THE NATURAL
CIRCUMSTANCES

440 01:20:17:09 01:20:19:08 THAT LED
TO THAT CATASTROPHE

441 01:20:19:10 01:20:21:05 REALLY WERE NOT UNUSUAL.

442 01:20:21:07 01:20:24:04 HIGH SEASONAL WINDS
ARE COMMON IN THE MIDWEST,

443 01:20:24:06 01:20:25:18 AND DROUGHT
OCCURS CYCLICALLY.

444 01:20:25:20 01:20:28:09 IT'S A COMMON PART
OF THAT ENVIRONMENT.

445 01:20:28:11 01:20:31:09 WHAT WAS UNUSUAL IS THAT
THE GRASSLAND THERE

446 01:20:31:11 01:20:35:24 HAD BEEN REMOVED
BY AGRICULTURE,
BY GRAZING,

447 01:20:35:26 01:20:38:08 AND THE LOOSE SOIL
UNDERNEATH,

448 01:20:38:10 01:20:40:17 A LOT OF WHICH IS DUST

449 01:20:40:19 01:20:45:00 BLOWN IN FROM
PAST GLACIAL EVENTS,

450 01:20:45:02 01:20:48:00 WAS FREE
AND EXPOSED TO THE WIND,

451 01:20:48:02 01:20:49:22 SO AWAY IT BLEW.

452 01:20:49:24 01:20:52:22 THIS WAS A CATASTROPHE
THAT DIDN'T SLOW DOWN.

453 01:20:52:24 01:20:56:25 IT CONTINUED BECAUSE
OF A SUSTAINED DROUGHT.
454 01:20:56:27 01:21:00:02 *PLOWED FIELDS WERE*
STRIPPED BARE OF TOPSOIL.
455 01:21:00:04 01:21:02:15 *PLANTED CROPS*
WERE RUINED,
456 01:21:02:17 01:21:05:00 *BURIED*
IN PILES OF DUST.
457 01:21:05:02 01:21:08:04 *FOR MANY FARMERS,*
THE RESULT WAS BANKRUPTCY.
458 01:21:08:06 01:21:10:18 IN RETROSPECT, A LOT
COULD HAVE BEEN DONE
459 01:21:10:20 01:21:13:03 TO PREVENT THE DISASTER
OF THE DUST BOWL,
460 01:21:13:05 01:21:15:17 BUT, OF COURSE,
IN THOSE DAYS
461 01:21:15:19 01:21:20:17 WE DIDN'T KNOW
AS MUCH AS WE DO NOW
ABOUT THESE PROBLEMS,
462 01:21:20:19 01:21:23:02 SO IT'S NO SURPRISE
IT HAPPENED,
463 01:21:23:04 01:21:25:14 AND NOBODY
CAN REALLY BE BLAMED.
464 01:21:25:16 01:21:28:17 *AS A RESULT*
OF THE DUST BOWL,
465 01:21:28:19 01:21:30:25 *THE UNITED STATES*
SOIL CONSERVATION SERVICE
466 01:21:30:27 01:21:32:09 *WAS ESTABLISHED*
IN 1935.
467 01:21:32:11 01:21:35:02 *ITS GOAL WAS TO DEVELOP*
FARMING TECHNIQUES
468 01:21:35:04 01:21:37:02 *THAT WOULD HELP*
TO PROTECT
469 01:21:37:04 01:21:38:27 *THIS PRECIOUS*
NATURAL RESOURCE
470 01:21:38:29 01:21:40:20 *AND TO PREVENT*
SIMILAR DISASTERS
471 01:21:40:22 01:21:42:02 *FROM EVER*
OCCURRING AGAIN.
472 01:21:45:25 01:21:48:02 *FOR FARMERS*
IN THE MOJAVE DESERT,
473 01:21:48:04 01:21:49:23 *THE ISSUE*
OF SOIL MANAGEMENT
474 01:21:49:25 01:21:52:02 *IS A MATTER*
OF ONGOING CONCERN.
475 01:21:52:04 01:21:53:17 *THERE ARE*
MULTIPLE FACTORS
476 01:21:53:19 01:21:56:06 *THAT THREATEN SOIL*
AND CROPS IN THIS REGION,
477 01:21:56:08 01:21:57:21 *RANGING FROM EROSION*
478 01:21:57:23 01:21:59:07 *TO LIMITED*
WATER RESOURCES.
479 01:21:59:09 01:22:01:05 *BECAUSE OF THE COMPLEXITY*
480 01:22:01:07 01:22:03:13 *OF THESE*
SOIL MANAGEMENT ISSUES,
481 01:22:03:15 01:22:05:01 *FARMER WAYNE SOPPELAND*

482 01:22:05:03 01:22:07:15 *TURNED TO THE SOIL*
CONSERVATION SERVICE.
483 01:22:09:22 01:22:12:20 *RICK AGUAYO,*
WHO WORKS FOR THE SERVICE,
484 01:22:12:22 01:22:15:05 *THEN MADE THE FIRST*
OF SEVERAL TRIPS
485 01:22:15:07 01:22:17:04 *TO SOPPELAND'S FARM.*
486 01:22:17:06 01:22:18:20 *HIS IMMEDIATE GOAL--*
487 01:22:18:22 01:22:21:05 *TO ANALYZE*
THE OVERALL SITUATION
488 01:22:21:07 01:22:24:06 *AND COME UP WITH*
A SOIL CONSERVATION PLAN.
489 01:22:24:08 01:22:27:12 WE DISCUSSED WHAT WAS
NEEDED IN THIS AREA
490 01:22:27:14 01:22:28:20 AND WHAT
CONSERVATION PRACTICES
491 01:22:28:22 01:22:30:20 I ALREADY HAD IN PLACE,
492 01:22:30:22 01:22:32:20 AND HE MADE
CERTAIN SUGGESTIONS
493 01:22:32:22 01:22:35:05 ON HOW THINGS
COULD BE IMPROVED,
494 01:22:35:07 01:22:37:04 AND WE CREATED A PLAN
495 01:22:37:06 01:22:39:07 OUT OF
THOSE SUGGESTIONS.
496 01:22:39:09 01:22:42:00 ONCE WE GET HIM
TO MAKE THE DECISION
497 01:22:42:02 01:22:43:26 TO HAVE
A CONSERVATION PLAN,
498 01:22:43:28 01:22:45:12 WE MUST DETERMINE
HIS OBJECTIVES--
499 01:22:45:14 01:22:49:11 WHAT'S HE PLANNING
FOR THAT PROPERTY NOW
AND DOWN THE ROAD?
500 01:22:49:13 01:22:51:25 THEN WE START EVALUATING
WHAT THE RESOURCES ARE,
501 01:22:51:27 01:22:54:23 THE SOIL RESOURCES
HE HAS TO WORK WITH,
502 01:22:54:25 01:22:57:25 HIS FARMING OPERATIONS,
HIS IRRIGATION SYSTEM.
503 01:22:57:27 01:23:01:00 *AT THE HEART*
OF THE CONSERVATION PLAN
504 01:23:01:02 01:23:03:07 *IS AN IN-DEPTH*
SOIL SURVEY
505 01:23:03:09 01:23:05:24 *TO DETERMINE*
THE PRECISE KIND OF SOIL
506 01:23:05:26 01:23:07:06 *ON SOPPELAND'S FARM.*
507 01:23:07:08 01:23:09:17 *ONCE AGUAYO*
ANALYZES THIS,
508 01:23:09:19 01:23:11:03 *HE CAN RECOMMEND*
509 01:23:11:05 01:23:14:20 *A VERY DETAILED SET*
OF CONSERVATION PRACTICES.
510 01:23:14:22 01:23:16:28 YOUR CONSERVATION PLAN'S
BEEN WORKED OUT.
511 01:23:17:00 01:23:18:27 *MANY OF AGUAYO'S*
SPECIFIC RECOMMENDATIONS
512 01:23:18:29 01:23:21:09 *ARE DESIGNED*

TO OVERCOME EROSION,

513 01:23:21:11 01:23:23:13 *ONE OF THE MOST*
TROUBLESOME THREATS

514 01:23:23:15 01:23:25:04 *TO SOPPELAND'S SOIL.*

515 01:23:25:06 01:23:27:17 OUR MAJOR PROBLEM
WITH SOIL EROSION

516 01:23:27:19 01:23:29:06 RESULTS FROM THE WIND.

517 01:23:29:08 01:23:32:19 THAT CAN HAPPEN AT
ANY TIME OF THE YEAR--

518 01:23:32:21 01:23:34:25 WINTER, SUMMER, FALL--
DOESN'T MATTER,

519 01:23:34:27 01:23:37:09 AND WE HAVE
FAIRLY HEAVY WINDS

520 01:23:37:11 01:23:39:12 FOR LONG
PERIODS OF TIME.

521 01:23:39:14 01:23:42:02 WE HAVE TO TAKE
A NUMBER OF PRECAUTIONS

522 01:23:42:04 01:23:43:13 RELATED TO THAT.

523 01:23:43:15 01:23:45:19 *ONE OF THESE PRECAUTIONS,*

524 01:23:45:21 01:23:48:19 *A BARRIER*
KNOWN AS A WINDBREAK,

525 01:23:48:21 01:23:51:19 *IS COMPOSED*
OF VERY TALL TREES.

526 01:23:51:21 01:23:54:25 *WAYNE SOPPELAND HAS*
RELIED ON THIS TECHNIQUE

527 01:23:54:27 01:23:56:17 *TO PROTECT*
HIS PRECIOUS SOIL

528 01:23:56:19 01:23:58:12 *FROM THE RAVAGES*
OF EROSION

529 01:23:58:14 01:23:59:23 *FOR A LONG TIME.*

530 01:24:01:29 01:24:04:12 *THE WINDBREAKS ALSO*
PROTECT SOPPELAND'S FARM

531 01:24:04:14 01:24:07:04 *FROM BEING SMOTHERED*
BY DRIFTING SAND.

532 01:24:08:20 01:24:11:02 *AS SOPPELAND HAS LEARNED*
THROUGH THE YEARS,

533 01:24:11:04 01:24:13:02 *A WINDBREAK*
IS EXTREMELY EFFECTIVE,

534 01:24:13:04 01:24:16:06 *PROVIDED IT'S SUFFICIENTLY*
DENSE AND TALL.

535 01:24:17:19 01:24:20:22 *WHEN THERE IS AN OPENING*
IN THE PROTECTION,

536 01:24:20:24 01:24:22:21 *OR NO WINDBREAK AT ALL,*

537 01:24:22:23 01:24:24:21 *THE DAMAGE*
CAN BE SEVERE.

538 01:24:26:27 01:24:29:16 *BUT WINDBREAKS*
ARE NOT THE TOTAL ANSWER

539 01:24:29:18 01:24:31:01 *TO EROSION PROBLEMS.*

540 01:24:34:16 01:24:37:06 *A TECHNIQUE CALLED*
CONSERVATION TILLAGE

541 01:24:37:08 01:24:40:16 *HAS ALSO PROVED*
TO BE ESPECIALLY USEFUL.

542 01:24:40:18 01:24:43:11 *TILLING,*
OR PLOWING THE FIELDS,

543 01:24:43:13 01:24:44:26 *IS ROUTINELY DONE*

544 01:24:44:28 01:24:47:11 *TO PREVENT*

THE FORMATION OF RESIDUES

545 01:24:47:13 01:24:49:16 *WHICH BLOCK*
THE PERCOLATION OF WATER

546 01:24:49:18 01:24:51:26 *THROUGH THE SOIL.*

547 01:24:51:28 01:24:54:15 *BUT IF TOO MUCH*
TILLING IS DONE,

548 01:24:54:17 01:24:56:26 *THE SOIL*
IS SO FREQUENTLY LOOSENED,

549 01:24:56:28 01:24:59:28 *MUCH OF IT CAN BE*
BLOWN OR WASHED AWAY.

550 01:25:00:00 01:25:01:24 INSTEAD OF
PLOWING THE SOIL

551 01:25:01:26 01:25:04:05 AND DISKING IT
A NUMBER OF TIMES,

552 01:25:04:07 01:25:05:21 LEAVING IT
COMPLETELY EXPOSED,

553 01:25:05:23 01:25:07:29 WE DO AS LITTLE
AS POSSIBLE.

554 01:25:08:01 01:25:10:14 WE'LL DISK ONCE,
LEAVING STUBBLE
ON THE GROUND.

555 01:25:10:16 01:25:12:13 IF A WINDSTORM
COMES UP,

556 01:25:12:15 01:25:14:15 VERY LITTLE DIRT
IS MOVING.

557 01:25:14:17 01:25:18:15 THEN WE TRY TO
PLANT THE NEXT CROP
AS SOON AS POSSIBLE

558 01:25:18:17 01:25:20:14 AND BEGIN
THE IRRIGATION.

559 01:25:20:16 01:25:24:20 THE PERIOD OF TIME
THE SOIL'S EXPOSED
IS VERY MINIMAL.

560 01:25:26:16 01:25:27:21 *ANOTHER CONCERN*

561 01:25:27:23 01:25:29:25 *FOR BOTH SOPPELAND*
AND AGUAYO

562 01:25:29:27 01:25:31:21 *IS IRRIGATION*
MANAGEMENT.

563 01:25:31:23 01:25:33:07 *THEY RECOGNIZE*

564 01:25:33:09 01:25:36:06 *THAT THE RIGHT AMOUNT*
OF WATER IS CRITICAL,

565 01:25:36:08 01:25:39:14 *NOT ONLY FOR THE IMMEDIATE*
NEEDS OF THE CROP,

566 01:25:39:16 01:25:43:06 *BUT FOR THE LONG-TERM*
HEALTH OF THE SOIL.

567 01:25:43:08 01:25:46:13 *TOO LITTLE WATER*
WOULD PARCH THE FIELDS,

568 01:25:46:15 01:25:48:13 *WHILE TOO MUCH*
WOULD RESULT

569 01:25:48:15 01:25:50:29 *IN THE FORMATION*
OF SALINE RESIDUES

570 01:25:51:01 01:25:53:14 *AND CAUSE ROOT PROBLEMS.*

571 01:25:53:16 01:25:56:14 IN THIS CASE, WAYNE HAS
SPRINKLER-IRRIGATION SYSTEMS

572 01:25:56:16 01:25:59:14 THAT A LOT OF THE FARMERS
ARE USING--

573 01:25:59:16 01:26:02:03 EITHER WHEEL LINES
OR CENTER PIVOTS.
574 01:26:02:05 01:26:04:02 WE TRY AND DESIGN THEM
575 01:26:04:04 01:26:07:26 SO THAT THEY PROVIDE
THE OPTIMUM MOISTURE
FOR THE CROP
576 01:26:07:28 01:26:09:11 WHILE REDUCING EROSION
577 01:26:09:13 01:26:11:28 AND GROUND WATER
CONTAMINATION ET CETERA.
578 01:26:12:00 01:26:14:20 WE DON'T WANT
TO OVERWATER.
579 01:26:14:22 01:26:16:20 *IN ADDITION*
TO HIS SUGGESTIONS
580 01:26:16:22 01:26:19:27 *CONCERNING TILLAGE*
AND WATER MANAGEMENT,
581 01:26:19:29 01:26:22:26 *AGUAYO HAS SET UP*
A CROP-ROTATION SEQUENCE
582 01:26:22:28 01:26:24:11 *DESIGNED TO MAXIMIZE*
583 01:26:24:13 01:26:26:12 *THE PRODUCTIVITY*
OF THE SOIL.
584 01:26:26:14 01:26:28:28 *ALONG WITH*
THE USE OF WINDBREAKS,
585 01:26:29:00 01:26:31:07 *THESE SOIL CONSERVATION*
TECHNIQUES
586 01:26:31:09 01:26:33:17 *HAVE ALREADY MADE*
A SIGNIFICANT DIFFERENCE
587 01:26:33:19 01:26:35:18 *ON WAYNE SOPPELAND'S FARM.*
588 01:26:35:20 01:26:38:12 *WHAT'S ESPECIALLY*
GRATIFYING FOR SOPPELAND
589 01:26:38:14 01:26:39:26 *IS THAT*
THESE IMPROVEMENTS
590 01:26:39:28 01:26:41:28 *ARE NOT JUST*
QUICK FIXES,
591 01:26:42:00 01:26:43:13 *BUT SIGNIFICANT CHANGES*
592 01:26:43:15 01:26:45:27 *THAT WILL KEEP*
HIS SOIL PRODUCTIVE
593 01:26:45:29 01:26:47:12 *FOR YEARS TO COME.*
594 01:26:53:28 01:26:56:28 THINKING OF SOIL AS JUST
ANOTHER PILE OF DIRT
595 01:26:57:00 01:26:58:28 IS AN EXTREMELY
SHORT-SIGHTED NOTION.
596 01:26:59:00 01:27:00:06 WITHOUT SOIL,
WITHOUT DIRT,
597 01:27:00:08 01:27:02:20 LIFE ON LAND COULD
NEVER HAVE DEVELOPED
598 01:27:02:22 01:27:04:16 AND FLOURISHED
AS IT HAS.
599 01:27:04:18 01:27:07:01 IT IS OUR RESPONSIBILITY
TO PROTECT AND PRESERVE
600 01:27:07:03 01:27:08:15 THIS VALUABLE RESOURCE,
601 01:27:08:17 01:27:10:01 BUT BEYOND THAT,
602 01:27:10:03 01:27:11:25 IT'S IMPORTANT
THAT WE RESPECT
603 01:27:11:27 01:27:14:06 AND UNDERSTAND THE ENTIRE
WEATHERING PROCESS.
604 01:27:14:08 01:27:16:05 OTHERWISE,

WE RUN THE RISK

605 01:27:16:07 01:27:18:11 OF UPSETTING
A DELICATE NATURAL BALANCE

606 01:27:18:13 01:27:20:11 OF PHYSICAL
AND CHEMICAL FACTORS

607 01:27:20:13 01:27:22:25 THAT HAVE COMBINED
TO SUPPORT TERRESTRIAL LIFE

608 01:27:22:27 01:27:25:19 FOR OVER
400 MILLION YEARS.

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