

1	01:01:42:18	01:01:46:01	Annenberg Media
2	01:01:46:03	01:01:49:16	§
3	01:01:49:18	01:01:52:17	HERN CALIFORNIA CONSORTIUM
4	01:02:37:18	01:02:39:15	THE RICH DIVERSITY
			OF LAND FORMS
5	01:02:39:17	01:02:41:13	AND GEOLOGIC ACTIVITY
			ON EARTH
6	01:02:41:15	01:02:43:29	MAKE IT UNIQUE
			IN OUR SOLAR SYSTEM.
7	01:02:44:01	01:02:45:28	THREE DECADES
			OF SPACE EXPLORATION
8	01:02:46:00	01:02:49:00	HAVE TAUGHT US THAT MOST
			OF OUR NEIGHBORING PLANETS
9	01:02:49:02	01:02:50:14	ARE GEOLOGICALLY STAGNANT
10	01:02:50:16	01:02:52:13	WHEN COMPARED
			WITH THE DYNAMIC EARTH.
11	01:02:52:15	01:02:54:00	UNTIL VERY RECENTLY,
12	01:02:54:02	01:02:57:00	GEOLOGIC PHENOMENA
			SUCH AS EARTHQUAKES AND OCEANS,
13	01:02:57:02	01:02:58:14	VOLCANOES AND GLACIATION,
14	01:02:58:16	01:03:01:15	WERE THOUGHT TO BE
			UNRELATED ASPECTS OF NATURE.
15	01:03:01:17	01:03:02:29	BUT IN THE 1960s,
16	01:03:03:01	01:03:06:08	EARTH SCIENTISTS HAD A BOLD
			AND REVOLUTIONARY REALIZATION
17	01:03:06:10	01:03:09:05	THAT COMPLETELY CHANGED
			OUR CONCEPT OF THE EARTH.
18	01:03:09:07	01:03:12:15	THEY SURMISED THAT THESE
			DIVERSE, GEOLOGIC PHENOMENA
19	01:03:12:17	01:03:15:14	COULD BE EXPLAINED
			BY A SINGLE, UNIFYING CONCEPT--
20	01:03:15:16	01:03:17:29	A BLUEPRINT
			OF GLOBAL GEOLOGIC ACTIVITY
21	01:03:18:01	01:03:20:15	CALLED THE THEORY
			OF PLATE TECTONICS.
22	01:03:20:17	01:03:22:29	PLATE TECTONICS
			IS BUILT ON THE PREMISE
23	01:03:23:01	01:03:25:15	THAT THE OUTER SKIN
			OF THE EARTH
24	01:03:25:17	01:03:28:00	IS COMPOSED
			OF INDIVIDUAL SLABS OR PLATES.
25	01:03:28:02	01:03:29:14	THESE RIGID PLATES,
26	01:03:29:16	01:03:31:14	WHICH CAN BE
			CONTINENTAL IN SIZE,
27	01:03:31:16	01:03:34:14	AND IN SOME PLACES
			HUNDREDS OF KILOMETERS THICK,
28	01:03:34:16	01:03:38:14	SLIDE AROUND ON A PARTIALLY
			MOLTEN MANTLE LAYER BELOW.
29	01:03:38:16	01:03:41:11	WHERE THE PLATES COLLIDE
			OR MOVE APART
30	01:03:41:13	01:03:43:13	OR SLIDE PAST ONE ANOTHER,
31	01:03:43:15	01:03:46:12	A GREAT VARIETY
			OF GEOLOGIC ACTIVITY RESULTS.
32	01:03:46:14	01:03:49:27	OCEAN BASINS OPEN AND CLOSE,
			MOUNTAIN BELTS EMERGE,
33	01:03:49:29	01:03:51:12	AND VOLCANOES ERUPT,

34 01:03:51:14 01:03:53:21 ALL ACCOMPANIED
BY COUNTLESS EARTHQUAKES
35 01:03:53:23 01:03:57:02 AND THE FORMATION
OF NEW ROCKS AND LAND FORMS.
36 01:03:57:04 01:03:58:26 ALTHOUGH THERE'S STILL
MUCH TO LEARN
37 01:03:58:28 01:04:00:26 ABOUT THE INTERNAL
MECHANISMS
38 01:04:00:28 01:04:02:28 WHICH CAUSE THE PLATES
TO MOVE,
39 01:04:03:00 01:04:04:12 MOST SCIENTISTS AGREE
40 01:04:04:14 01:04:06:22 THAT THE CONCEPT
OF PLATE TECTONICS IS VALID.
41 01:04:08:14 01:04:10:12 TODAY, THE THEORY
OF PLATE TECTONICS
42 01:04:10:14 01:04:12:12 IS WIDELY EMBRACED,
43 01:04:12:14 01:04:15:12 BUT THE ROAD
TO ITS ACCEPTANCE WAS LONG,
44 01:04:15:14 01:04:17:28 AND AT TIMES,
FRAUGHT WITH CONTROVERSY.
45 01:04:19:14 01:04:21:09 DURING THE 15th CENTURY,
46 01:04:21:11 01:04:24:12 EUROPE BEGAN
ITS GREAT AGE OF EXPLORATION.
47 01:04:26:14 01:04:29:12 AS NAVIGATORS CHARTED
COASTLINES THE WORLD OVER,
48 01:04:29:14 01:04:31:27 SCHOLARS BECAME INTRIGUED
BY THE SIMILARITY
49 01:04:31:29 01:04:36:11 BETWEEN THE ATLANTIC COASTS
OF AFRICA AND SOUTH AMERICA.
50 01:04:38:27 01:04:42:10 IN 1912,
SCIENTIST ALFRED WEGENER
51 01:04:42:12 01:04:45:02 INTRODUCED HIS THEORY
OF CONTINENTAL DRIFT,
52 01:04:45:04 01:04:49:10 WHICH SOUGHT TO EXPLAIN
THIS SIMILARITY.
53 01:04:49:12 01:04:52:09 ALFRED WEGENER IS ONE
OF THE INDIVIDUALS WHO,
54 01:04:52:11 01:04:53:26 IN THE 20th CENTURY,
55 01:04:53:28 01:04:56:27 HAS HAD A MAJOR INFLUENCE
ON GEOLOGICAL THOUGHT.
56 01:04:56:29 01:04:59:25 HE OBSERVED,
LIKE SEVERAL BEFORE HIM,
57 01:04:59:27 01:05:03:25 THE GEOGRAPHIC RELATIONSHIPS
ALONG THE ATLANTIC OCEAN
58 01:05:03:27 01:05:07:25 AND THE OBVIOUS MATCH
BETWEEN, PARTICULARLY,
59 01:05:07:27 01:05:10:14 THE AFRICAN
AND SOUTH AMERICAN CONTINENT.
60 01:05:10:16 01:05:15:10 THIS LED HIM TO CONCLUDE
THAT THE SURFACE OF THE EARTH,
61 01:05:15:12 01:05:18:16 THAT THE CONTINENTS
WERE NOT STABLE, BUT MOBILE,
62 01:05:18:18 01:05:22:09 AND LED TO HIS IDEA
OF DRIFTING CONTINENTS.
63 01:05:22:11 01:05:25:06 AT THE TIME,
IT WAS NOT ACCEPTED.

64 01:05:25:08 01:05:28:26 IT WAS NOT...WELL ACCEPTED
IN EITHER GEOLOGICAL

65 01:05:28:28 01:05:31:25 OR OTHER
SCIENTIFIC THOUGHTS

66 01:05:31:27 01:05:34:10 BUT, ULTIMATELY,
BECAME THE FOUNDATION

67 01:05:34:12 01:05:37:21 FOR WHAT WAS
A REAL REVOLUTION IN GEOLOGY.

68 01:05:39:01 01:05:41:22 *WEGENER Poured over*
GEOLOGICAL MAPS,

69 01:05:41:24 01:05:45:07 *MAPS THAT SHOWED*
IDENTICAL ROCK TYPES, FOSSILS,

70 01:05:45:09 01:05:48:08 *AND MINERAL DEPOSITS*
IN MANY DIFFERENT LANDS.

71 01:05:48:10 01:05:51:23 *HE WAS INTRIGUED*
BY WHAT HE DISCOVERED.

72 01:05:54:04 01:05:57:12 HE BEGAN TO SEE THAT
CERTAIN PATTERNS MATCHED UP

73 01:05:57:14 01:06:00:07 IF YOU CARRIED THEM ACROSS
MAJOR OCEAN BASINS,

74 01:06:00:09 01:06:02:24 PARTICULARLY IN THE SOUTHERN
HEMISPHERE CONTINENTS,

75 01:06:02:26 01:06:04:24 OR WHAT WE NOW CALL GONDWANA,
76 01:06:04:26 01:06:08:22 WHICH IS SPLIT APART
INTO ANTARCTICA, AUSTRALIA,

77 01:06:08:24 01:06:10:23 SOUTH AMERICA, AND AFRICA.
78 01:06:10:25 01:06:13:23 WHAT HE FOUND IS THAT
CERTAIN PLANT FOSSILS

79 01:06:13:25 01:06:16:24 MATCHED UP NICELY
ON THESE DIFFERENT CONTINENTS.

80 01:06:16:26 01:06:18:24 HE FOUND CERTAIN
CLIMATIC ZONES,

81 01:06:18:26 01:06:20:23 GLACIATION ZONES,
OR COAL BED ZONES

82 01:06:20:25 01:06:22:23 MATCHED UP
ON THESE VARIOUS CONTINENTS,

83 01:06:22:25 01:06:24:23 AND THEY DID MAKE SENSE
84 01:06:24:25 01:06:26:23 WITH WHERE THE CONTINENTS
ARE TODAY

85 01:06:26:25 01:06:29:08 IN TERMS OF
THE CURRENT CLIMATIC ZONES.

86 01:06:29:10 01:06:32:07 *WHEN HE FIT AFRICA*
AGAINST SOUTH AMERICA,

87 01:06:32:09 01:06:33:24 *WEGENER DISCOVERED*
88 01:06:33:26 01:06:36:24 *THAT THE ROCKS OF*
A SOUTH AFRICAN MINERAL BELT

89 01:06:36:26 01:06:39:08 *COINCIDED WITH SIMILAR*
FORMATIONS IN BRAZIL.

90 01:06:39:10 01:06:42:21 *A SOUTH AFRICAN MOUNTAIN RANGE,*
ENDING AT THE COAST,

91 01:06:42:23 01:06:45:21 *LINED UP NICELY*
WITH A SIMILAR RANGE

92 01:06:45:23 01:06:48:06 *IN ARGENTINA.*
93 01:06:48:08 01:06:52:02 *FURTHERMORE, THE AREAS*
OF ANCIENT ROCK IN AFRICA

94 01:06:52:04 01:06:56:04 *FORMED A CONTINUOUS BELT*

95 01:06:57:08 01:06:58:21 WITH THOSE IN SOUTH AMERICA.
 96 01:06:58:23 01:07:00:20 WEGENER WROTE,
 WE WERE TO REFIT
 97 01:07:00:22 01:07:02:22 "THE TORN PIECES
 OF A NEWSPAPER
 98 01:07:02:24 01:07:04:07 "BY MATCHING THEIR EDGES,
 99 01:07:04:09 01:07:07:06 "AND THEN CHECK WHETHER
 THE LINES OF PRINT
 100 01:07:07:08 01:07:09:02 "RUN SMOOTHLY ACROSS.
 101 01:07:09:04 01:07:12:19 "IF THEY DO, THERE IS
 NOTHING LEFT BUT TO CONCLUDE
 102 01:07:12:21 01:07:17:12 THAT THE PIECES WERE,
 IN FACT, JOINED IN THIS WAY."
 103 01:07:17:14 01:07:20:24 WEGENER REALLY PUT TOGETHER
 THE STORY FOR THE CONTINENTS
 104 01:07:20:26 01:07:23:06 AND WROTE IT DOWN
 105 01:07:23:08 01:07:27:22 AND COLLECTED ALL THE EVIDENCE
 THAT HE COULD ABOUT IT,
 106 01:07:27:24 01:07:31:06 SO THAT'S PARTLY WHY WE HEAR
 SO MUCH ABOUT WEGENER,
 107 01:07:31:08 01:07:33:14 BECAUSE HE BROUGHT IT
 ALL TOGETHER.
 108 01:07:33:16 01:07:35:06 WEGENER'S SUGGESTION
 109 01:07:35:08 01:07:38:06 THAT THE CONTINENTS
 HAD ONCE BEEN JOINED
 110 01:07:38:08 01:07:41:04 AND DRIFTED APART
 TO THEIR PRESENT POSITIONS
 111 01:07:41:06 01:07:44:22 IGNITED A MAJOR CONTROVERSY
 IN THE SCIENTIFIC COMMUNITY.
 112 01:07:44:24 01:07:48:14 ACCEPTANCE OF WEGENER'S
 CONTINENTAL DRIFT THEORIES
 113 01:07:48:16 01:07:52:04 SEEMED TO BE DIVIDED ROUGHLY
 ALONG HEMISPHERIC LINES.
 114 01:07:53:29 01:07:56:27 I THINK THE GEOLOGISTS
 WHO WERE WORKING
 115 01:07:56:29 01:07:59:23 IN THE SOUTHERN CONTINENTS
 NEVER HAD ANY DOUBT,
 116 01:07:59:25 01:08:02:03 BECAUSE THE EVOLUTION
 OF SPECIES
 117 01:08:02:05 01:08:04:05 IS SO CLEARLY PARALLEL
 ON THEM,
 118 01:08:04:07 01:08:08:04 AND THEY HAVE SO MANY OTHER
 GEOLOGICAL EVENTS IN COMMON
 119 01:08:08:06 01:08:11:04 BETWEEN THE SOUTH AFRICANS,
 SOUTH AMERICA, AND INDIA,
 120 01:08:11:06 01:08:14:04 AND ANTARCTICA,
 ONCE WE BEGAN TO EXPLORE IT,
 121 01:08:14:06 01:08:16:05 THAT THERE WAS JUST NO DOUBT
 122 01:08:16:07 01:08:19:05 THAT THEY WERE ALL PARTS
 OF ONE PIECE.
 123 01:08:19:07 01:08:20:20 BUT MOST GEOLOGISTS
 124 01:08:20:22 01:08:22:20 WEREN'T WORKING
 IN THE SOUTHERN CONTINENTS.
 125 01:08:22:22 01:08:25:19 THEY WERE WORKING
 IN EUROPE AND NORTH AMERICA,

126 01:08:25:21 01:08:27:18 AND THEY DIDN'T CATCH ON.
127 01:08:29:21 01:08:32:03 *MANY SCIENTISTS*
WERE ESPECIALLY DISTURBED
128 01:08:32:05 01:08:34:01 *BY WEGENER'S EXPLANATION*
129 01:08:34:03 01:08:36:13 *FOR HOW THE CONTINENTS*
MOVED APART.
130 01:08:37:28 01:08:41:03 WEGENER EXPLAINED HIS THEORY
OF CONTINENTAL DRIFT
131 01:08:41:05 01:08:44:02 BASED ON THE FACT
THAT THE CONTINENTS
132 01:08:44:04 01:08:47:17 WERE MOVING
THROUGH THE OCEAN BASINS,
133 01:08:47:19 01:08:49:02 AND THE CONTINENTAL CRUST
134 01:08:49:04 01:08:51:24 WAS BASICALLY PLOWING THROUGH
THIS OCEANIC CRUST.
135 01:08:51:26 01:08:55:01 GEOLOGISTS, AT THE TIME,
COULD NOT UNDERSTAND
136 01:08:55:03 01:08:58:26 HOW THE RIGID, TOUGH
CONTINENTAL ASSEMBLIES
137 01:08:58:28 01:09:01:17 COULD PLOW THROUGH
THE WEAK OCEANIC BASINS,
138 01:09:01:19 01:09:03:16 AND STILL
IT WAS THE CONTINENTS
139 01:09:03:18 01:09:06:16 THAT WERE DEFORMED
TO MAKE MOUNTAIN RANGES.
140 01:09:06:18 01:09:08:04 THAT SEEMED RATHER PECULIAR.
141 01:09:10:20 01:09:12:04 *ACCORDING TO WEGENER,*
142 01:09:12:06 01:09:14:14 *THE MECHANISM*
BEHIND CONTINENTAL DRIFT
143 01:09:14:16 01:09:17:02 *WAS THE CENTRIFUGAL FORCE*
OF EARTH'S ROTATION,
144 01:09:17:04 01:09:20:09 *AND THE TIDAL DRAG*
OF THE MOON AND SUN.
145 01:09:20:11 01:09:22:28 *GEOPHYSICISTS*
QUICKLY AND CORRECTLY
146 01:09:23:00 01:09:26:18 *EXPOSED THE FLAWS*
IN THIS REASONING.
147 01:09:26:20 01:09:30:03 IN FACT, THE MOST DIFFICULT
ASPECT OF THIS THEORY
148 01:09:30:05 01:09:35:01 WAS THAT HE ALLUDED TO
A CENTRIFUGAL FORCE
149 01:09:35:03 01:09:38:28 AS EXPLAINING WHY, IN FACT,
THE CONTINENTS DRIFTED.
150 01:09:39:00 01:09:43:14 IT WAS SHOWN QUITE CONCLUSIVELY
THAT THE FORCES WERE TOO SMALL,
151 01:09:43:16 01:09:45:15 THE ROCKS WERE FAR TOO STRONG,
152 01:09:45:17 01:09:47:21 FOR THIS TO HAVE BEEN
THE CASE.
153 01:09:47:23 01:09:50:15 SO PEOPLE WERE ABLE
TO REJECT HIS HYPOTHESIS
154 01:09:50:17 01:09:52:22 COMPLETELY AT THE TIME
155 01:09:52:24 01:09:56:08 BASED ON A MECHANISM
WHICH, IN FACT,
156 01:09:56:10 01:09:59:01 WAS SHOWN TO BE INCORRECT.
157 01:10:01:17 01:10:04:20 *BECAUSE WEGENER'S EXPLANATION*
FOR WHY CONTINENTS DRIFT

158 01:10:04:22 01:10:06:08 *DID NOT HOLD UP,*
159 01:10:06:10 01:10:08:22 *HE COULDN'T CONVINC*
MOST OTHER SCIENTISTS
160 01:10:08:24 01:10:12:27 *THAT THE CONTINENTS HAD,*
IN FACT, EVER DRIFTED AT ALL.
161 01:10:18:01 01:10:21:16 SOME PEOPLE SAY THAT SCIENTISTS
ARE SO FUDDY DUDDY
162 01:10:21:18 01:10:24:15 THEY REFUSE TO LET
ANY NEW IDEA COME IN.
163 01:10:24:17 01:10:27:14 THAT'S A BAD WAY
TO THINK ABOUT THIS.
164 01:10:27:16 01:10:29:00 WE REALLY ARE CAREFUL.
165 01:10:29:02 01:10:33:00 WE DON'T WANT TO LEAP
ON SOME GLAMOROUS NEW IDEA
166 01:10:33:02 01:10:35:16 UNLESS OUR DATA
REALLY DOES SUPPORT IT,
167 01:10:35:18 01:10:38:12 AND OUR UNDERSTANDING
OF HOW THE WORLD WORKS
168 01:10:38:14 01:10:39:29 REALLY CAN INCORPORATE THAT,
169 01:10:40:01 01:10:43:14 SO I THINK WE REALLY
DID NOT HAVE ANY DATA
170 01:10:43:16 01:10:46:12 THAT WAS SO CUTTING
AND SO CLEAR
171 01:10:46:14 01:10:49:17 THAT WE HAD TO ACCEPT
THIS THEORY.
172 01:10:49:19 01:10:53:27 SO I THINK THEY WERE ACTUALLY
BEING RESPONSIBLE, NOT--
173 01:10:53:29 01:10:55:29 THEY WERE BEING CONSERVATIVE--
174 01:10:56:01 01:10:59:01 BUT THEY WERE ALSO BEING
RESPONSIBLE SCIENTISTS.
175 01:11:01:00 01:11:04:24 *IN 1930, ALFRED WEGENER*
DIED OF A HEART ATTACK
176 01:11:04:26 01:11:07:28 *WHILE ATTEMPTING TO CROSS*
THE GREENLAND ICE CAP.
177 01:11:08:00 01:11:09:25 *BY THE 1940s,*
178 01:11:09:27 01:11:12:22 *WITH A LACK OF ANY*
CONCLUSIVE EVIDENCE,
179 01:11:12:24 01:11:14:29 *THE HEATED ARGUMENTS*
ABOUT CONTINENTAL DRIFT
180 01:11:15:01 01:11:16:24 *COOLED OFF.*
181 01:11:16:26 01:11:20:05 *WEGENER'S THEORY, HOWEVER,*
WOULD SOON ONCE AGAIN
182 01:11:20:07 01:11:23:13 *BE PROPELLED TO THE FOREFRONT*
OF SCIENTIFIC DEBATE,
183 01:11:23:15 01:11:26:09 *BUT IN A MOST UNEXPECTED WAY.*
184 01:11:28:20 01:11:30:07 TO UNDERSTAND
CONTINENTAL DRIFT,
185 01:11:30:09 01:11:34:19 WE NEEDED TO KNOW HOW THE OCEANS
ARE MADE AND DESTROYED.
186 01:11:34:21 01:11:36:12 WE HAD VERY LITTLE
UNDERSTANDING--
187 01:11:36:14 01:11:38:28 EVEN THE SHAPE
OF THE SEA FLOOR--
188 01:11:39:00 01:11:41:27 SO WE REALLY NEEDED
SOME NEW TECHNOLOGY.
189 01:11:41:29 01:11:45:13 OCEANOGRAPHIC VENTURES

190 01:11:45:15 ARE VERY DRIVEN BY TECHNOLOGY,
 191 01:11:47:00 01:11:46:28 AND IT TURNS OUT--
 01:11:50:27 I HATE TO ADMIT ANYTHING
 192 01:11:50:29 01:11:54:12 WAS GOOD ABOUT WORLD WAR II,
 01:11:54:12 BUT IT WAS VERY GOOD
 193 01:11:54:14 01:11:58:24 FOR DEVELOPING NEW TECHNOLOGIES.
 01:11:58:24 THIS NEW TECHNOLOGY
 194 01:11:58:26 01:12:01:24 DEVELOPED FOR WORLD WAR II
 01:12:01:24 INCLUDED THE FATHOMETER,
 195 01:12:01:26 01:12:05:02 AN ECHO-SOUNDING DEVICE
 01:12:05:02 THAT INSTANTLY MEASURED DEPTHS
 196 01:12:05:04 01:12:08:05 TO THE SEA FLOOR,
 01:12:08:05 ENABLING TROOP SHIPS
 197 01:12:08:07 01:12:11:08 TO MOVE INTO SHALLOW WATER.
 01:12:11:08 ONE TRANSPORT COMMANDER,
 198 01:12:11:10 01:12:12:28 HARRY HESS,
 199 01:12:13:00 01:12:15:11 MADE A HABIT OF RUNNING
 01:12:15:11 HIS SHIP'S FATHOMETER
 200 01:12:17:16 01:12:20:14 CONTINUALLY.
 01:12:20:14 A GEOLOGIST AND PRINCETON
 201 01:12:20:16 01:12:22:05 PROFESSOR IN CIVILIAN LIFE,
 202 01:12:22:07 01:12:25:00 HESS WANTED TO LEARN MORE
 01:12:25:00 ABOUT THE TOPOGRAPHY
 203 01:12:26:18 01:12:29:18 OF THE SEA FLOOR.
 01:12:29:18 HE SOON DISCOVERED
 204 01:12:29:20 01:12:31:14 THAT THE OCEAN FLOOR
 205 01:12:31:16 01:12:34:09 WAS NOT LEVEL AS EXPECTED,
 01:12:34:09 BUT WAS INSTEAD DOTTED
 206 01:12:34:11 01:12:36:28 WITH FLAT TOP MOUNTAINS
 01:12:36:28 WHICH HE NAMED GUYOTS.
 207 01:12:37:00 01:12:40:11 HESS WAS PERPLEXED
 01:12:40:11 BY HOW THESE MOUNTAINS FORMED.
 208 01:12:40:13 01:12:42:10 THEIR FLAT SUMMITS
 209 01:12:42:12 01:12:45:11 COULD SEEMINGLY BE EXPLAINED
 01:12:45:11 BY WAVE EROSION.
 210 01:12:45:13 01:12:49:15 BUT WHY, THEN, DID THE GUYOTS
 01:12:49:15 LIE SO DEEP UNDER WATER?
 211 01:12:51:01 01:12:53:27 HESS THOUGHT HE SAW A CLUE
 01:12:53:27 TO THIS MYSTERY
 212 01:12:53:29 01:12:56:26 WHEN HE OBSERVED
 01:12:56:26 THAT THE DEEPEST GUYOTS
 213 01:12:56:28 01:12:59:24 LAY FARTHEST FROM
 01:12:59:24 THE MID-OCEAN RIDGE SYSTEM.
 214 01:13:02:28 01:13:05:15 HESS AND A COLLEAGUE,
 01:13:05:15 ROBERT DIETZ,
 215 01:13:05:17 01:13:09:05 SUGGESTED THAT GUYOTS ARE,
 01:13:09:05 IN FACT, WAVE-ERODED ISLANDS
 216 01:13:09:07 01:13:13:00 WHICH SUBMERGE AS THE CRUST
 01:13:13:00 BENEATH THEM SUBSIDES.
 217 01:13:15:13 01:13:17:11 TO ACCOUNT FOR THIS
 01:13:17:11 SUBSIDENCE,
 218 01:13:17:13 01:13:19:16 THEY PROPOSED
 01:13:19:16 A RADICAL NEW THEORY
 219 01:13:19:18 01:13:22:10 WHICH THEY CALLED
 01:13:22:10 SEA-FLOOR SPREADING.
 220 01:13:24:29 01:13:27:26 HARRY HESS HAD A BOLD,

221 01:13:27:28 01:13:30:19 WHICH HE ENUNCIATED IN 1962.
 222 01:13:30:21 01:13:35:11 IT STATED THAT THE NEWLY-FOUND
 MID-ATLANTIC RIDGE
 223 01:13:35:13 01:13:39:23 WAS ACTUALLY THE SITE
 OF UPWELLING MANTLE
 224 01:13:39:25 01:13:42:07 BENEATH THE RIDGE,
 225 01:13:42:09 01:13:44:06 AND THAT AS IT SOLIDIFIED,
 226 01:13:44:08 01:13:48:10 THE MELTS DERIVED FROM IT
 SOLIDIFIED AT THE RIDGE,
 227 01:13:48:12 01:13:52:11 THEY WERE CARRIED Laterally,
 PIGGY-BACK AWAY FROM THE RIDGE,
 228 01:13:52:13 01:13:57:09 MUCH AS THE FROTH
 IN A POT OF CONVECTING STEW
 229 01:13:57:11 01:13:59:23 WOULD BE CARRIED AWAY
 230 01:13:59:25 01:14:02:29 FROM THE CENTRAL
 UPWELLING CURRENT.
 231 01:14:03:01 01:14:06:09 WHAT WEGENER HAD EVOKED
 232 01:14:06:11 01:14:10:09 WAS CONTINENTS FLOATING ON
 AND PLOWING
 233 01:14:10:11 01:14:13:11 OR DRIFTING THROUGH
 OCEAN BASINS.
 234 01:14:13:13 01:14:15:25 WHAT HESS AND OTHERS SHOWED
 235 01:14:15:27 01:14:19:19 WAS THAT THE OCEAN BASINS
 THEMSELVES WERE GROWING
 236 01:14:19:21 01:14:22:10 FROM THE MID-OCEANIC RIDGES,
 237 01:14:22:12 01:14:25:09 AND THAT OVER
 THE COURSE OF TIME,
 238 01:14:25:11 01:14:28:09 THEY ENLARGED FROM THE RIDGE
 AND SPREAD Laterally.
 239 01:14:28:11 01:14:31:08 THESE WOULD THEN BE CAPABLE
 OF CARRYING THE CONTINENTS,
 240 01:14:31:10 01:14:33:10 INITIALLY MUCH CLOSER TOGETHER
 241 01:14:33:12 01:14:36:24 AND ACTUALLY JOINED
 AT THE ONSET AT THE RIDGE,
 242 01:14:36:26 01:14:40:18 DIRECTLY AWAY FROM ONE ANOTHER
 BY THE SPREADING PROCESS.
 243 01:14:40:20 01:14:43:13 THE COMBINATION
 OF CONTINENTAL DRIFT
 244 01:14:43:15 01:14:45:07 AND SEA-FLOOR SPREADING
 245 01:14:45:09 01:14:49:07 GAVE THEM BOTH THE MECHANISM
 AND THE MANNER AND TIMING
 246 01:14:49:09 01:14:52:08 IN WHICH THE CONTINENTS
 HAD DRIFTED APART
 247 01:14:52:10 01:14:54:01 FROM ONE ANOTHER.
 248 01:14:55:25 01:14:57:13 *IF MID-OCEAN RIDGES*
 249 01:14:57:15 01:14:59:21 *WERE CONTINUOUSLY CREATING*
NEW SEA FLOOR,
 250 01:14:59:23 01:15:03:07 *IT WOULD SEEM THAT THE EARTH*
MUST BE GROWING,
 251 01:15:03:09 01:15:05:07 *SWELLING*
ALONG THE OCEAN RIDGES
 252 01:15:05:09 01:15:08:16 *LIKE A BALL*
SLOWLY BEING INFLATED.
 253 01:15:08:18 01:15:11:23 *BUT SCIENTISTS*
SAW NO CONVINCING EVIDENCE

254 01:15:11:25 01:15:13:21 *FOR AN EXPANDING EARTH.*
 255 01:15:13:23 01:15:17:27 *HOW, THEN, COULD THE EXCESS*
OCEANIC CRUST BE EXPLAINED?
 256 01:15:20:08 01:15:22:06 *HESS SUGGESTED*
THAT THE OCEAN FLOOR
 257 01:15:22:08 01:15:24:16 *SIMPLY SINKS*
BACK INTO THE PLANET
 258 01:15:24:18 01:15:27:18 *AT DEEP MARINE TRENCHES.*
 259 01:15:27:20 01:15:31:05 *HE CLAIMED THAT THIS PROCESS,*
NOW CALLED SUBDUCTION,
 260 01:15:31:07 01:15:35:14 *DESTROYS THE SURFACE*
FORMED BY SEA-FLOOR SPREADING.
 261 01:15:35:16 01:15:39:05 *JUST AS WEGENER'S HYPOTHESIS*
WAS WEAKENED BY LACK OF DATA,
 262 01:15:39:07 01:15:42:20 *SO, TOO, WAS THE MODEL*
OF SEA-FLOOR SPREADING.
 263 01:15:42:22 01:15:45:14 *HESS CAUTIOUSLY REFERRED*
TO HIS OWN THEORY
 264 01:15:45:16 01:15:47:06 *AS "GEOPOETRY."*
 265 01:15:47:08 01:15:49:11 *BUT SUPPORTING EVIDENCE*
WOULD COME
 266 01:15:49:13 01:15:52:29 *FROM THE EMERGING FIELD*
OF PALEOMAGNETISM.
 267 01:15:53:01 01:15:55:09 *THE TERM PALEOMAGNETISM*
 268 01:15:55:11 01:15:58:20 *REFERS TO ANCIENT*
MAGNETIC FIELDS OF THE EARTH.
 269 01:15:58:22 01:16:02:21 *WE CAN LEARN ABOUT,*
WE CAN SAY SOMETHING ABOUT
 270 01:16:02:23 01:16:05:13 *ANCIENT MAGNETIC FIELDS*
OF THE EARTH
 271 01:16:05:15 01:16:08:18 *BECAUSE OF THE RECORD*
THEY LEAVE IN ROCKS.
 272 01:16:08:20 01:16:12:20 *MANY ROCKS BECOME MAGNETIZED*
WHEN THEY ARE FORMED,
 273 01:16:12:22 01:16:15:04 *OR SOMETIME*
AFTER THEY ARE FORMED.
 274 01:16:15:06 01:16:18:06 *WHEN THEY BECOME MAGNETIZED,*
THEY BECOME MAGNETIZED
 275 01:16:18:08 01:16:21:14 *PARALLEL TO THE FIRST*
MAGNETIC FIELD AT THAT TIME.
 276 01:16:21:16 01:16:24:11 *IF YOU CAN COLLECT*
A ROCK SAMPLE,
 277 01:16:24:13 01:16:26:05 *MEASURE WHICH WAY*
IT'S MAGNETIZED,
 278 01:16:26:07 01:16:28:04 *AND DETERMINE*
WHEN IT WAS MAGNETIZED,
 279 01:16:28:06 01:16:30:05 *THEN YOU CAN LEARN ABOUT*
 280 01:16:30:07 01:16:32:25 *THE ORIENTATION*
OF THE MAGNETIC FIELD
 281 01:16:32:27 01:16:34:29 *AT THAT TIME IN THE PAST.*
 282 01:16:36:25 01:16:38:12 *BY THE EARLY 1960s,*
 283 01:16:38:14 01:16:40:29 *GEOLOGISTS WERE MAPPING*
THE MAGNETIZATION
 284 01:16:41:01 01:16:43:25 *OF ROCKS WORLD-WIDE.*
 285 01:16:43:27 01:16:46:18 *ONE STARTLING DISCOVERY*
CAME FROM THE OCEAN BOTTOM

286 01:16:46:20 01:16:50:01 WHERE OCEANOGRAPHERS DISCOVERED
AN UNUSUAL PATTERN

287 01:16:50:03 01:16:52:08 OF STRONG AND WEAK
MAGNETIC STRIPES

288 01:16:52:10 01:16:53:26 IN SEA FLOOR LAVA.

289 01:16:56:21 01:16:59:03 CAMBRIDGE UNIVERSITY STUDENT,
FREDERICK VINE

290 01:16:59:05 01:17:01:09 AND HIS ADVISER,
DRUMMOND MATTHEWS,

291 01:17:01:11 01:17:03:16 WERE ESPECIALLY INTRIGUED.

292 01:17:03:18 01:17:06:07 TWO QUESTIONS FASCINATED THEM--

293 01:17:06:09 01:17:09:07 WHAT CAUSES THE STRONG
AND WEAK PARTS

294 01:17:09:09 01:17:11:03 OF THE MAGNETIC PATTERNS,

295 01:17:11:05 01:17:13:12 AND WHY IS THE PATTERN
STRIPED?

296 01:17:15:19 01:17:17:03 THEY SOON REALIZED

297 01:17:17:05 01:17:20:03 THAT THE CHANGING INTENSITY
OF THE PATTERN

298 01:17:20:05 01:17:23:16 WAS CAUSED BY THE REVERSAL
OF EARTH'S MAGNETIC FIELD.

299 01:17:25:21 01:17:29:18 THE EVIDENCE WE HAVE
THAT THE FIRST MAGNETIC FIELD

300 01:17:29:20 01:17:32:04 HAS BEEN REVERSED IN THE PAST

301 01:17:32:06 01:17:35:16 IS SIMPLY
THAT WE FIND OLD ROCKS

302 01:17:35:18 01:17:37:18 THAT ARE REVERSELY MAGNETIZED.

303 01:17:37:20 01:17:41:01 THAT IS TO SAY THEY ARE
MAGNETIZED POINTING SOUTH

304 01:17:41:03 01:17:42:23 RATHER THAN POINTING NORTH.

305 01:17:42:25 01:17:47:16 THE...THERE WAS MUCH
SCIENTIFIC DEBATE AT FIRST

306 01:17:47:18 01:17:49:16 BECAUSE IT'S KNOWN

307 01:17:49:18 01:17:54:01 THAT SOME ROCKS CAN BE PLACED
IN A MAGNETIC FIELD

308 01:17:54:03 01:17:55:28 POINTING ONE WAY,

309 01:17:56:00 01:18:00:04 AND BECOME MAGNETIZED EXACTLY
OPPOSITE TO THAT DIRECTION.

310 01:18:00:06 01:18:02:10 AND THE FACT
THAT SUCH ROCKS EXISTED

311 01:18:02:12 01:18:04:10 MEANT THAT IT WAS POSSIBLE

312 01:18:04:12 01:18:06:09 THAT REVERSELY
MAGNETIZED ROCKS

313 01:18:06:11 01:18:09:13 WERE SIMPLY RECORDING
NORMAL MAGNETIC FIELD.

314 01:18:09:15 01:18:13:05 THE CLINCHING EVIDENCE
CAME WHEN

315 01:18:13:07 01:18:15:15 SCIENTISTS FROM THE U.S.
GEOLOGICAL SURVEY

316 01:18:15:17 01:18:18:24 AND FROM OTHER PLACES

317 01:18:18:26 01:18:22:01 WENT ON EXPEDITIONS
AROUND THE WORLD,

318 01:18:22:03 01:18:24:25 COLLECTED ROCKS
OF DIFFERENT AGES,

319 01:18:24:27 01:18:26:16 AND WERE ABLE TO SHOW

320 01:18:26:18 01:18:29:16 THAT ROCKS COLLECTED

321 01:18:29:18 FROM AROUND THE WORLD
 01:18:33:17 OF THE SAME AGE
 ALWAYS HAD THE SAME POLARITY.
 322 01:18:33:19 01:18:37:27 ROCKS THAT WERE YOUNGER
 THAN 700,000 YEARS OLD
 323 01:18:37:29 01:18:39:11 WERE NORMALLY MAGNETIZED.
 324 01:18:39:13 01:18:42:14 ROCKS OLDER THAN 700,000 YEARS
 WERE REVERSELY MAGNETIZED.
 325 01:18:42:16 01:18:45:14 THIS GLOBAL PATTERN
 OF MAGNETIC POLARITY
 326 01:18:45:16 01:18:48:14 RECORDED IN THE ROCKS
 IS WHAT CONVINCED PEOPLE
 327 01:18:48:16 01:18:50:20 THAT IT WAS
 THE MAGNETIC FIELD ITSELF
 328 01:18:50:22 01:18:51:28 CHANGING POLARITY.
 329 01:18:54:02 01:18:55:15 VINE AND MATTHEWS NOTED
 330 01:18:55:17 01:18:57:15 THAT THE STRIPED,
 REVERSAL PATTERN
 331 01:18:57:17 01:19:00:13 IS PARALLEL
 TO MID-OCEAN RIDGES.
 332 01:19:00:15 01:19:02:01 BY 1965,
 333 01:19:02:03 01:19:05:09 THEY CONCLUDED THE BEST WAY
 TO EXPLAIN THIS RELATIONSHIP,
 334 01:19:05:11 01:19:07:18 IS BY SEA-FLOOR SPREADING.
 335 01:19:10:16 01:19:12:00 TO CHECK THEIR CONCLUSION,
 336 01:19:12:02 01:19:14:08 VINE STUDIED
 THE MAGNETIC STRIPE PATTERN
 337 01:19:14:10 01:19:16:14 ACROSS SEVERAL
 MID-OCEAN RIDGES.
 338 01:19:16:16 01:19:20:02 HE PREDICTED IF SEA-FLOOR
 SPREADING DID OCCUR,
 339 01:19:20:04 01:19:22:28 THE MAGNETIC PATTERN
 ON ONE SIDE OF A RIDGE
 340 01:19:23:00 01:19:24:19 SHOULD BE THE MIRROR IMAGE
 341 01:19:24:21 01:19:26:27 OF THE PATTERN
 SEEN ON THE OTHER.
 342 01:19:26:29 01:19:28:15 WITH STARTLING PRECISION,
 343 01:19:28:17 01:19:30:28 VINE'S PREDICTION
 PROVED CORRECT.
 344 01:19:31:00 01:19:33:29 VINE AND MATTHEWS
 FIGURED OUT THIS IDEA
 345 01:19:34:01 01:19:37:29 AND PUBLISHED IT
 IN A KIND OF OBSCURE PAPER,
 346 01:19:38:01 01:19:40:26 BUT WHEN FRED VINE COLLECTED
 ENOUGH PROFILES
 347 01:19:40:28 01:19:42:29 ACROSS DIFFERENT
 MID-OCEAN RIDGES
 348 01:19:43:01 01:19:44:28 AND SAW THAT IT WAS TRUE,
 349 01:19:45:00 01:19:47:29 HE WENT ON THE ROAD
 AND TALKED ABOUT IT
 350 01:19:48:01 01:19:49:28 TO ANYONE WHO WOULD LISTEN.
 351 01:19:50:00 01:19:51:14 IN DECEMBER OF '66,
 352 01:19:51:16 01:19:54:13 HE GAVE A LECTURE AT SCRIPPS
 OCEANOGRAPHIC INSTITUTION
 353 01:19:54:15 01:19:56:27 THAT JUST CHANGED
 THE WHOLE DIRECTION

354 01:19:56:29 01:19:59:04 OF THE INSTITUTION.
355 01:19:59:06 01:20:01:09 I ARRIVED THERE
AS A GRADUATE STUDENT
356 01:20:01:11 01:20:02:28 IN JANUARY OF 1967.
357 01:20:03:00 01:20:05:16 I THOUGHT I WAS COMING
TO THIS VENERABLE
358 01:20:05:18 01:20:07:03 OLD OCEANOGRAPHIC
INSTITUTE,
359 01:20:07:05 01:20:09:27 THAT EVERYBODY WOULD BE
A LITTLE BORED,
360 01:20:09:29 01:20:11:26 AND THEY WERE JUST CRAZY.
361 01:20:11:28 01:20:14:27 THERE WERE RECORDS
STREWN OUT ON THE FLOOR.
362 01:20:14:29 01:20:17:15 EVERYBODY
WAS JUST ALL IN A CHAOS
363 01:20:17:17 01:20:18:28 OVER THIS NEW IDEA.
364 01:20:19:00 01:20:20:28 IT MEANT A TOTALLY
DIFFERENT WAY
365 01:20:21:00 01:20:23:27 TO EXPLAIN ALMOST EVERYTHING
ON THE SEA FLOOR.
366 01:20:25:28 01:20:27:11 *A FURTHER TEST*
367 01:20:27:13 01:20:29:12 *OF THE SEA-FLOOR SPREADING*
HYPOTHESIS
368 01:20:29:14 01:20:31:12 *WAS CARRIED OUT*
BY GEOPHYSICISTS
369 01:20:31:14 01:20:34:22 *J. TUZO WILSON*
AND LYNN SYKES.
370 01:20:34:24 01:20:37:13 *THEY WERE INTERESTED*
IN THE FAULTING
371 01:20:37:15 01:20:39:27 *WHICH OFFSETS*
MID-OCEAN RIDGES.
372 01:20:39:29 01:20:44:17 *IF A FEATURE SUCH AS A ROAD*
OR A FENCE IS SPLIT
373 01:20:44:19 01:20:46:19 *AND MOVED BY AN EARTHQUAKE,*
374 01:20:46:21 01:20:50:05 *ONE CAN DEDUCE HOW THE CRUST*
SHIFTED ALONG THE FAULT
375 01:20:50:07 01:20:52:07 *BY MEASURING THE DIRECTION*
OF MOVEMENT
376 01:20:52:09 01:20:54:13 *AND THE AMOUNT OF OFFSET.*
377 01:20:56:13 01:20:59:10 *MANY SCIENTISTS EXPECTED*
THE SAME TO HOLD TRUE
378 01:20:59:12 01:21:02:15 *AT FAULTS CUTTING ACROSS*
THE MID-OCEAN RIDGES.
379 01:21:03:27 01:21:05:28 *BUT WILSON AND SYKES*
POINTED OUT
380 01:21:06:00 01:21:08:16 *THAT IF NEW CRUST*
IS FORMING AT RIDGES,
381 01:21:08:18 01:21:10:12 *THEN GROWING SEA FLOOR*
382 01:21:10:14 01:21:13:25 *SHOULD SHIFT ALONG THE FAULTS*
IN THE OPPOSITE DIRECTION.
383 01:21:13:27 01:21:16:10 *BASED ON HIS STUDY*
OF SEISMIC RECORDS
384 01:21:16:12 01:21:18:09 *FROM THE MID-ATLANTIC*
RIDGE,
385 01:21:18:11 01:21:21:25 *SYKES CONCLUDED THAT THIS,*
IN FACT, WAS TAKING PLACE.

386 01:21:21:27 01:21:24:13 WILSON AND SYKES
 NAMED THE NEW CLASS
 387 01:21:24:15 01:21:27:11 OF GEOLOGIC STRUCTURE
 "TRANSFORM FAULTS,"
 388 01:21:27:13 01:21:30:25 WHICH SERVED AS FURTHER PROOF
 OF SEA-FLOOR SPREADING.
 389 01:21:30:27 01:21:33:10 AS TRANSFORM FAULTS
 WERE BEING DISCOVERED,
 390 01:21:33:12 01:21:34:27 OCEANOGRAPHERS PREPARED
 391 01:21:34:29 01:21:38:09 FOR THE MOST INTENSIVE
 SAMPLING OF THE SEA FLOOR
 392 01:21:38:11 01:21:39:25 EVER UNDERTAKEN,
 393 01:21:39:27 01:21:43:21 USING THE RESEARCH VESSEL
 GLOMAR CHALLENGER.
 394 01:21:43:23 01:21:47:10 IN 1968,
 DRILL CORES SHOWED
 395 01:21:47:12 01:21:50:09 THAT THE SEA FLOOR GROWS OLDER
 WITH DISTANCE
 396 01:21:50:11 01:21:52:11 FROM THE MID-OCEAN RIDGES.
 397 01:21:55:16 01:21:57:27 TOGETHER
 WITH THE MAGNETIC DATA
 398 01:21:57:29 01:21:59:12 AND TRANSFORM FAULTS,
 399 01:21:59:14 01:22:00:26 THE CORES INDICATED
 400 01:22:00:28 01:22:03:18 SEA-FLOOR SPREADING
 MUST TAKE PLACE.
 401 01:22:07:12 01:22:09:29 SUDDENLY,
 SCIENTISTS COULD EASILY EXPLAIN
 402 01:22:10:01 01:22:12:24 MANY ASPECTS OF EARTH'S
 GEOLOGY AND HISTORY
 403 01:22:12:26 01:22:15:20 WHICH HAD LONG BEEN UNCLEAR.
 404 01:22:15:22 01:22:18:11 NOT ONLY COULD
 THE DISTRIBUTION OF FOSSILS
 405 01:22:18:13 01:22:20:10 AND PALEO-CLIMATES
 BE EXPLAINED,
 406 01:22:20:12 01:22:22:25 BUT THE ORIGINS
 OF MOUNTAIN RANGES,
 407 01:22:22:27 01:22:25:10 MINERAL RESOURCES,
 LARGE FAULTS,
 408 01:22:25:12 01:22:28:15 AND MAGNETIC FIELD PATTERNS
 ALSO MADE SENSE.
 409 01:22:31:13 01:22:33:29 GEOLOGISTS REALIZED
 THAT EARTH'S SURFACE
 410 01:22:34:01 01:22:37:00 IS DIVIDED BY THE SYSTEM
 OF MID-OCEAN RIDGES,
 411 01:22:37:02 01:22:38:25 SUBDUCTION ZONES AND FAULTS
 412 01:22:38:27 01:22:41:28 INTO GIANT PLATES
 WHICH SLOWLY SEPARATE,
 413 01:22:42:00 01:22:45:18 CONVERGE,
 OR SLIDE BY ONE ANOTHER.
 414 01:22:45:20 01:22:49:08 IN 1967, DONALD MCKENZIE
 AND ROBERT PALMER
 415 01:22:49:10 01:22:53:03 INTRODUCED THE TERM
 "PLATE TECTONICS"
 416 01:22:53:05 01:22:56:23 TO DESCRIBE THIS REVOLUTIONARY
 VIEW OF OUR WORLD.
 417 01:22:59:08 01:23:01:07 I GUESS YOU COULD SAY

418 01:23:01:09 01:23:03:25 THAT THE EMERGENCE
OF THE CONCEPT
419 01:23:03:27 01:23:05:17 OF PLATE TECTONICS
420 01:23:05:19 01:23:09:12 IS AN EXAMPLE OF
THE SCIENTIFIC METHOD IN ACTION.
421 01:23:09:14 01:23:13:07 WE USE A GREAT NUMBER
422 01:23:13:09 01:23:15:07 OF KINDS OF OBSERVATIONS,
423 01:23:15:09 01:23:18:08 ALL DIFFERENT,
ALL SEEMINGLY UNRELATED,
424 01:23:18:10 01:23:19:25 AND BRING IT TOGETHER
425 01:23:19:27 01:23:22:11 IN A MODEL
THAT EXPLAINS EVERYTHING.
426 01:23:22:13 01:23:25:09 PRIOR TO THE ADVENT
OF PLATE TECTONICS,
427 01:23:25:11 01:23:28:08 WE KNEW THAT WE HAD
MOUNTAIN RANGES,
428 01:23:28:10 01:23:29:25 BUT WE DIDN'T KNOW WHY.
429 01:23:29:27 01:23:33:08 WE DIDN'T KNOW WHY THERE WAS
THIS INCREDIBLE SHORTENING.
430 01:23:33:10 01:23:35:23 WE KNEW
THAT WE HAD VOLCANISM
431 01:23:35:25 01:23:37:29 NEAR THE MARGIN
OF THE CONTINENTS.
432 01:23:38:01 01:23:39:16 WE DIDN'T KNOW WHY.
433 01:23:39:18 01:23:43:16 THESE THINGS ARE EXPLICABLE
BASED ON PLATE TECTONICS,
434 01:23:43:18 01:23:47:07 AND IT IS THE FACT
THAT THIS N@W MODEL,
435 01:23:47:09 01:23:50:15 THIS NEW PARADIGM
RESOLVED SO MANY DIVERGENT,
436 01:23:50:17 01:23:54:04 SEEMINGLY UNRELATED
GEOLOGIC FACTS,
437 01:23:54:06 01:23:55:21 OBSERVATIONS
WE ALREADY KNEW,
438 01:23:55:23 01:23:57:22 THAT ALLOW US
TO MOVE FORWARD
439 01:23:57:24 01:24:00:19 TO A NEW LEVEL
OF UNDERSTANDING.
440 01:24:00:21 01:24:03:00 PLATE TECTONICS HAS BECOME
441 01:24:03:02 01:24:05:13 ONE OF THE MAJOR
UNIFYING THEORIES
442 01:24:05:15 01:24:07:12 OF EARTH SCIENCES.
443 01:24:07:14 01:24:09:06 IN MANY WAYS,
444 01:24:09:08 01:24:12:21 IT'S COMPARABLE
TO THE THEORY OF EVOLUTION
445 01:24:12:23 01:24:14:22 IN LIFE SCIENCES.
446 01:24:14:24 01:24:17:07 IT PROVIDES
THAT UNIFYING THEME
447 01:24:17:09 01:24:20:06 UPON WHICH WE CAN UNDERSTAND,
448 01:24:20:08 01:24:22:26 AND BY WHICH
WE CAN UNDERSTAND
449 01:24:22:28 01:24:27:06 A VERY WIDE ARRAY
OF PROCESSES
450 01:24:27:08 01:24:30:09 WHICH ARE TAKING PLACE
IN THE EARTH'S CRUST.
451 01:24:30:11 01:24:32:15 SO I THINK IT'S QUITE CLEAR

452 01:24:32:17 01:24:36:08 THAT IT IS PROBABLY
 THE MOST IMPORTANT CONTRIBUTION
 453 01:24:36:10 01:24:39:04 WHICH HAS BEEN MADE
 TO GEOLOGICAL THOUGHT
 454 01:24:39:06 01:24:41:20 IN MUCH OF ITS
 DEVELOPMENT.
 455 01:24:44:06 01:24:47:04 *PLATE TECTONICS THEORY*
FUNDAMENTALLY CHANGED
 456 01:24:47:06 01:24:50:02 *THE WAY EARTH SCIENTISTS*
VIEW OUR WORLD.
 457 01:24:51:23 01:24:55:05 *ACCEPTANCE OF THE THEORY*
HAS TAKEN HOLD WORLD-WIDE,
 458 01:24:55:07 01:24:57:04 *ALTHOUGH A FEW SKEPTICS*
REMAIN.
 459 01:24:58:27 01:25:01:04 THERE ARE SKEPTICS
 TO EVERY THEORY,
 460 01:25:01:06 01:25:04:04 AND I GUESS
 YOU'D HAVE TO SAY
 461 01:25:04:06 01:25:06:09 WHETHER WE'RE TALKING
 ABOUT EVOLUTION
 462 01:25:06:11 01:25:07:24 OR A SPHERICAL EARTH.
 463 01:25:07:26 01:25:11:19 YOU'D HAVE TO SAY
 THERE ARE SKEPTICS.
 464 01:25:11:21 01:25:14:18 THERE ARE PEOPLE, I'M TOLD,
 WHO DON'T BELIEVE
 465 01:25:14:20 01:25:17:24 THE APOLLO MISSION
 ACTUALLY WENT TO THE MOON.
 466 01:25:17:26 01:25:21:20 MY BELIEF IS THAT IT IS
 A VERY HEALTHY THING
 467 01:25:21:22 01:25:27:05 THAT THERE ARE SUCH SKEPTICS,
 BECAUSE THEY TEST OUR...
 468 01:25:27:07 01:25:29:04 OUR HONESTY, BASICALLY.
 469 01:25:29:06 01:25:33:04 IT'S THE EMPEROR HAS NO CLOTHES
 SORT OF PHENOMENON.
 470 01:25:33:06 01:25:36:24 WE ALL BELIEVE
 IN A NEW HYPOTHESIS
 471 01:25:36:26 01:25:39:02 AND ACCEPT IT SO COMPLETELY
 472 01:25:39:04 01:25:42:02 THAT PERHAPS WE DON'T TEST
 WHERE WE SHOULD.
 473 01:25:42:04 01:25:45:11 IT IS VERY IMPORTANT
 THAT THESE SKEPTICS EXIST.
 474 01:25:48:04 01:25:49:24 *ALTHOUGH PLATE TECTONICS*
 475 01:25:49:26 01:25:52:21 *EXPLAINS MANY*
GEOLOGICAL PHENOMENA,
 476 01:25:52:23 01:25:56:08 *CERTAIN QUESTIONS ABOUT HOW*
IT ACTUALLY OPERATES REMAIN.
 477 01:25:56:10 01:26:00:03 *EARTH SCIENTISTS*
ARE STILL TRYING TO UNDERSTAND
 478 01:26:00:05 01:26:02:17 *THE MECHANICS*
OF TECTONIC ACTIVITY.
 479 01:26:04:19 01:26:08:02 IN TERMS OF THE NEXT
 CHALLENGE OF PLATE TECTONICS,
 480 01:26:08:04 01:26:11:17 IT REALLY GOES BACK
 TO THE INITIAL DEBATES,
 481 01:26:11:19 01:26:13:16 BACK TO WEGENER'S TIME,
 482 01:26:13:18 01:26:17:10 WHICH CENTERED ON THE ACTUAL

DRIVING MECHANISM.

483 01:26:17:12 01:26:20:02 WE KNOW THAT THE EARTH
IS CONVECTING,

484 01:26:20:04 01:26:22:27 AND THAT THE MOVEMENTS
OF THE PLATES

485 01:26:22:29 01:26:25:01 IS RELATED TO THIS CONVECTION.

486 01:26:25:03 01:26:27:02 WE DON'T REALLY UNDERSTAND
THE DYNAMICS

487 01:26:27:04 01:26:28:17 OF THE CONVECTION
VERY WELL--

488 01:26:28:19 01:26:30:19 WHETHER OR NOT THE UPDRAFTS

489 01:26:30:21 01:26:32:26 ARE ACTUALLY
DRIVING THE PLATES APART,

490 01:26:32:28 01:26:35:18 OR WHETHER THE COLDER PARTS
OF THE PLATES

491 01:26:35:20 01:26:38:09 THAT ARE BEING DRIVEN
BACK INTO THE MANTLE

492 01:26:38:11 01:26:40:15 ARE ACTUALLY
PULLING THE PLATES APART,

493 01:26:40:17 01:26:42:22 OR WHETHER IT'S SOME
COMBINATION OF THE TWO.

494 01:26:42:24 01:26:44:06 IT'S THIS QUESTION

495 01:26:44:08 01:26:46:27 THAT A LOT OF DEBATE
IS FOCUSED ON.

496 01:26:46:29 01:26:49:28 IN TERMS OF THE MORE
SURFACE LEVEL PROCESSES,

497 01:26:50:00 01:26:54:15 I THINK THE MAJOR ADVANCES
OR FRONTIERS

498 01:26:54:17 01:26:58:00 REALLY DEAL WITH
RATES OF PROCESSES--

499 01:26:58:02 01:27:02:15 HOW FAST DO CERTAIN PLATES
MOVE PAST ONE ANOTHER,

500 01:27:02:17 01:27:05:14 AND HOW RAPIDLY DOES THAT
CAUSE MOUNTAINS TO FORM,

501 01:27:05:16 01:27:07:06 BASINS TO DROP DOWN,

502 01:27:07:08 01:27:09:09 BASINS TO TURN BACK
INTO MOUNTAINS?

503 01:27:11:03 01:27:12:16 *THE PLATE TECTONICS
REVOLUTION*

504 01:27:12:18 01:27:17:15 *HAS HAD A PROFOUND IMPACT
ON OUR VIEW OF PLANET EARTH,*

505 01:27:17:17 01:27:20:15 *EVEN EXTENDING BEYOND
THE FIELD OF GEOLOGY.*

506 01:27:20:17 01:27:24:02 THE THEORY OF
PLATE TECTONICS HAS BEEN,

507 01:27:24:04 01:27:25:15 IF NOT INSTRUMENTAL,

508 01:27:25:17 01:27:28:15 CERTAINLY ONE OF THE MAJOR
CONTRIBUTORS TO US

509 01:27:28:17 01:27:30:18 INCREASINGLY
LOOKING AT THE EARTH

510 01:27:30:20 01:27:31:29 AS A SINGLE SYSTEM,

511 01:27:32:01 01:27:34:01 AND ALL THE COMPONENTS OF IT

512 01:27:34:03 01:27:36:21 AS BEING AN INTERRELATED
PART OF THAT SYSTEM.

513 01:27:36:23 01:27:39:12 AND OUR
INCREASING UNDERSTANDING

514 01:27:39:14 01:27:41:18 OF ENVIRONMENTAL SYSTEMS
 515 01:27:41:20 01:27:46:11 IS ESSENTIALLY A FOLLOW THROUGH
 OF THAT BASIC THEME.
 516 01:27:46:13 01:27:51:06 AND SOMETHING THAT'S BEEN
 VERY NECESSARY.
 517 01:27:51:08 01:27:53:26 BY THE LATE 1960s,
 SEA-FLOOR SPREADING
 518 01:27:53:28 01:27:56:02 AND THE CONCEPT
 OF CONTINENTAL DRIFT
 519 01:27:56:04 01:27:57:15 HAD GAINED WIDE ACCEPTANCE.
 520 01:27:57:17 01:27:59:08 EVENTUALLY,
 THEY WERE COMBINED
 521 01:27:59:10 01:28:01:24 INTO A GLOBAL MODEL
 OF CRUSTAL DYNAMICS
 522 01:28:01:26 01:28:03:14 THAT REVOLUTIONIZED GEOLOGY.
 523 01:28:03:16 01:28:05:13 THE THEORY OF PLATE TECTONICS
 524 01:28:05:15 01:28:08:15 HAS HAD A PERVASIVE IMPACT
 ON THE EARTH SCIENCES.
 525 01:28:08:17 01:28:11:23 IT'S DEMONSTRATED
 THAT EARTHQUAKES AND VOLCANISM,
 526 01:28:11:25 01:28:13:23 MOUNTAIN RANGES
 AND OCEAN BASINS
 527 01:28:13:25 01:28:15:06 ARE ALL INTERRELATED,
 528 01:28:15:08 01:28:17:13 THE CONSEQUENCES
 OF TECTONIC ACTIVITY
 529 01:28:17:15 01:28:19:08 AT PLATE BOUNDARIES.
 530 01:28:19:10 01:28:22:28 IT'S PROVIDED NEW PERSPECTIVES
 AND IMPOSED NEW CONSTRAINTS
 531 01:28:23:00 01:28:25:07 ON ALL GEOLOGIC
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 532 01:28:25:09 01:28:27:04 THE THEORY
 OF PLATE TECTONICS
 533 01:28:27:06 01:28:29:11 HAS SHOWN
 THE GEOLOGIC DIVERSITY
 534 01:28:29:13 01:28:30:29 AND ACTIVITY OF EARTH
 535 01:28:31:01 01:28:33:28 TO BE THE CONSEQUENCE
 OF DYNAMIC TECTONISM
 536 01:28:34:00 01:28:36:19 THAT'S BEEN FUNCTIONING
 FOR BILLIONS OF YEARS.
 537 01:28:36:21 01:28:38:26 MOST CURRENT RESEARCH
 IN PLATE TECTONICS
 538 01:28:38:28 01:28:41:19 FOCUSES ON DOCUMENTING
 THE MOVEMENTS OF PLATES
 539 01:28:41:21 01:28:44:01 IN THE EARLIEST PERIODS
 OF EARTH HISTORY,
 540 01:28:44:03 01:28:46:00 AND ON UNDERSTANDING
 THE MECHANISMS
 541 01:28:46:02 01:28:48:01 OF PLATE FORMATION
 AND MOVEMENT.
 542 01:28:48:03 01:28:51:12 THESE MECHANISMS OPERATE
 IN A MOST INACCESSIBLE PLACE--
 543 01:28:51:14 01:28:53:13 DEEP WITHIN THE EARTH'S MANTLE.
 544 01:28:53:15 01:28:55:23 UNRAVELING THE DYNAMICS
 OF THE MANTLE
 545 01:28:55:25 01:28:57:28 AND ITS LINK WITH THE PLATES
 546 01:28:58:00 01:29:01:02 IS ONE OF THE MOST FORMIDABLE

547 01:29:01:04 AND EXCITING CHALLENGES
01:29:03:08 FACING GEOLOGISTS
IN THE FUTURE.

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