

Wegener's Theory of Continental Drift

Wegener, ikke Wegner

Alfred Wegener was a German Meteorologist in the early 1900s who studied ancient climates. Like most people, the jigsaw puzzle appearance of the Atlantic continental margins caught his attention. He put together the evidence of ancient glaciations and the distribution of fossil to formulate a theory that the continents have moved over the surface of the Earth, sometimes forming large supercontinents and other times forming separate continental masses. He proposed that prior to about 200 million years ago all of the continents formed one large land mass that he called Pangea (see figures on pages 57 to 62 in your text).

Disse Marshak figurer kommer nå i denne forelesningen, og blir dermed en del av vår pensum.

The weakness of Wegener's theory, and the reason it was not readily accepted by geologists was that he proposed that the continents slide over ocean floor. Geophysicists disagreed, stating the ocean floor did not have enough strength to hold the continents and too much frictional resistance would be encountered.

- Wegner's Theory of Continental Drift

Riktig

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Dette er villedende, fordi sannheten er pinlig for vitenskap.

Alfred Wegener 1912

Wegener forsket på Grønlands innlandsis mange sommer og døde der midt på vinter 1930, som 50-åring.



FIGURE 3.1 Alfred Wegener, the German meteorologist who proposed a comprehensive model of continental drift and presented geologic evidence in support of the idea.

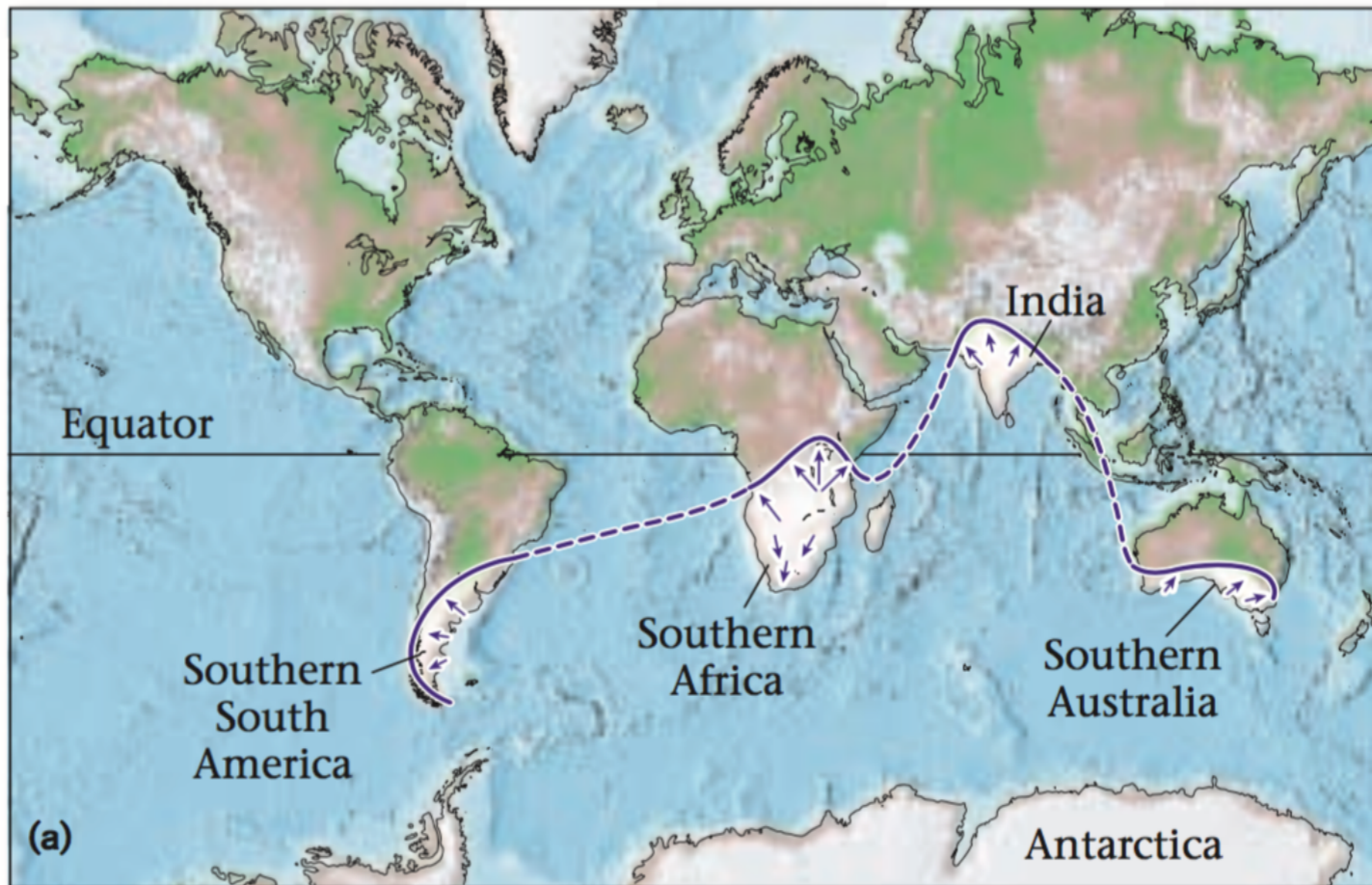


FIGURE 3.1 Alfred Wegener, the German meteorologist who proposed a comprehensive model of continental drift and presented geologic evidence in support of the idea.

Jeg liker ikke særlig dette Wegener-bilde.

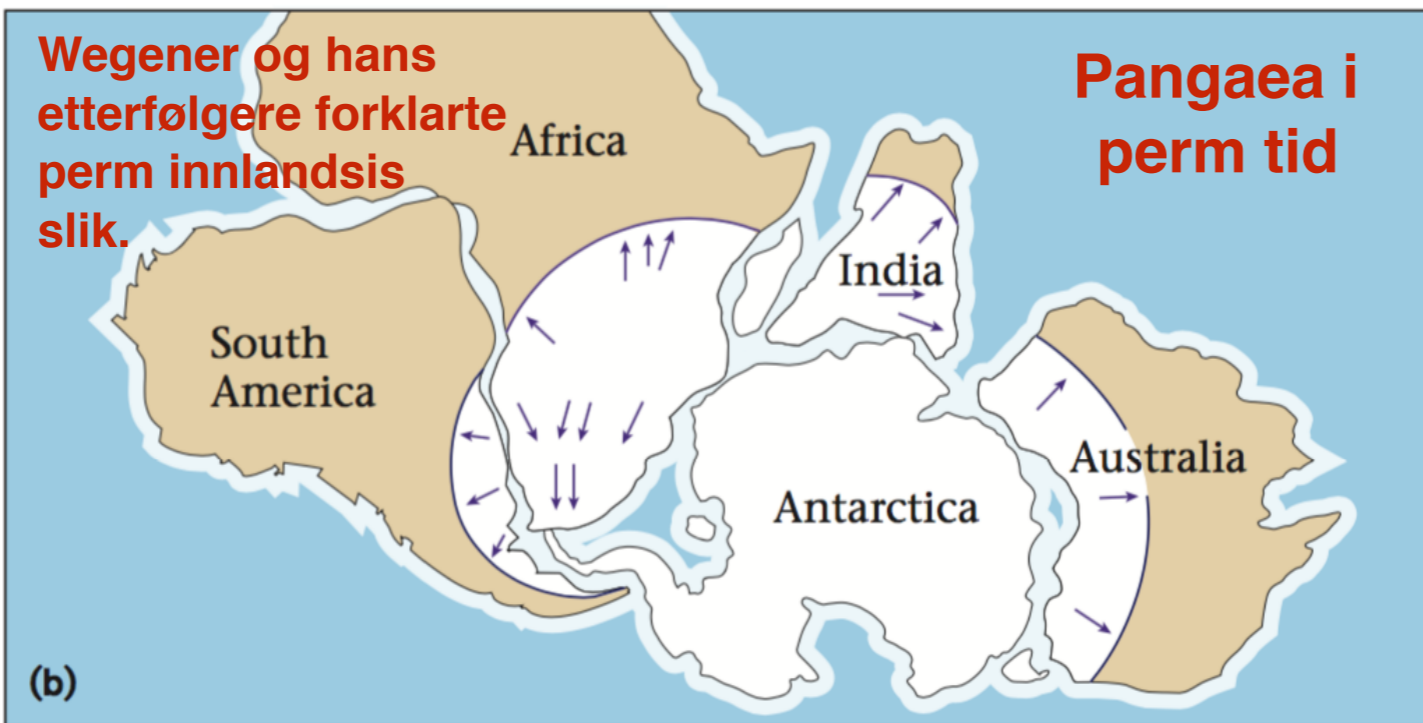


Figure 23. Alfred Wegener and two of his fellow explorers displaying their shoe collection in 1912. From Wegener and Koch (1919).



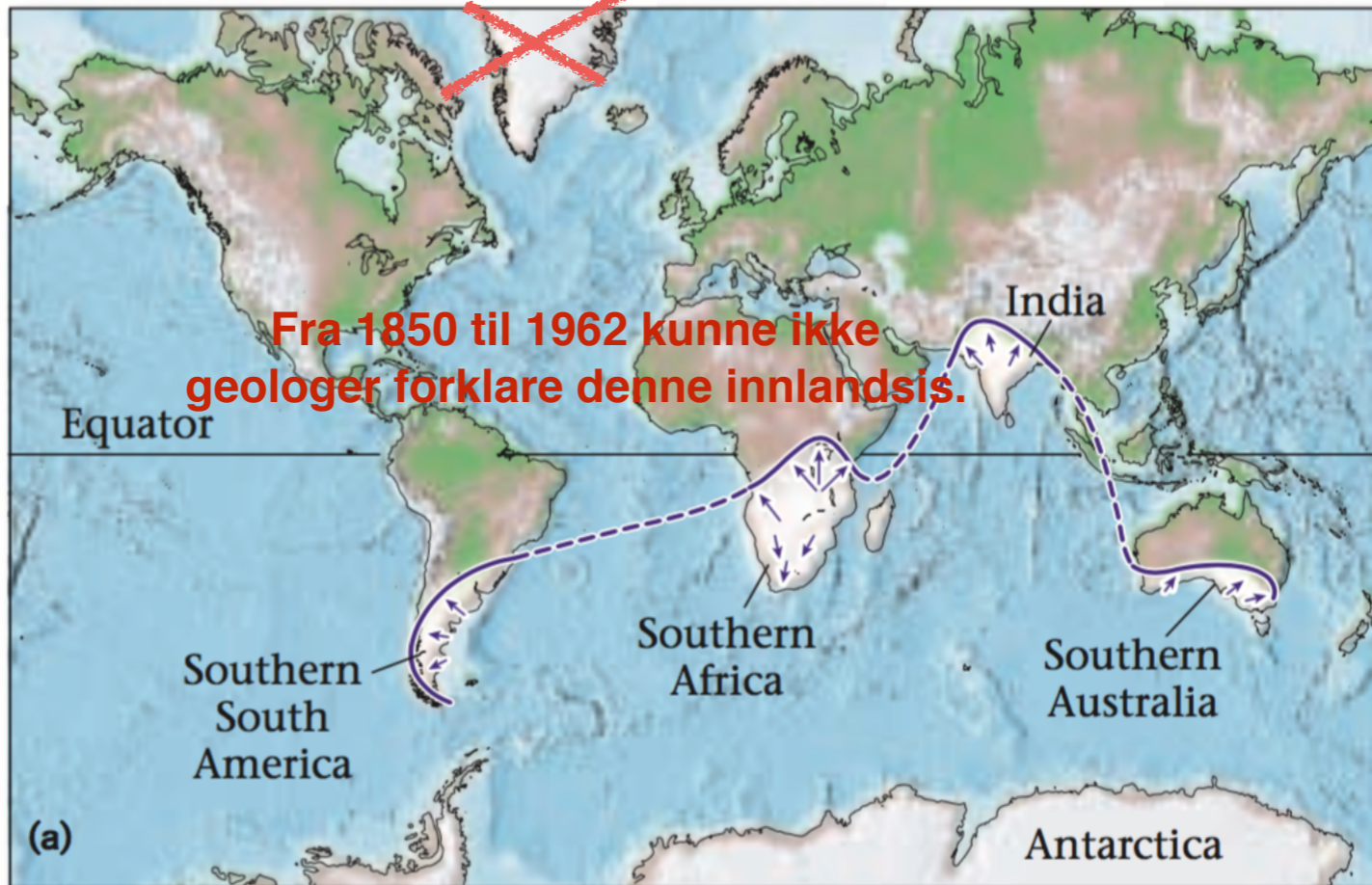
Bevis for at kontinentene hadde beveget seg.

Innlands-isen i perm tid



Pangaea i perm tid

FIGURE 3.3 (a) The distribution of late Paleozoic glacial deposits on a map of the present-day Earth. The arrows indicate the orientation of striations. (b) The distribution of these glacial deposits on a map of the



Bevis for at kontinentene hadde beveget seg.

Innlands-isbreer i perm tid

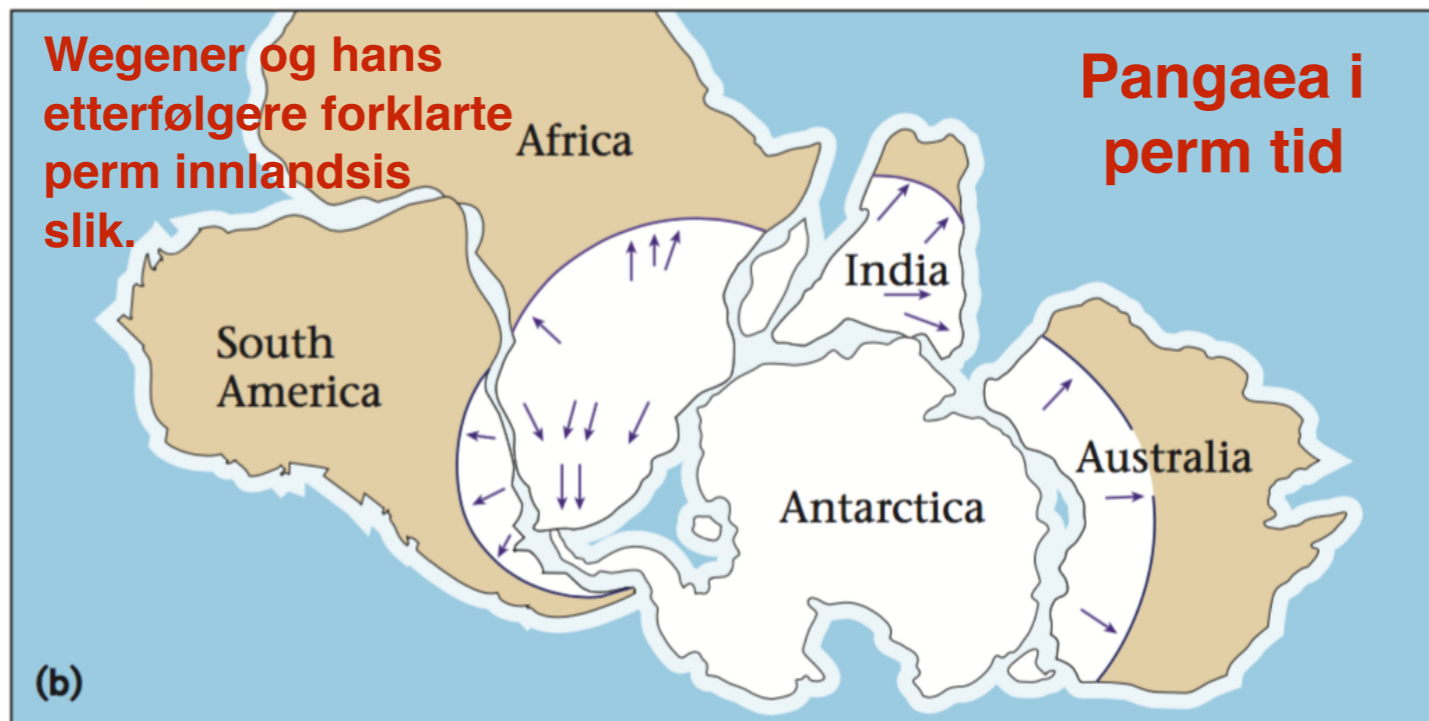
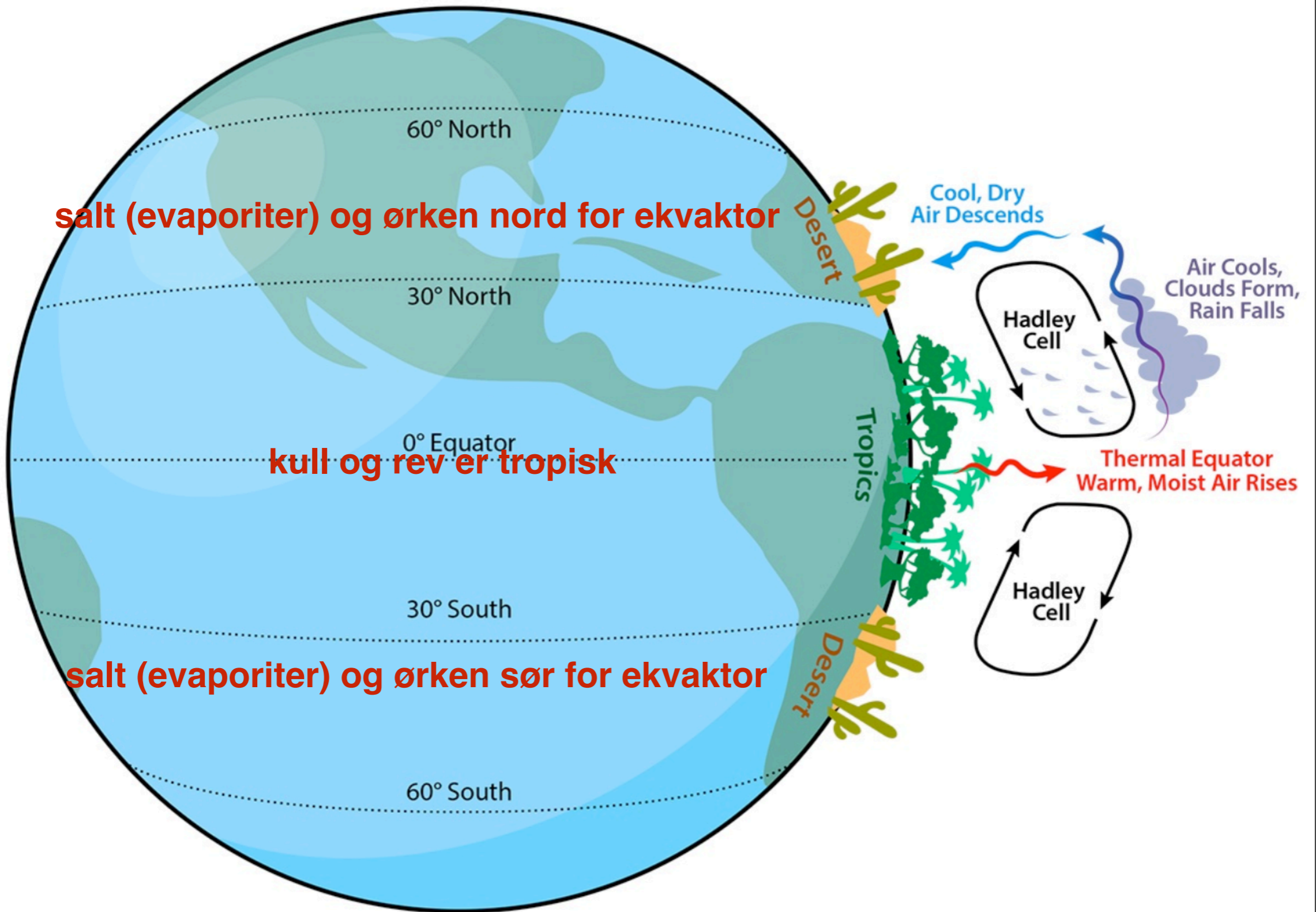


FIGURE 3.3 (a) The distribution of late Paleozoic glacial deposits on a map of the present-day Earth. The arrows indicate the orientation of striations. (b) The distribution of these glacial deposits on a map of the

Litt bakgrunn: Jordkloden i dag har 'klimabelter'.





Perm tid

ingen land langt i nord, derfor ingen isbreeavsetninger



Klima-mysterier kunne også forklares med Pangaea.

FIGURE 3.4 Map of Pangaea, showing the distribution of coal deposits and reefs (indicating tropical environments), and sand-dune deposits and salt deposits (indicating subtropical environments). Note how deposits now on different continents align in distinct belts.

Drifting Continents and Spreading Seas

Perm tid



Geopuzzle

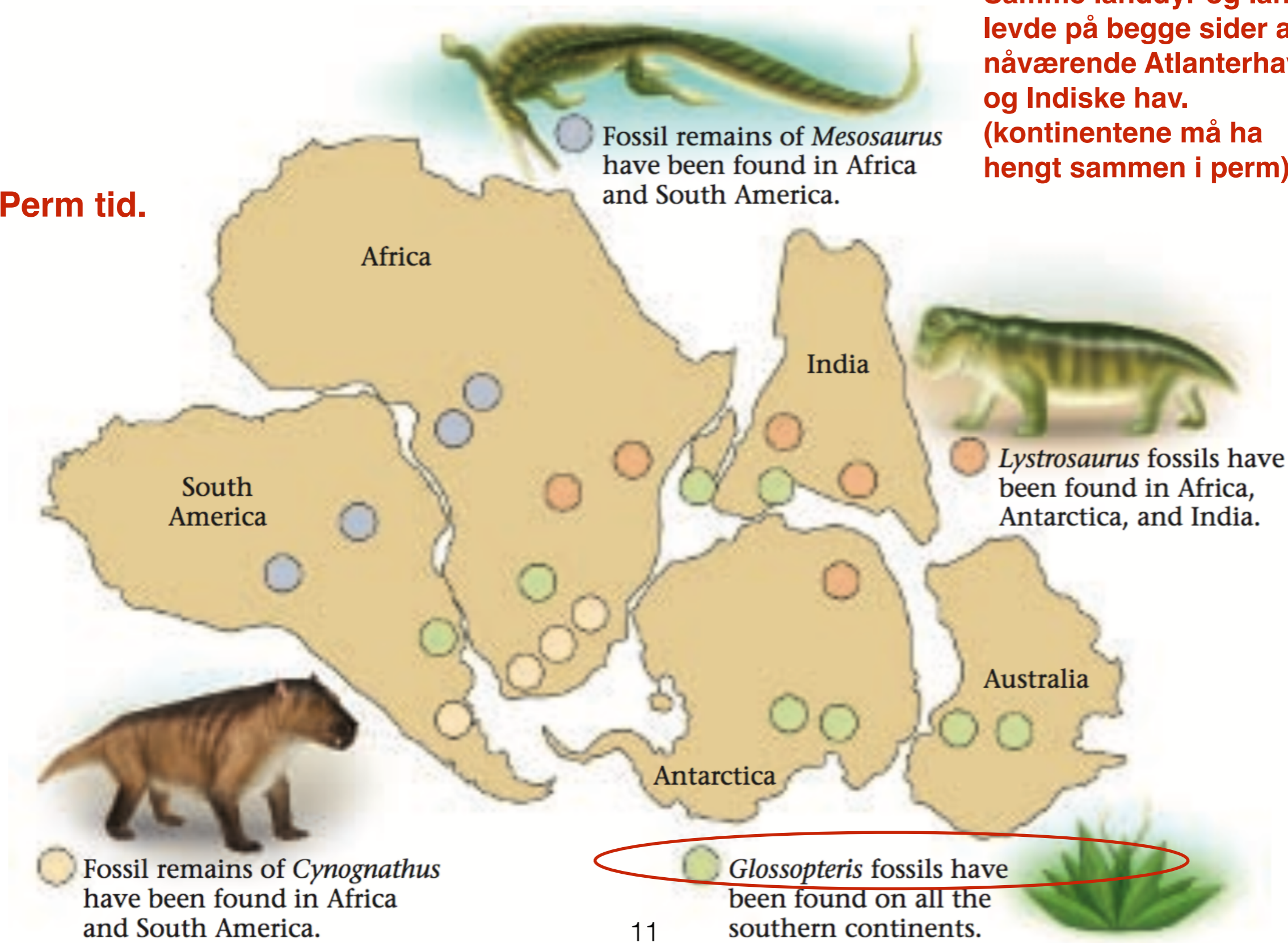
At first glance, it looks like the continents on either side of the Atlantic Ocean could once have fitted together quite nicely, like the pieces of a jigsaw puzzle. Do continents really move? Or, to put it another way, does the map of Earth's surface change over time?

Fossil leaves of *Glossopteris* from an exposure in Australia. The presence of this fossil on many continents was one of the observations that led to the proposal of continental drift.

FIGURE 3.5 This map shows the distribution of terrestrial (land-based) fossil species. Note that creatures such as *Lystrosaurus* could not have swum across the Atlantic to reach Africa. Sample locations are approximate.

Samme landdyr og landplanter levde på begge sider av nåværende Atlanterhav og Indiske hav. (kontinentene må ha hengt sammen i perm)

Perm tid.



Sammenhengende bergarter finnes på to sider av Atlanterhavet

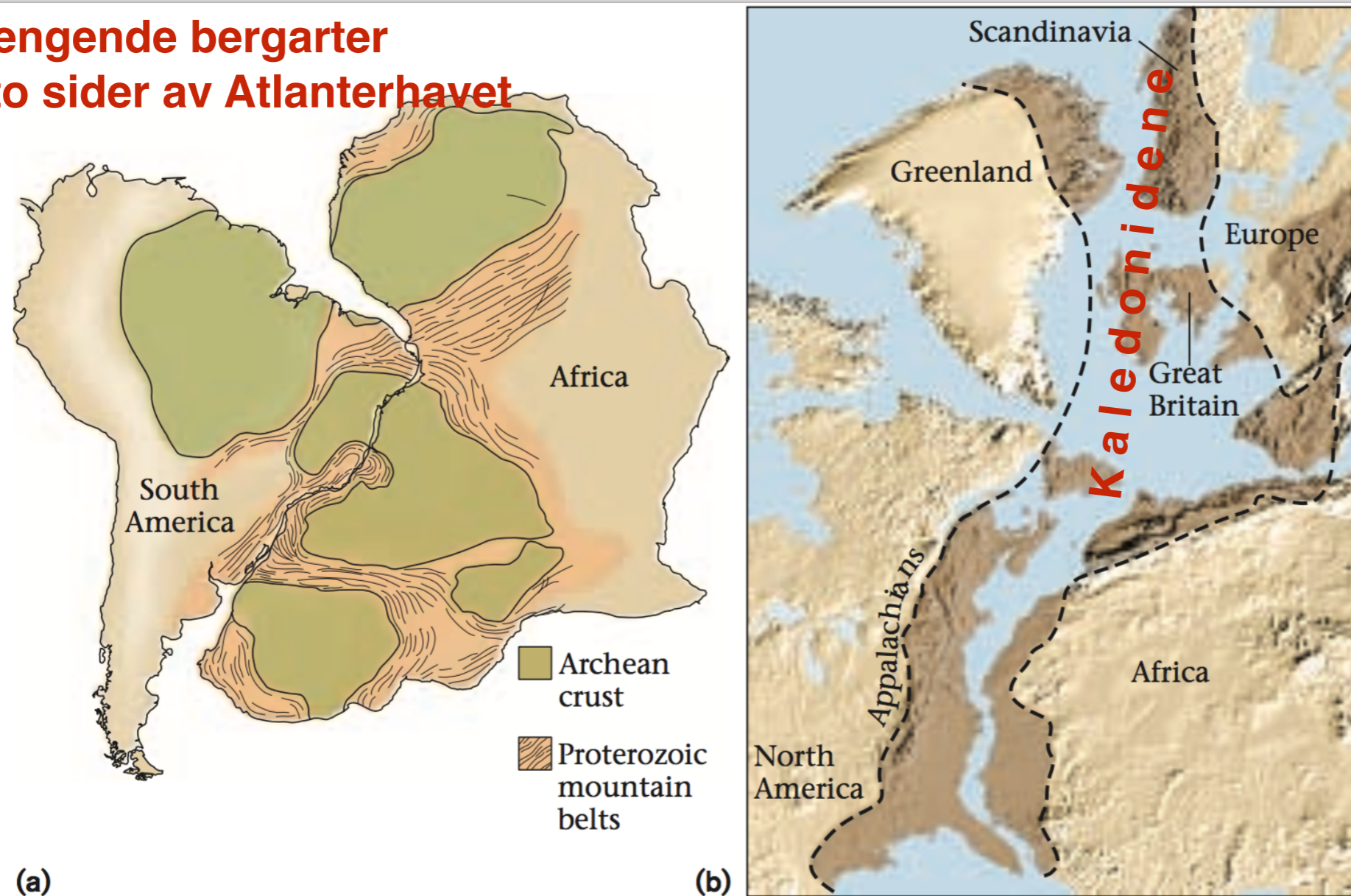


FIGURE 3.6 (a) Distinctive areas of rock assemblages on South America link with those on Africa, as if they were once connected and later broke apart. “Archean” is the older part of the Precambrian, and “Proterozoic” is the younger part. (b) If the continents are returned to their positions in Pangaea by closing the Atlantic, mountain belts (shown in brown) of the Appalachians lie adjacent to similar-age mountain belts in Greenland, Great Britain, Scandinavia, and Africa.

Wegener formulerte det slik (min oversettelse fra hans tysk):

**“Kontinenter ser ut som biter av en opprevet avis:
Ikke bare passer bitene sammen, men man kan også lese tekst
fra en bit til en annen.”**

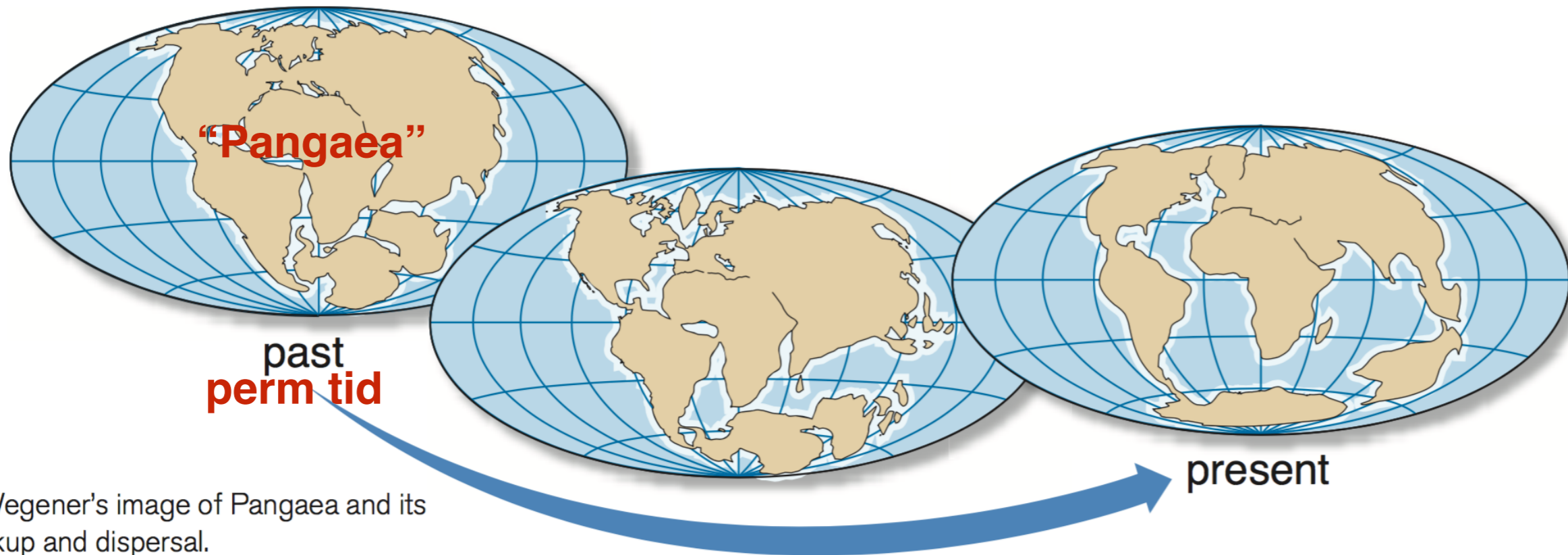


FIGURE 3.2 Wegener's image of Pangaea and its subsequent breakup and dispersal.

“Pan” betyr ‘alle’ (som i *pan-demi*)

Pan-gaea betyr “all-geo”

(men Wegener faktisk ikke brukte det ordet selv...)

Wegeners *continental drift* var i stor grad riktig, og i 1965 ble det bekreftet med paleomagnetisme (magnetiske anomalier) og ble til '*plate-tektonikk*'.

Nytt navn fordi Wegeners *continental drift* hadde blitt latterliggjort av geologer fra 1912 til 1962.

**Når jeg leste om denne historien i lærebøker,
tvilte jeg på de vanlige forklaringer.**

**Jeg mente at denne fornektelsen var en skandale.
Ved skandaler er det ofte en “cover-up.”**

***Resten av denne forelesning
er min forskning,
og er IKKE pensum.***

Jeg forsket på dette og fant betydelig “cover-up.”

IKKE PENSUM

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Not Getting the Drift

A Hard Look at the Early History of Plate-Tectonic Ideas

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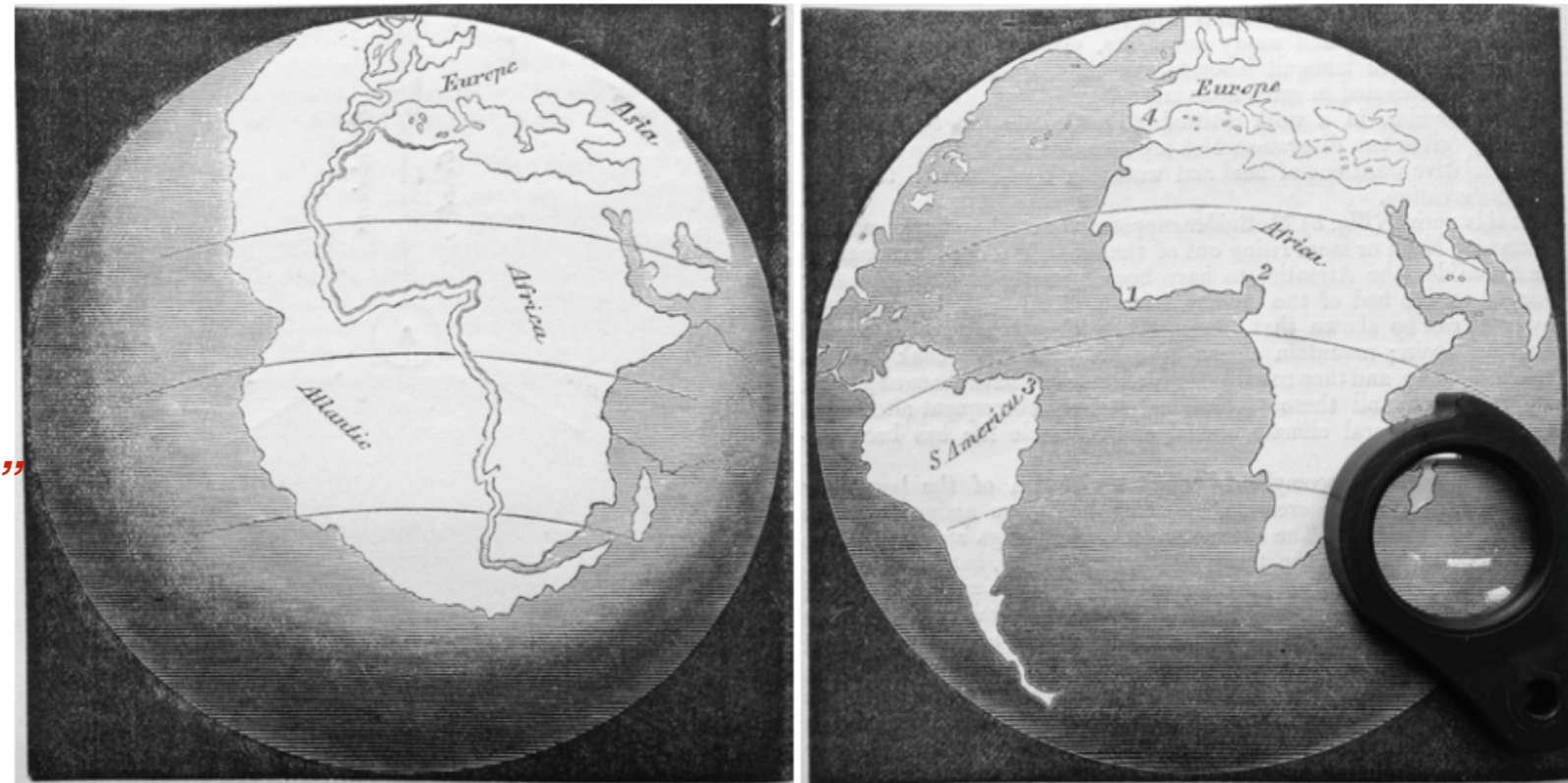
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et eksempel av "catch and kill"

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Allan Krill

Professor of Geology, NTNU, Norway



Pepper's continental-drift hypothesis in 1861.
No one got it. History forgot it.

**IKKE
PENSUM**

A fully documented revisionist history that finally explains why Alfred Wegener's hypothesis of continental drift was rejected for so long.

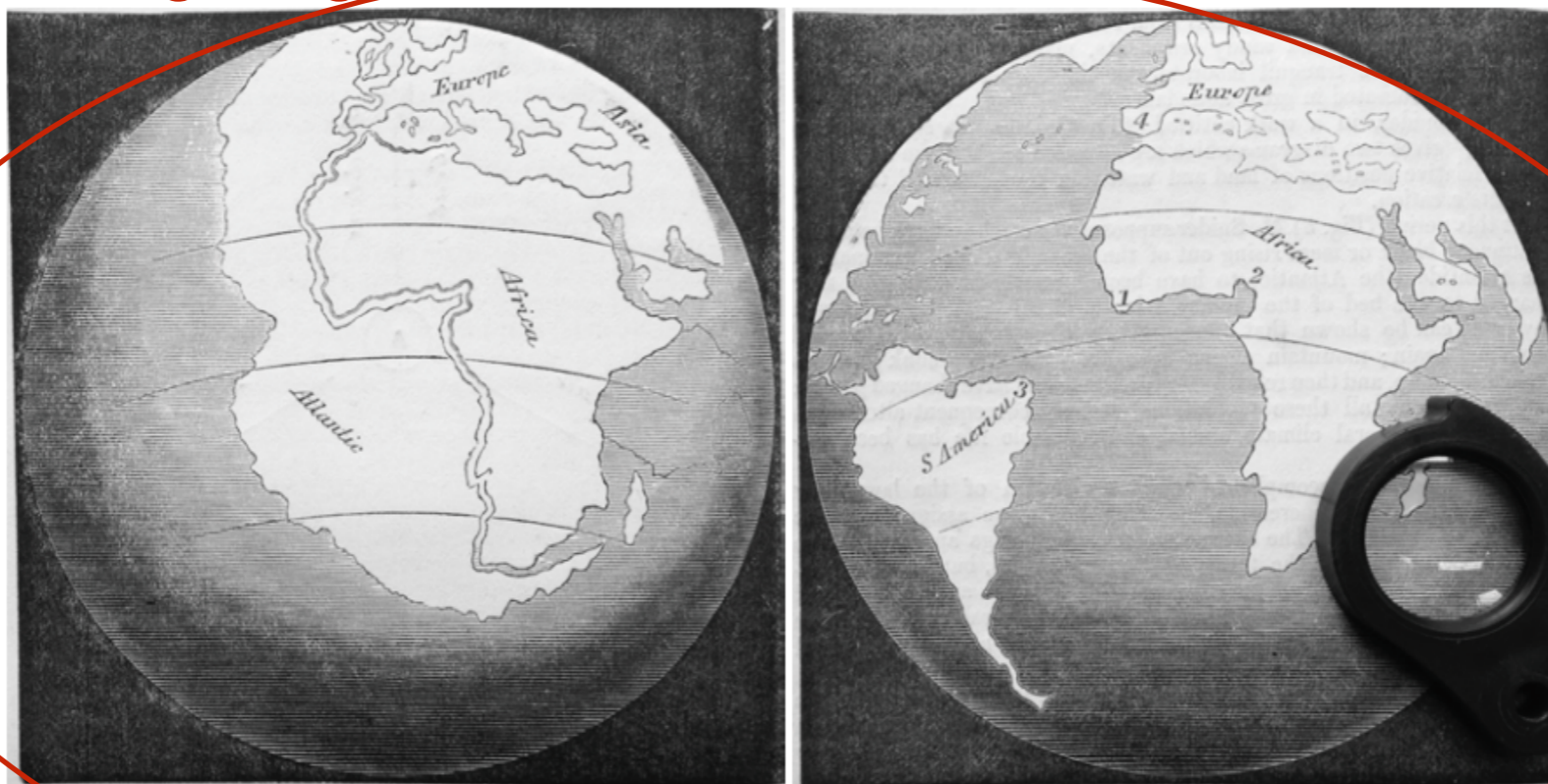
Not Getting the Drift

A Hard Look at the Early History of Plate-Tectonic Ideas

Allan Krill

Jeg fant en 1861 driftmodell. *Professor of Geology, NTNU, Norway*

Fullstendig ukjent for geologer.



Pepper's continental-drift hypothesis in 1861.

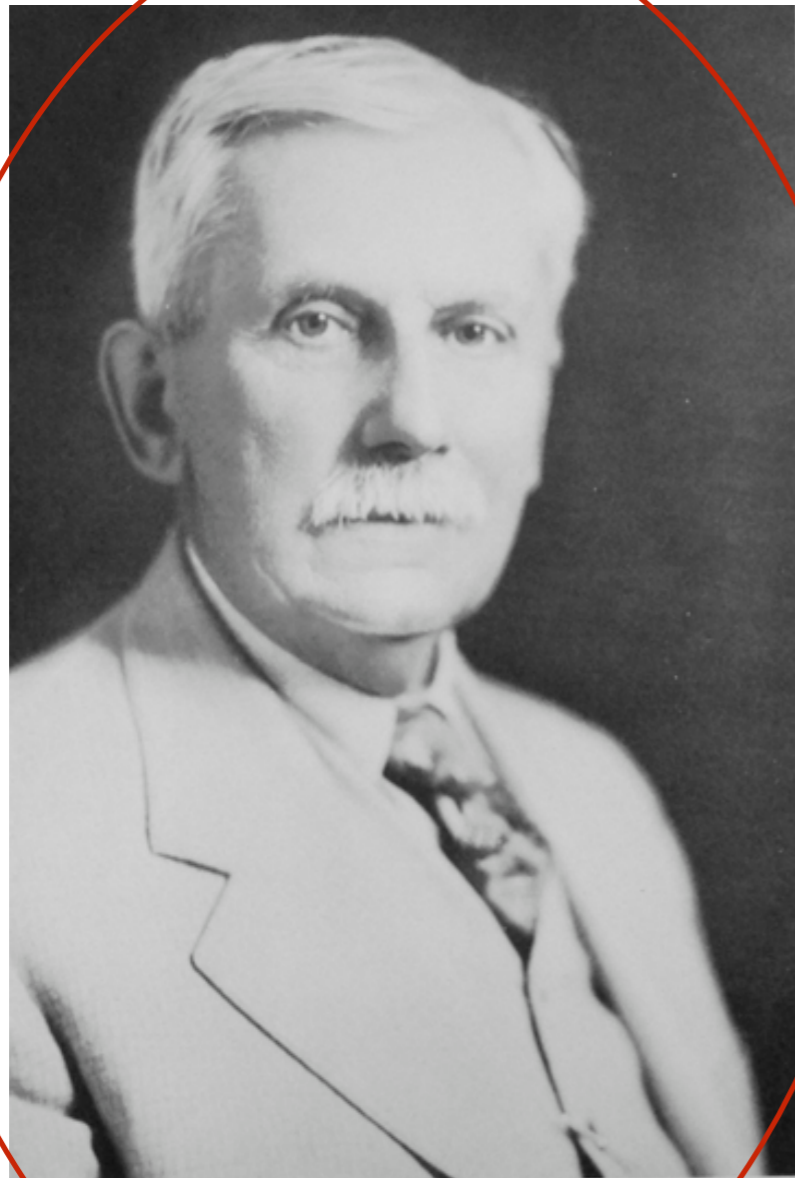
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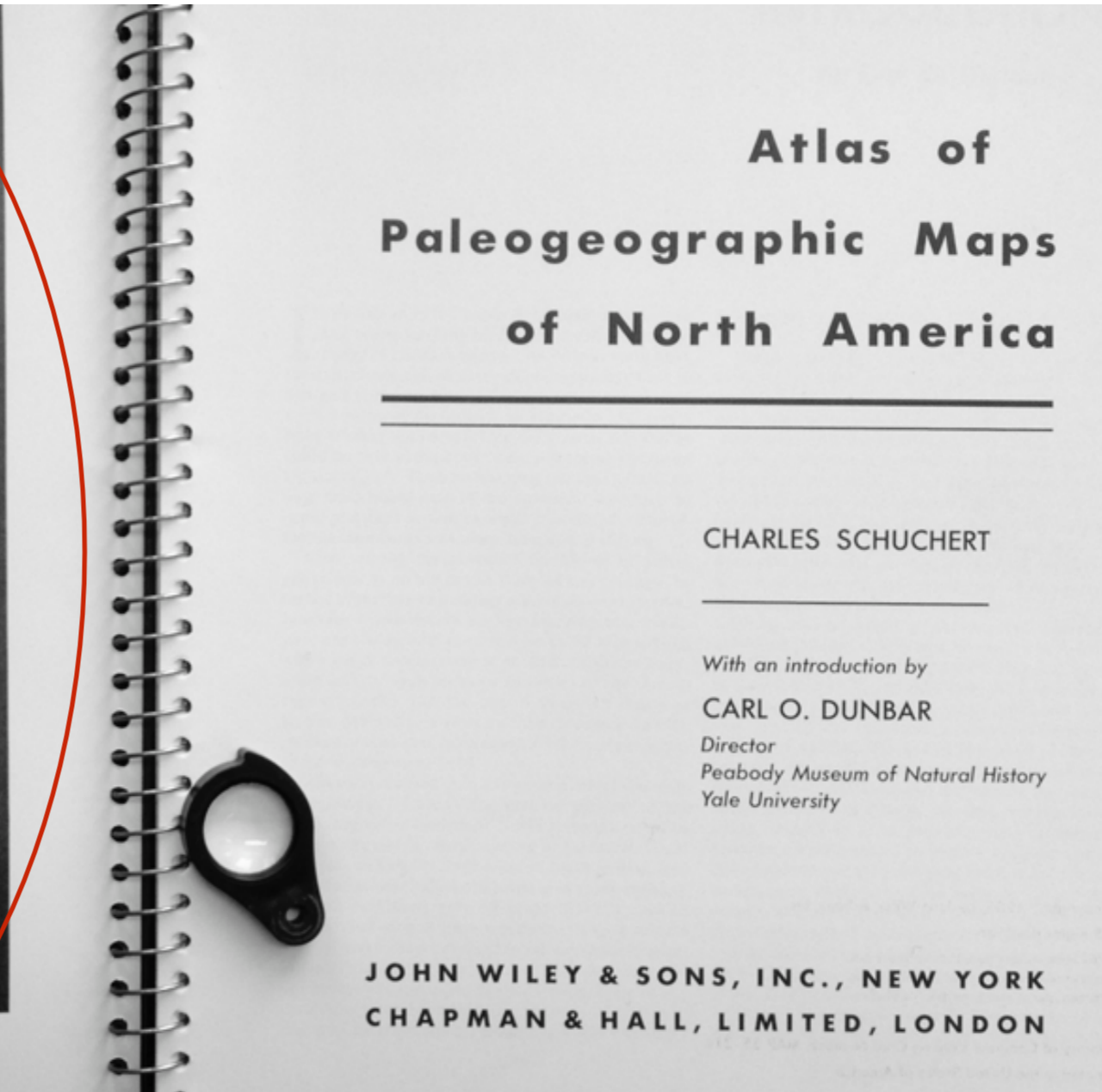
**IKKE
PENSUM**

Her er skandalen og cover-up:

En av verdens ledende geologer, Charles Schuchert var Yale professor fra 1904-1942. Han var president i GSA, og redaktør i American Journal of Science. Jeg oppdaget at han ledet kampanjen mot Alfred Wegener, selv om han forsto at Wegener og kontinental drift var i stor grad riktig.



CHARLES SCHUCHERT, 1858-1942
"Foremost paleogeographer of our time"



Schuchert var verdens fremste lærebokforfatter i geologi og fossiler, og Wegeners model ville ødelegge hans kjære modeller.

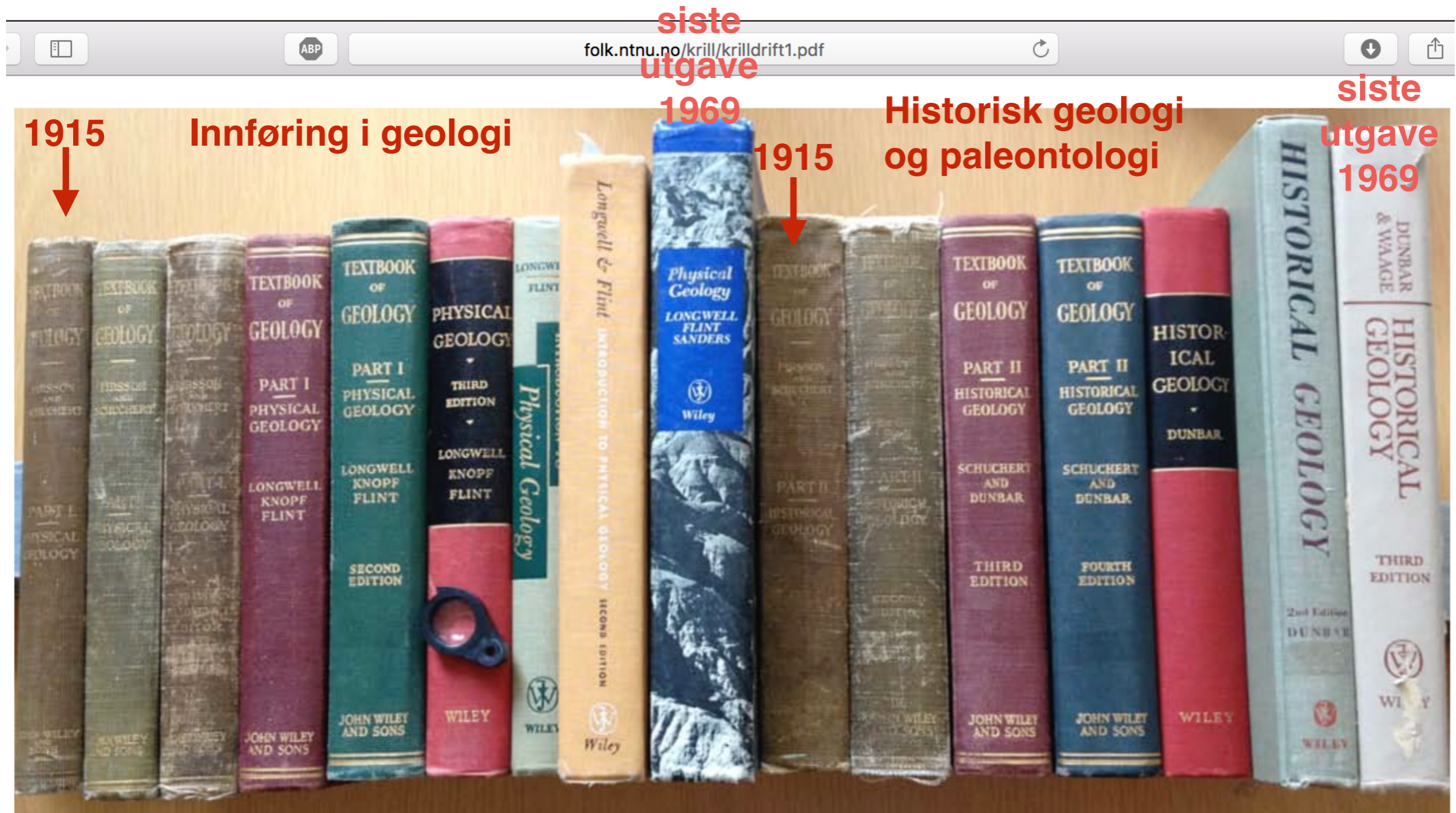
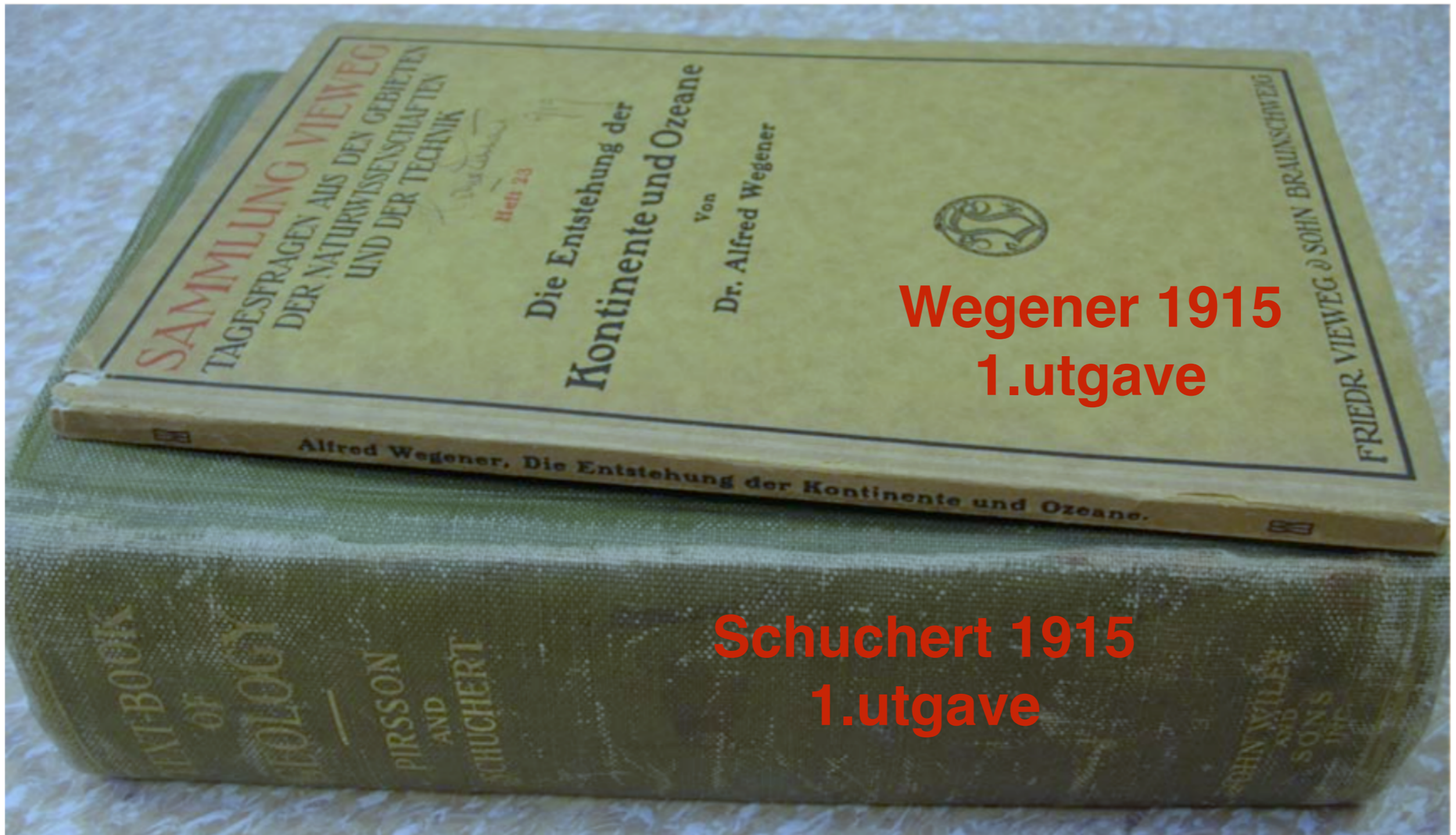


Figure 91. Schuchert's family of geology textbooks. Revised editions of *Physical Geology* (left) and *Historical Geology* (right).



**Wegener 1915
1.utgave**

**Schuchert 1915
1.utgave**

Two opposing -isms: fixism and mobilism; not yet named, but irrevocably set in print in 1915. Pirsson & Schuchert's *Textbook of Geology*, and Wegener's *Die Entstehung der Kontenente und Ozeane*.

Kontinentene hang sammen.

På den måten kunne dyr og planter migrere til flere kontinenter.

Den gamle teorien, som Schuchert brukte:
“landbruer” over Atlanterhavet.

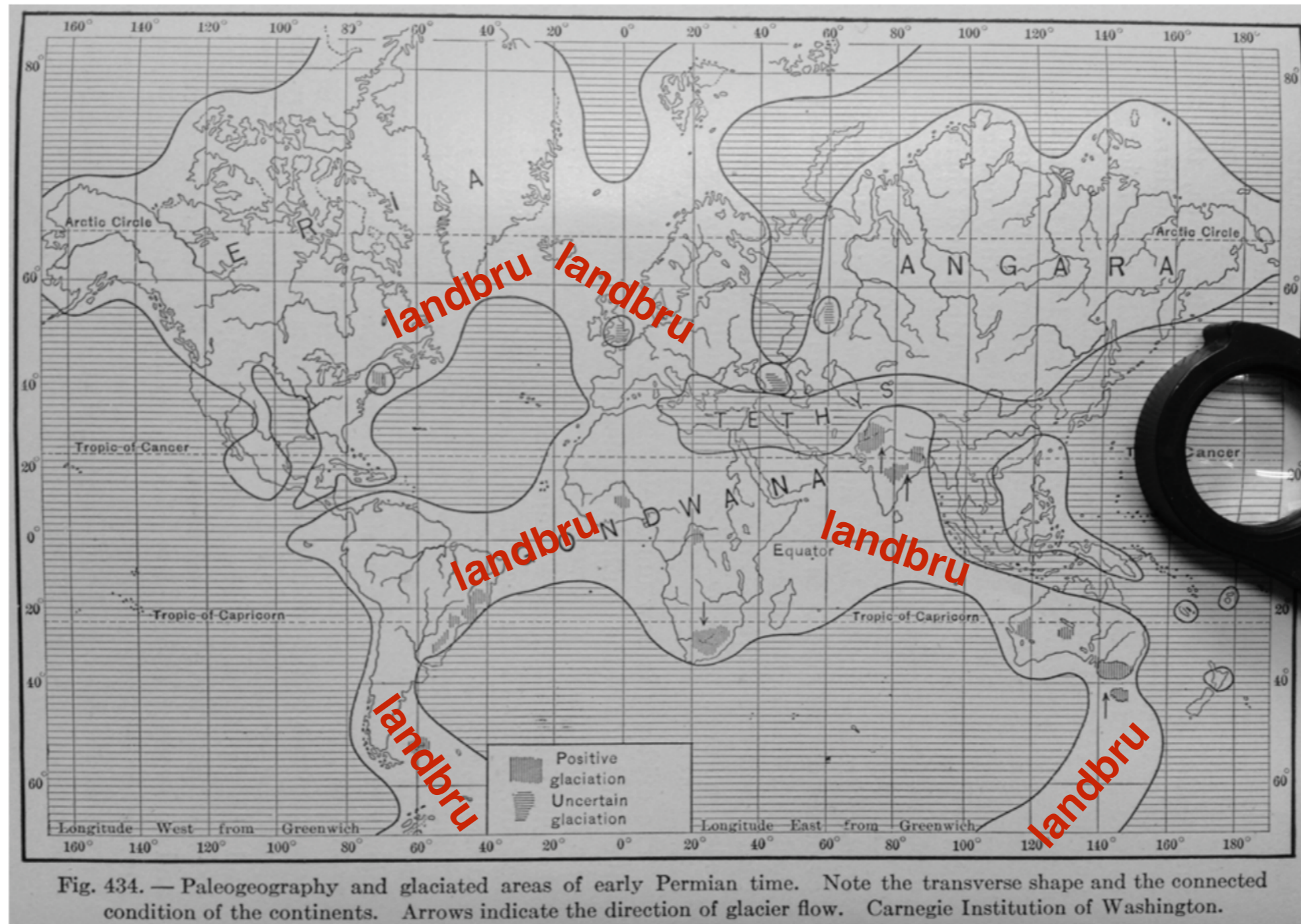
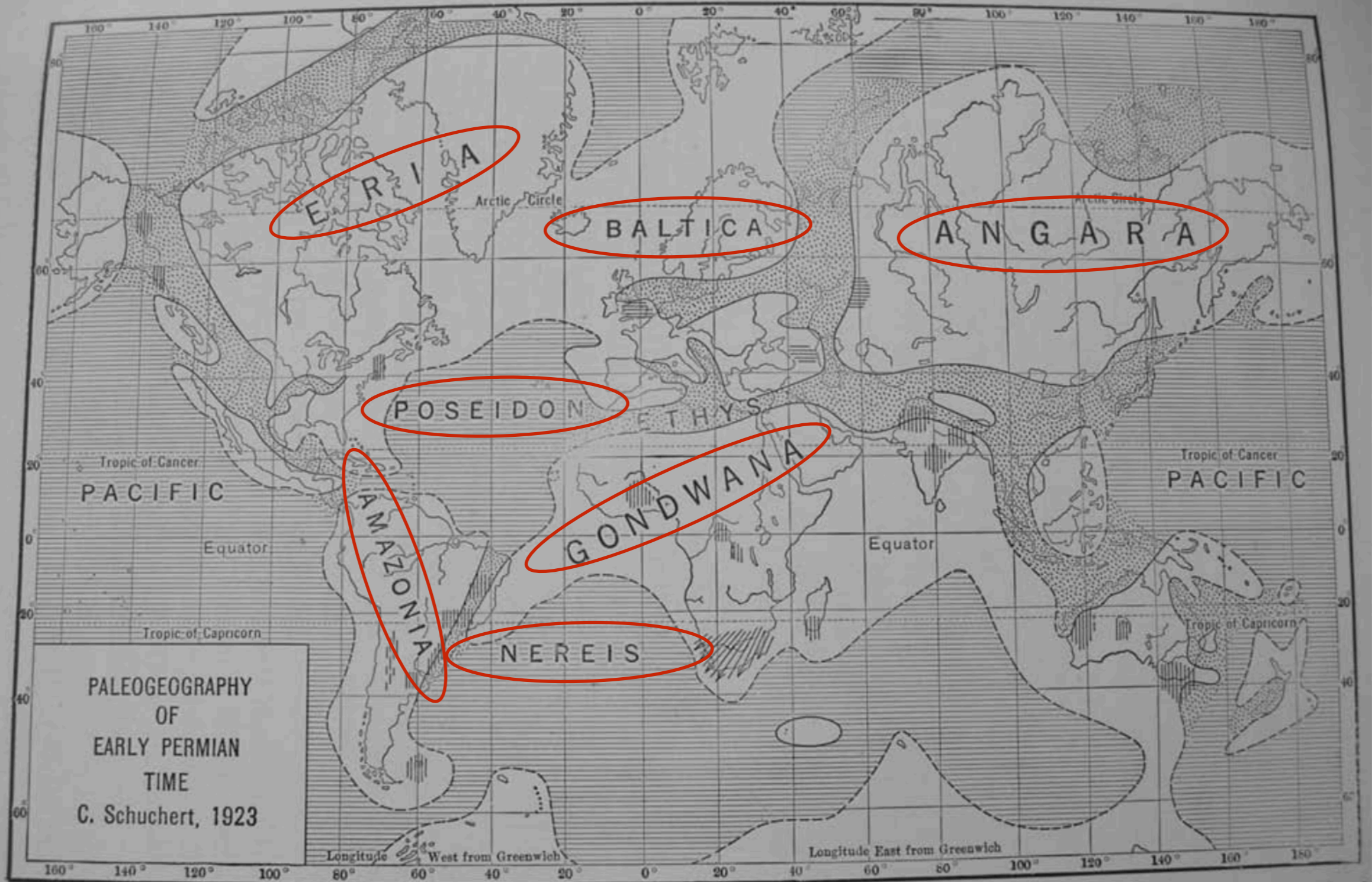


Figure 22. Schuchert's Fig. 434. In Permian time the continents were continuous, where today we have the Atlantic and Indian Oceans. In the present coastlines, Schuchert noted "the geologic appearance of broken-down eastern and western margins." From Schuchert (1915).

IKKE PENSUM

Disse paleo-geografiske navn var Schucherts 'hjertebarn' og Wegeners modell ville drepe dem.



145. — Paleogeography and areas of known glaciation of early Permian time. Oceans are ruled, epeiric seas dotted, and places of glaciation lined (vertical lines, areas of proved glaciation; horizontal lines, of uncertain glaciation). Note the transverse shape and connected condition of the continents of this time.

Schuchert's map dated 1923. Arrows from Schuchert's 1915 map showing ice flow directions in Australia and India have here been removed. From Schuchert (1924).

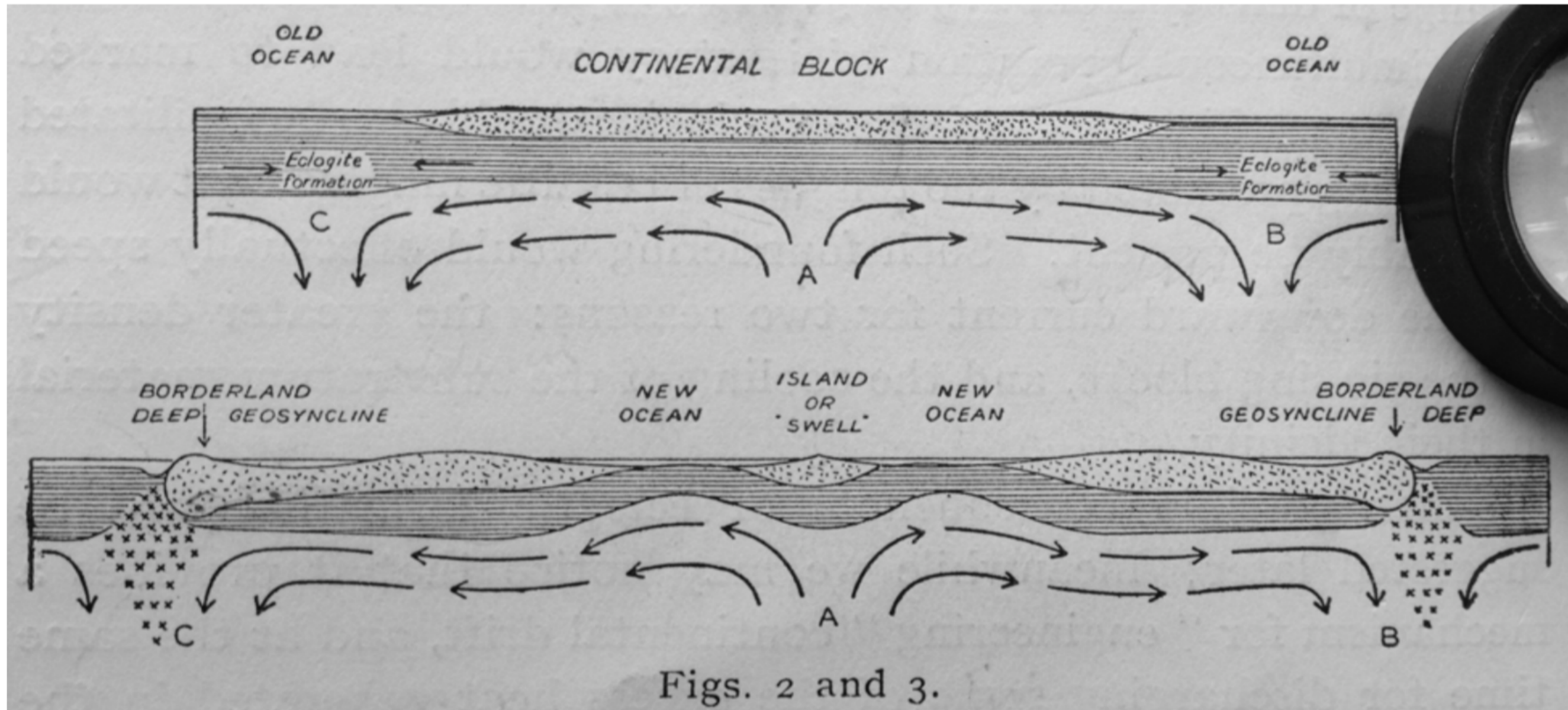


Figure 51. Holmes' illustration of convection currents in the mantle. From Holmes (1931).

Allerede i 1927 forsto geolog Arthur Holmes konveksjonsmekanismen som drev "kontinentaldrift".

Schuchert var redaktør av *American Journal of Science*, verdens ledende geologisk tidsskrift.

Han refuserte Holmes manuskript i 1927.

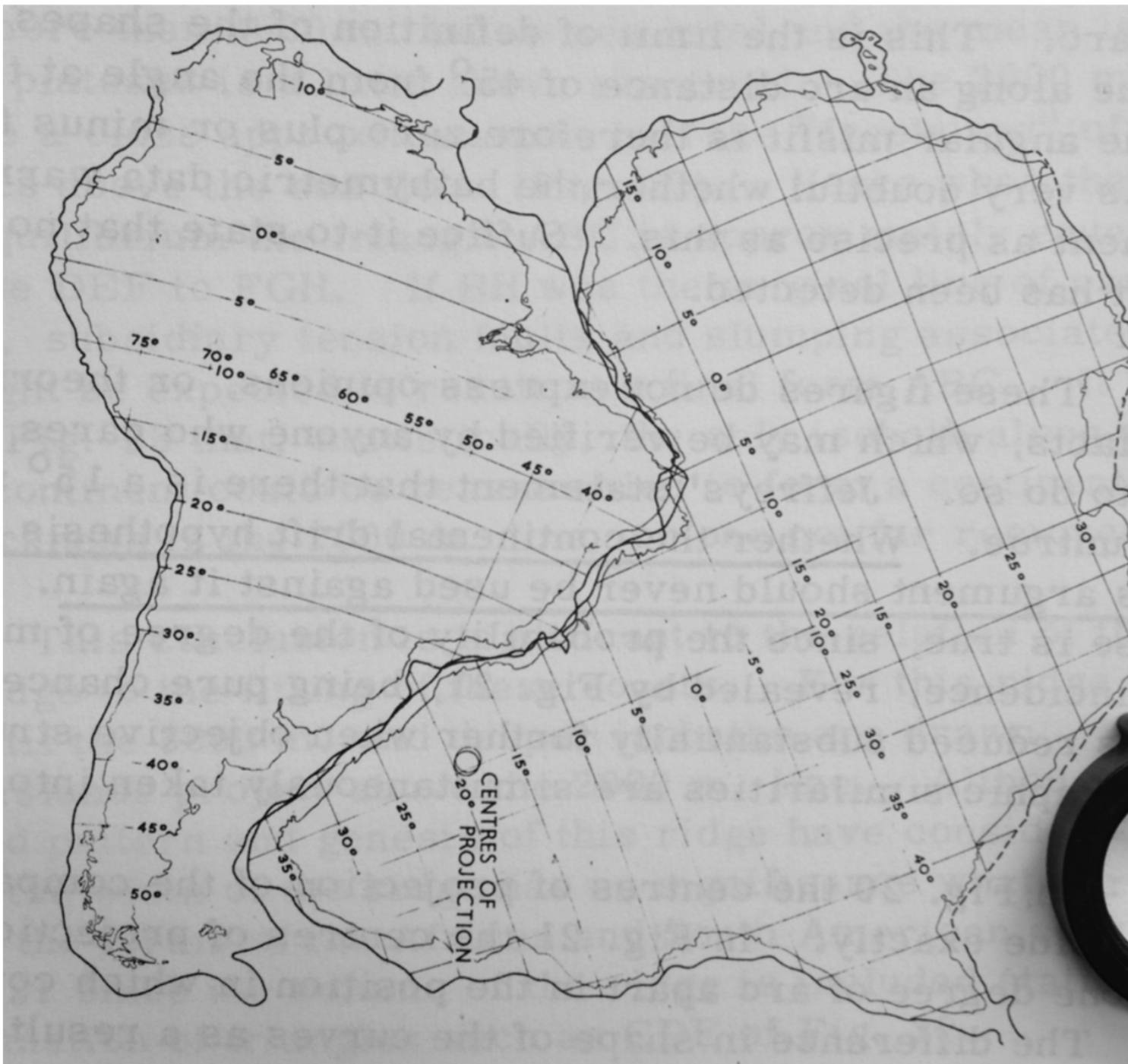


Figure 86. The Carey-refute, contesting a claim by Jeffreys that South America and Africa do not really fit. This map shows they fit quite well, and best at the 2000-meter isobath. From Carey 1958.

I 1958 at kontinentene passet perfekt,

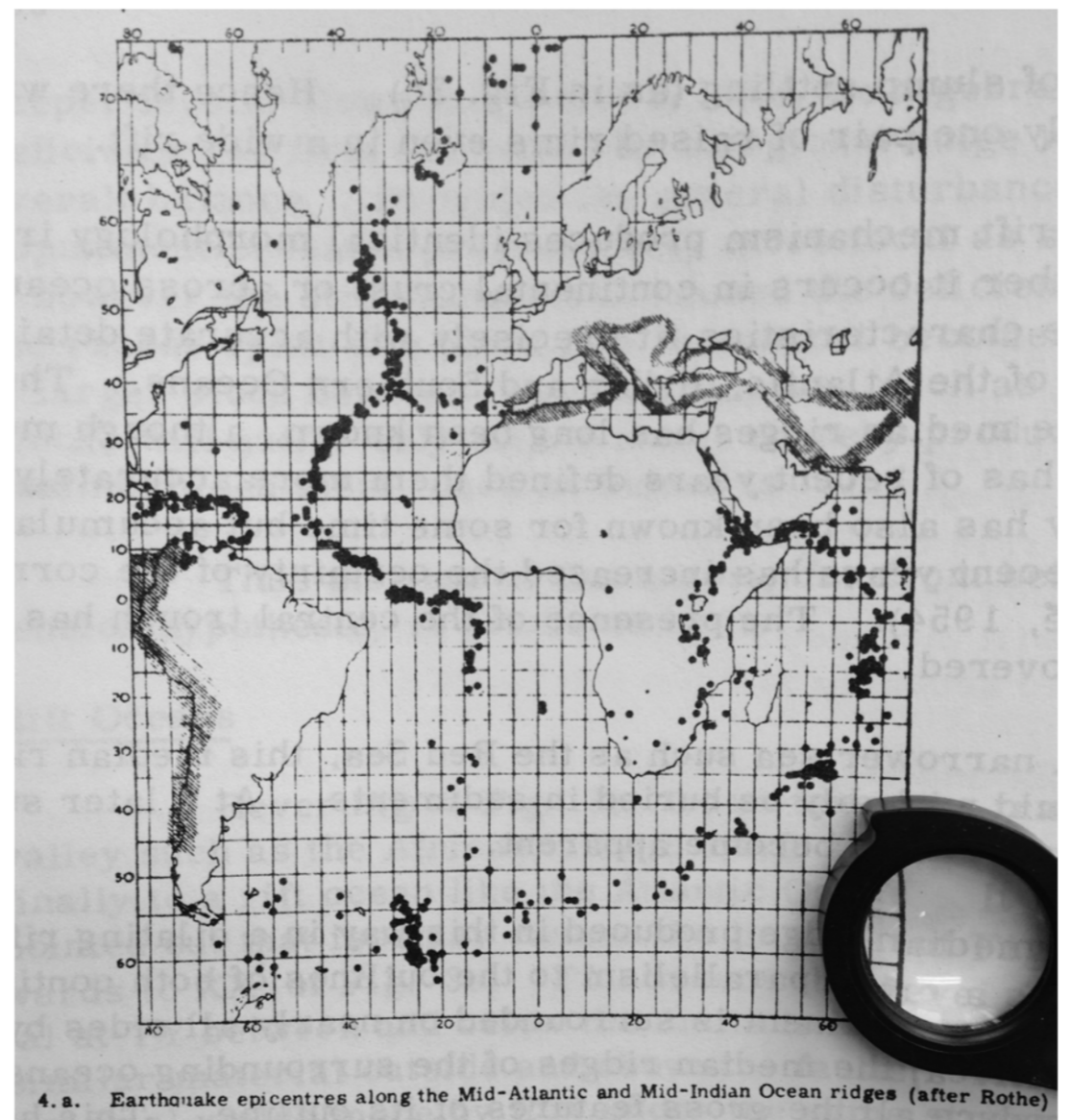


Figure 88. Modern earthquake data from Rothé, presented at the symposium on continental drift and published by Carey (1958.) The accurately located earthquakes clearly show the mid-ocean ridges in the Atlantic and Indian Oceans. From Carey (1958).

og at det var jordskjelv ved alle midt-havs ryggene.

1962 lærebok brukte gammel data (1899-1930) for å skjule mønster av jordskjelv episentre

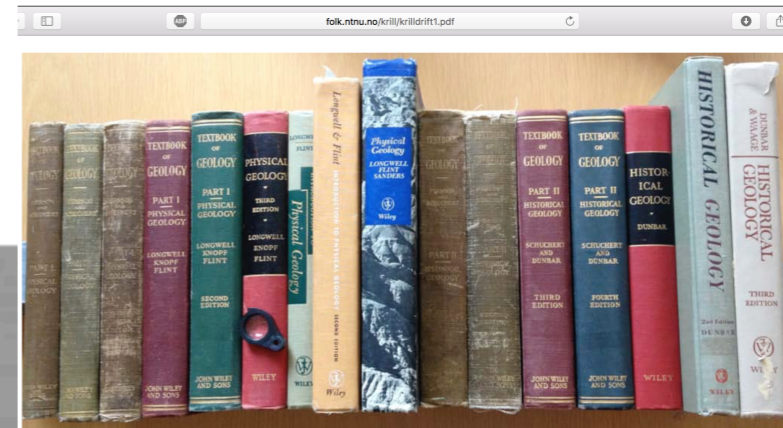
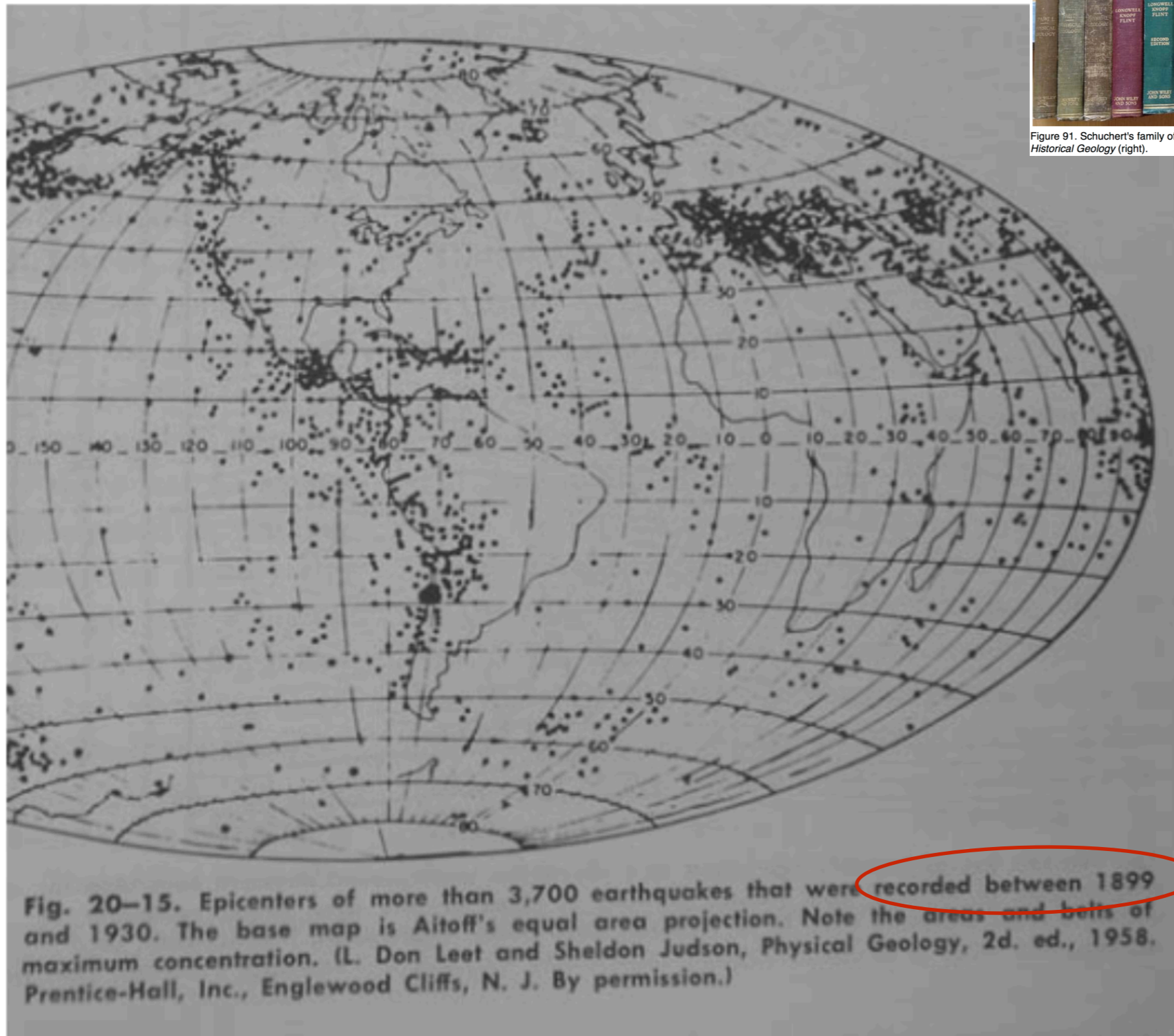


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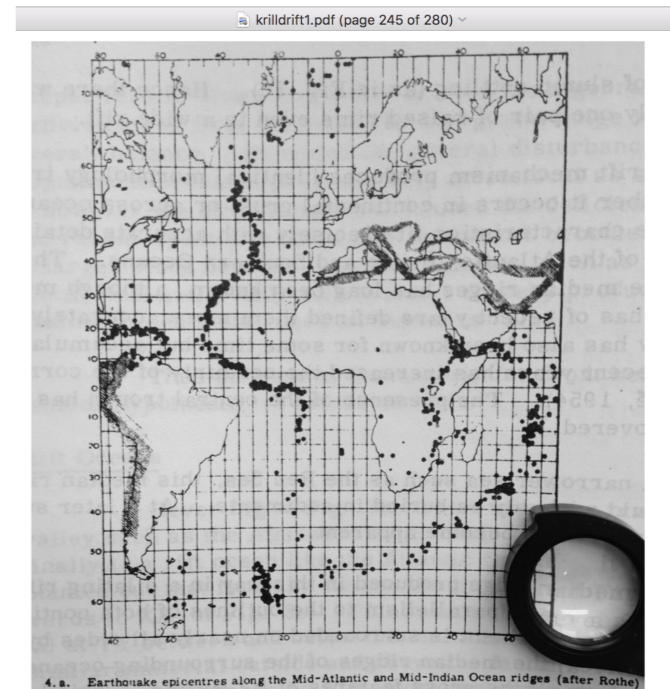


Figure 88. Modern earthquake data from Roth, presented at the symposium on continental drift and published by Carey (1958.) The accurately located earthquakes clearly show the mid-ocean ridges in the Atlantic and Indian Oceans. From Carey (1958).

**Endelig i ca. 1965 kom revolusjonen i geologi.
Ble kalt “Plate Tectonics”
(for å unngå å bruke latterliggjort navn “Continental Drift)**

Nå kunne man forstå:

Paleoklima (innlandsis og ørken i perm tid)

Dannelse av fjellkjeder (begge sider av Atlanterhavet, og ellers)

Årsaken til vulkaner og jordskjelv

Årsaken til midthavsryggene

Paleogeografi av fossiler

(og mye mer som ikke kunne forståes uten continental drift)

Siden 1863 hadde amerikanske geologer ment at North America var verdens beste 'modell' for et kontinent.

40



Denne status ble ødelagt med continental drift.

Nå var North America bare var en del av Pangaea i tidligere geologiske tider.

Figure 17. Dana's map of North America in Azoic (Precambrian) time. The white areas are Precambrian, and follow the general pattern of the Atlantic and Pacific coasts. From Dana (1863a).

IS THERE *REALLY* A NORTH AMERICAN PLATE



Allan Krill, Dept. of Geology, Norwegian University
of Science & Technology (NTNU), Trondheim, Norway

?

**American geologists finally yielded to
Alfred Wegener's continental drift in the 1960s.**

North America lost its status as the "type continent"
It was just another drifted fragment of Pangæa.

**But North American geologists
still managed to get their own plate.**

Geologists do not question this misinterpretation,
just as earlier geologists did not question fixism.

***Resten av denne forelesningen
går gjennom min poster.
Lenken til den her:***

Early plate-tectonic maps showed a single American Plate

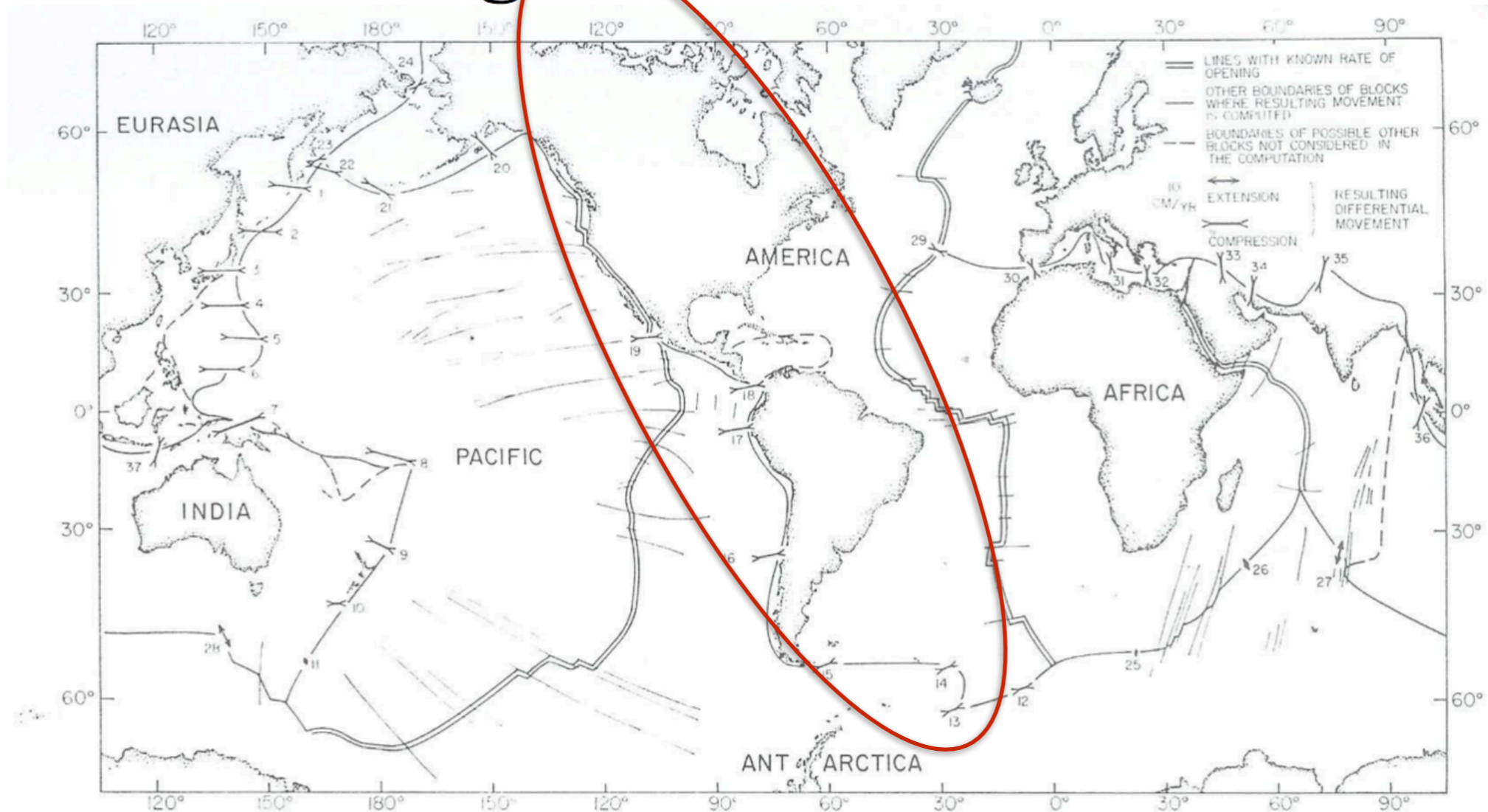


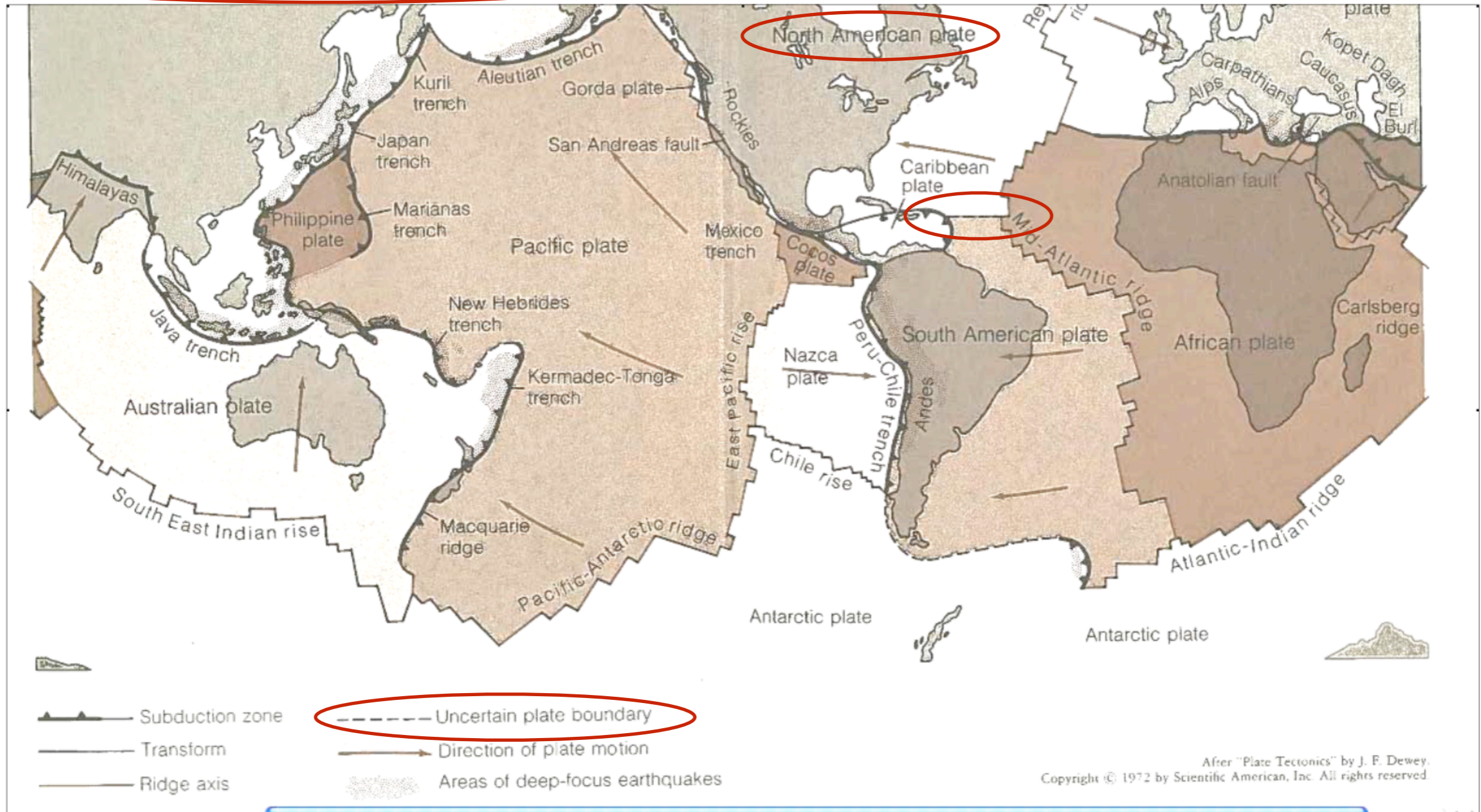
Fig. 6. The locations of the boundaries of the six blocks used in the computations. The numbers next to the vectors of differential movement refer to Table 5. Note that the boundaries where the rate of shortening or slippage exceeds about 2 cm/yr account for most of the world earthquake activity.

Le Pichon (1968).

Først publisert platetektonisk kart (i 1968) viste “American Plate”
å inkludere både North America og South America.

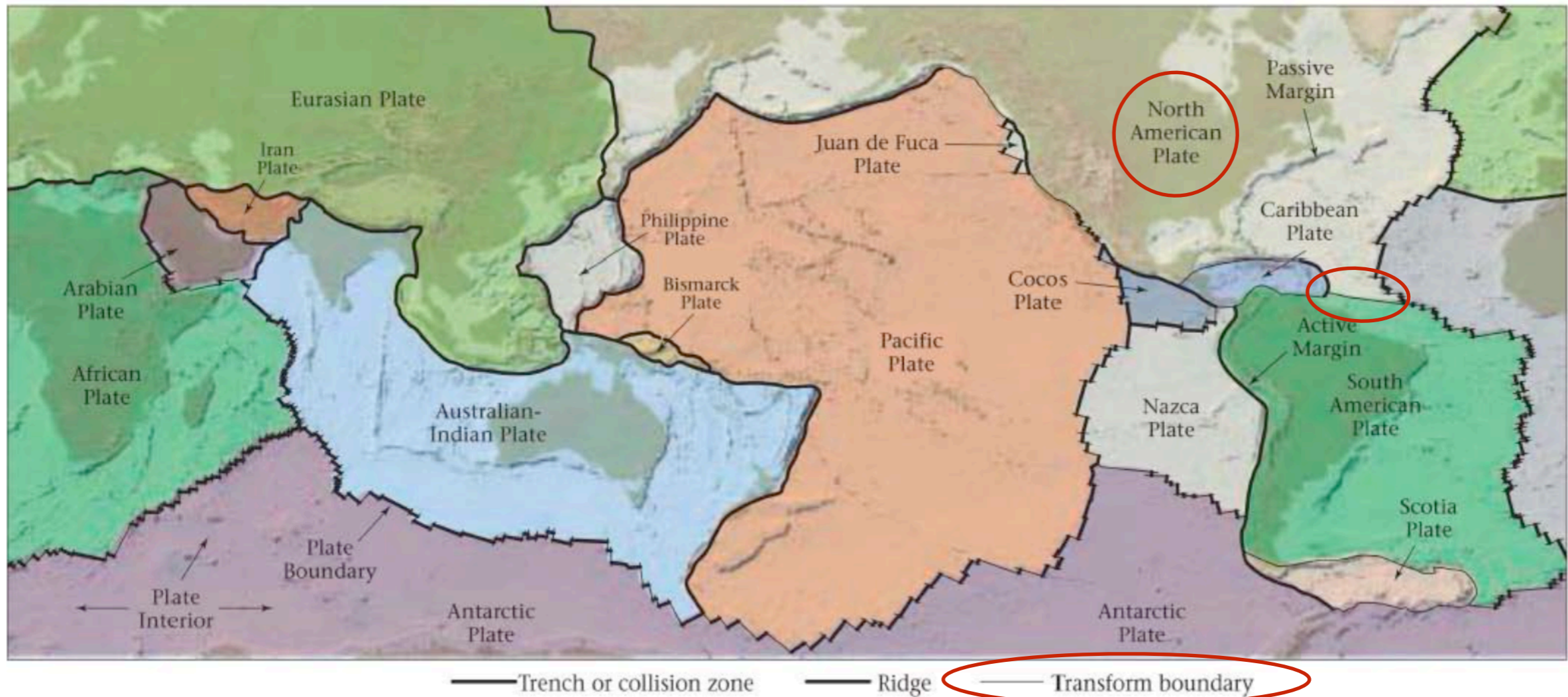
The leading textbook in 1974 indicated a

North American Plate on the inside front cover



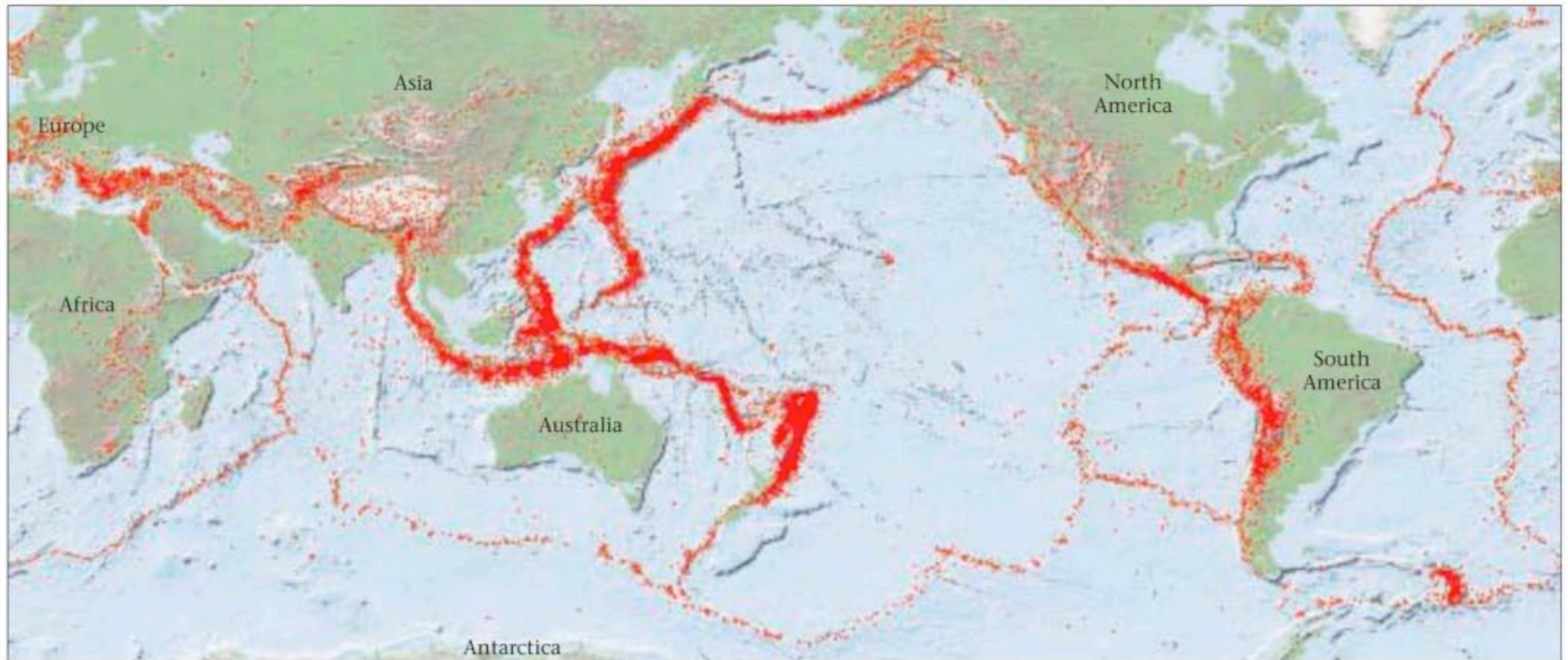
Press & Siever (1974) *Earth*

Modern textbooks invent a "transform boundary" to divide what I call the Two-American Plate



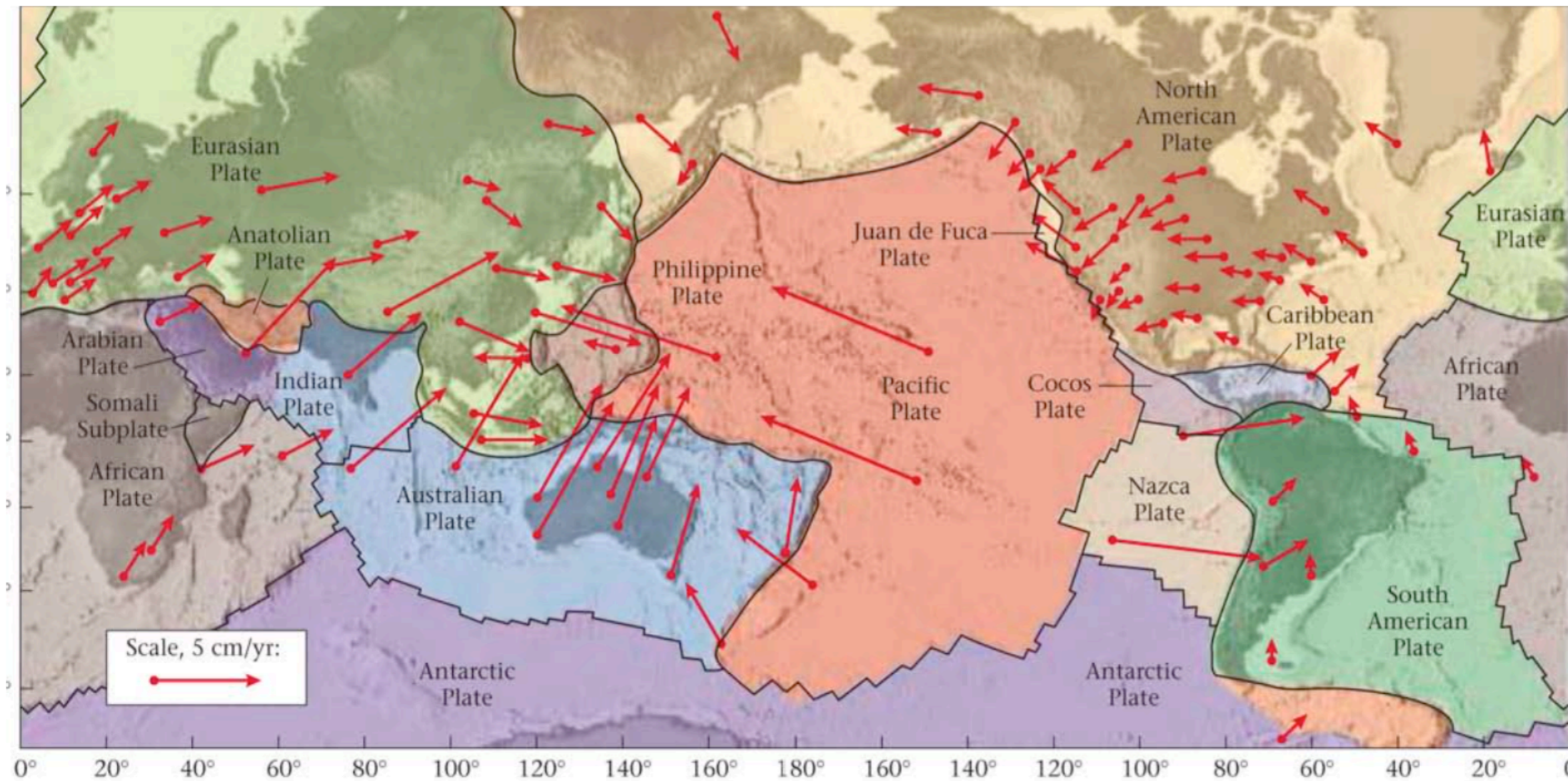
Marshak (2008) *Earth: Portrait of a Planet*

Modern textbooks show no earthquake epicenters dividing what I call the Two-American Plate



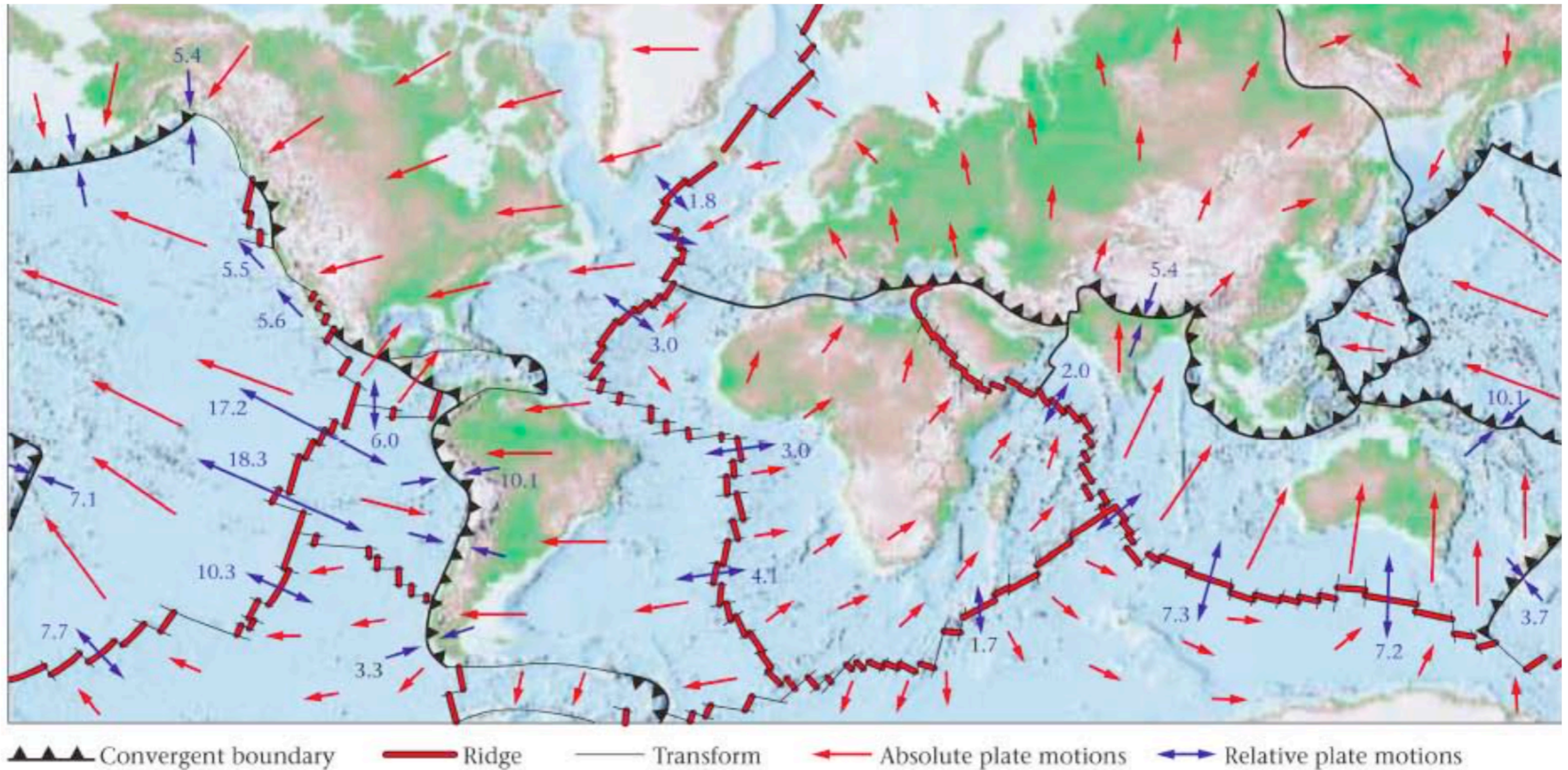
Marshak (2008) *Earth: Portrait of a Planet*

Modern textbooks show no GPS contrasts dividing what I call the Two-American Plate



Marshak (2008) *Earth: Portrait of a Planet*

Modern textbooks show no velocity contrasts within what I call the Two-American Plate



Marshak (2008) *Earth: Portrait of a Planet*

Leading textbook authors have opinions that can easily become scientific doctrine.

J.D.Dana (*Manual of Geology* 1863, 1874, ...1895) taught that continents (and humans) were divinely created entities. America was the type continent, continuously developing since Azoic time.

Schuchert (*Text-book of Geology* 1915, 1924, 1933, ...1960) taught fixist-paleogeography, with his cherished continents *Eria* and *Gondwana*, and oceans *Poseidon* and *Nereis*. Schuchert, Longwell, and Dunbar warned students to avoid drift ideas, even after they knew that drift-paleogeography was more correct.

Press & Siever (*Earth* 1974) showed a map with a "North American Plate" separated by an "uncertain plate boundary".

How modern textbooks divide what I call the Two-American Plate

Two plates divided by transform boundary:

Marshak

Montgomery

Plummer, Carlson, & McGearry

Skinner & Porter

Two plates divided by unspecified boundary:

Chernicoff & Fox (plate labels, no line shown)

Davidson, Read, & Davis (unlabeled line)

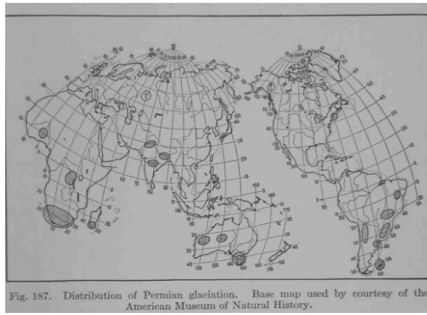
Dolgoff (color change, no line shown)

Grotzinger, Jordan, Press, & Siever (unlabeled line)

Monroe & Wicander (line labeled "uncertain plate boundary")

Tarbuck & Lutgens (color change, no line shown)

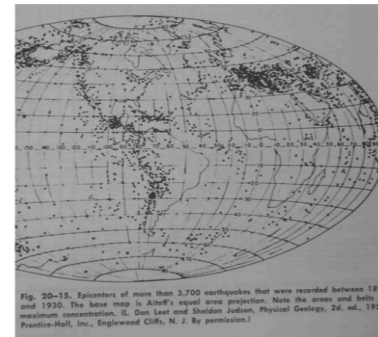
How textbook authors manipulate maps to hide global tectonic problems



Schuchert & Dunbar (1942) wanted to avoid having to illustrate their untenable Permian land bridges across the Atlantic, so they replaced their Mercator map with this one, which had no Atlantic Ocean.



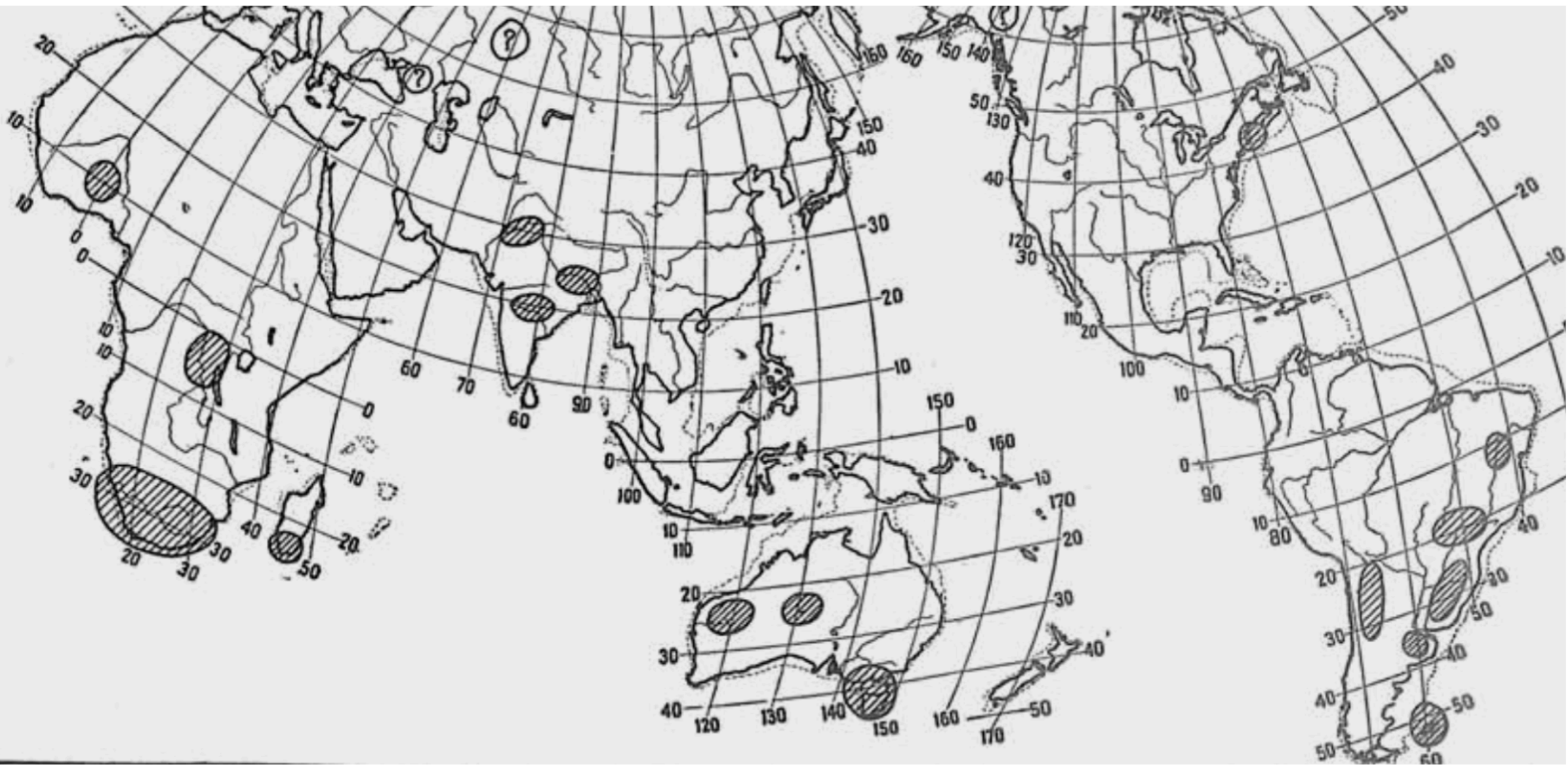
Dunbar (1949) wanted to hide Schuchert's incorrect Atlantic coast in pre-Cretaceous times, so he had an artist paint clouds on that coast, with clouds added to other coasts as a diversion. Clouds were used on 33 maps. They were removed in the next edition.



Longwell (1962) wanted to hide the increasingly striking and precise pattern of mid-Atlantic ridge seismicity, so he replaced his clear 1955-map with this one, showing poorly located earthquake epicenters that were all recorded before 1930.



Marshak (2008) wanted a plate boundary where none really existed, so he drew an inactive fracture zone from the mid-Atlantic ridge and labeled it a "transform boundary." A textbook without a North American Plate would be less popular in America.



skjulte Atlanterhav



skjulte kontinentmarginer

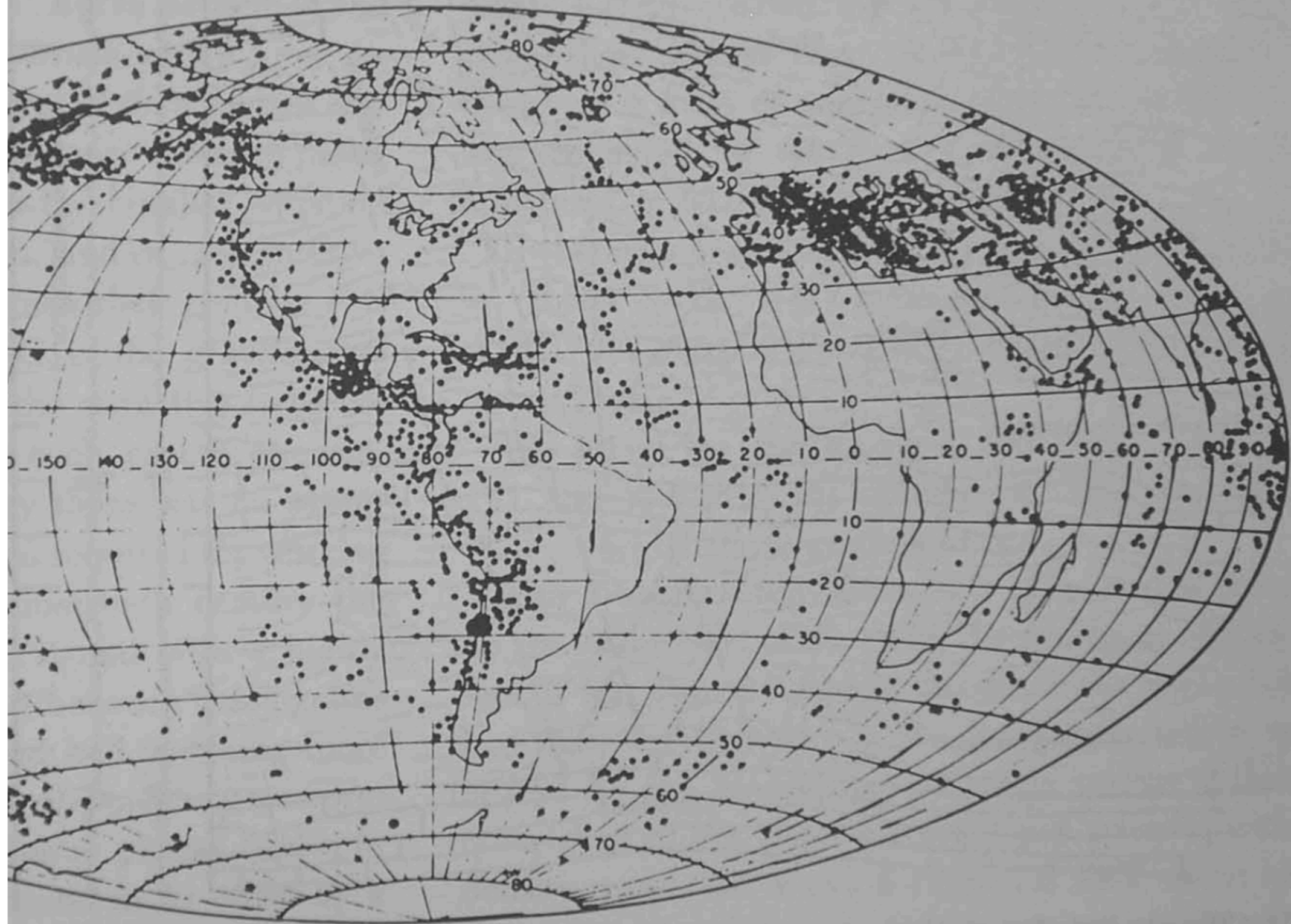


Fig. 20-15. Epicenters of more than 3,700 earthquakes that were recorded between 1899 and 1930. The base map is Aitoff's equal area projection. Note the areas and belts of maximum concentration. (L. Don Leet and Sheldon Judson, *Physical Geology*, 2d. ed., 1958. Prentice-Hall, Inc., Englewood Cliffs, N. J. By permission.)

skjulte Midt-Atlantisk rygg

IKKE PENSUM

Before the 1960s, geology students learned that continents were fixed.

Today, geology students learn that there is a North American Plate.

What else do we learn that should be questioned?

(Dette var et spørsmål som jeg stilte her i 2011 og er alltid opptatt av.)

What else do we learn that should be questioned?

1. At mennesker evolverte i savanna i øst Afrika.



2. At helleristninger er laget i steinalderen.

3. At folk levde i Vest Norge og Nord Norge tidlig i steinalderen.

4. At sifrene 0 1 2 3 4 5 6 7 8 9 er ideell for moderne bruk.