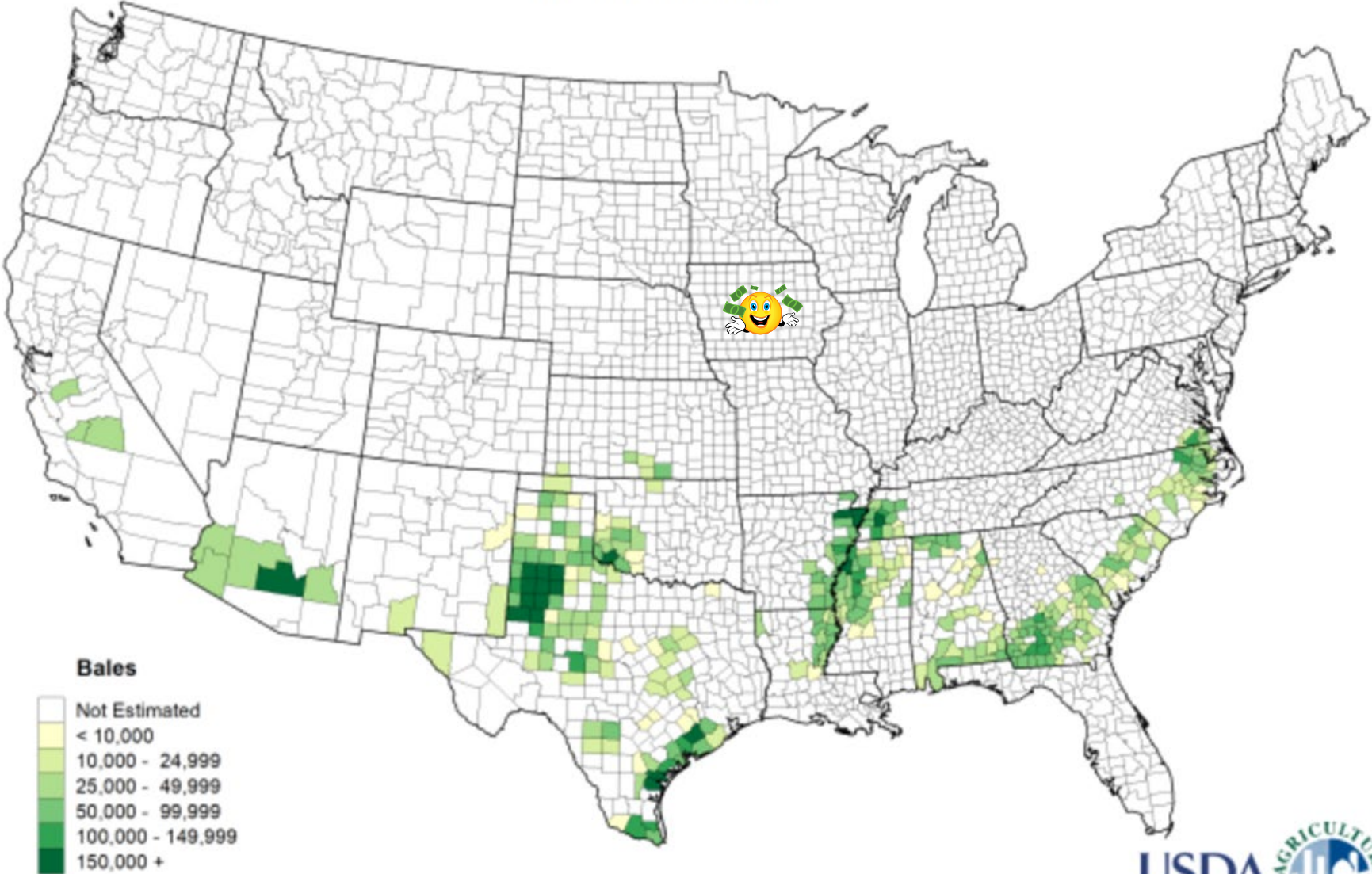
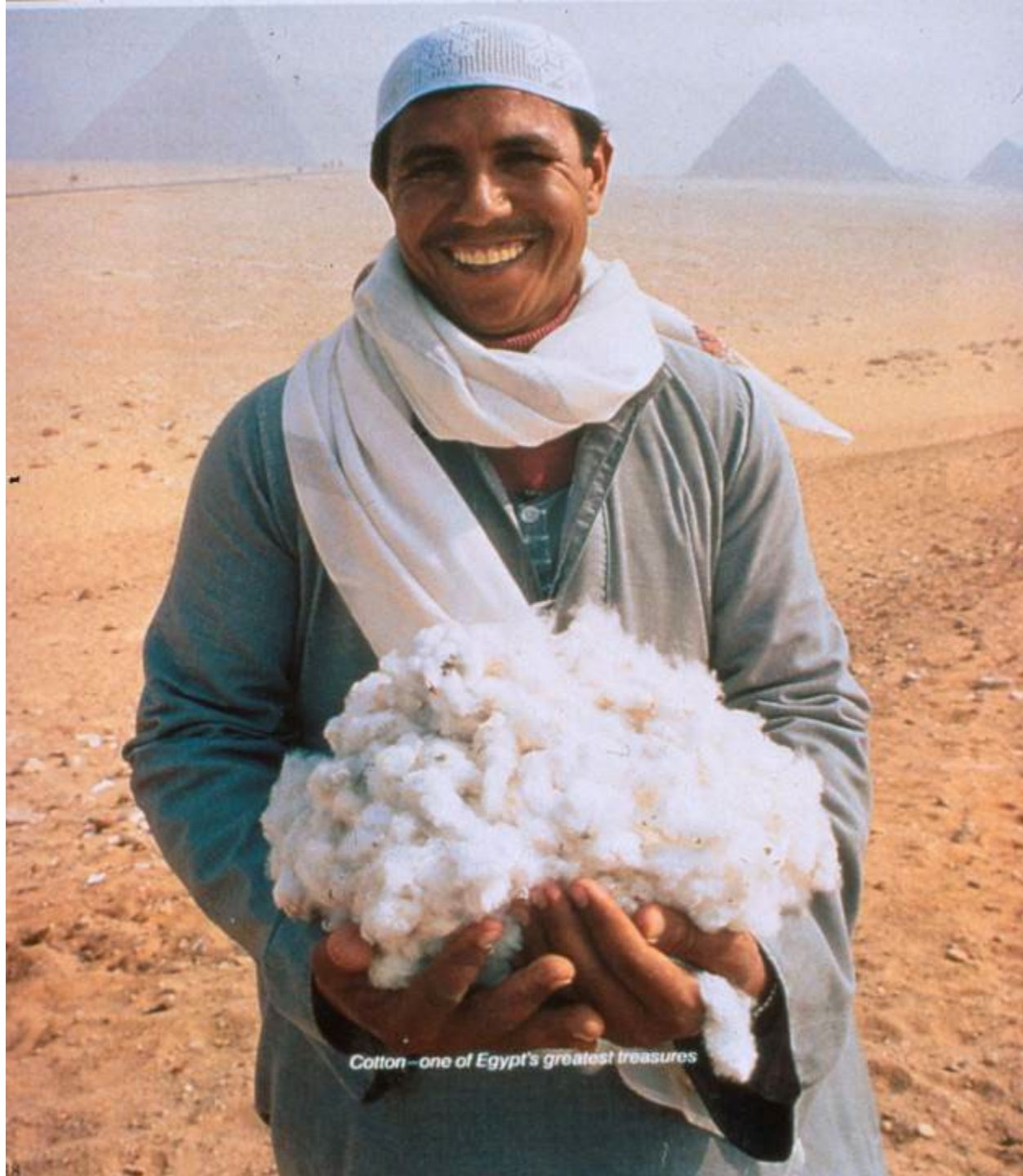


- Introduction to *Gossypium*
- Taxonomy, how we know what we know
- Extraordinary evolutionary history
- New species, genomic mergers and reunions
- Why this perspective might matter to you



Upland Cotton 2019 Production by County for Selected States





Cotton—one of Egypt's greatest treasures

Parallel domestication



- Two Old World, Diploid
- Two New World, Allopolyploid



RAM



G. hirsutum

G. barbadense

G. herbaceum



Wild vs. domesticated *G. hirsutum*



TX2094



TX2090



TX2095



TX665



TX1228



MAXXA



TM1



Cascot L-7



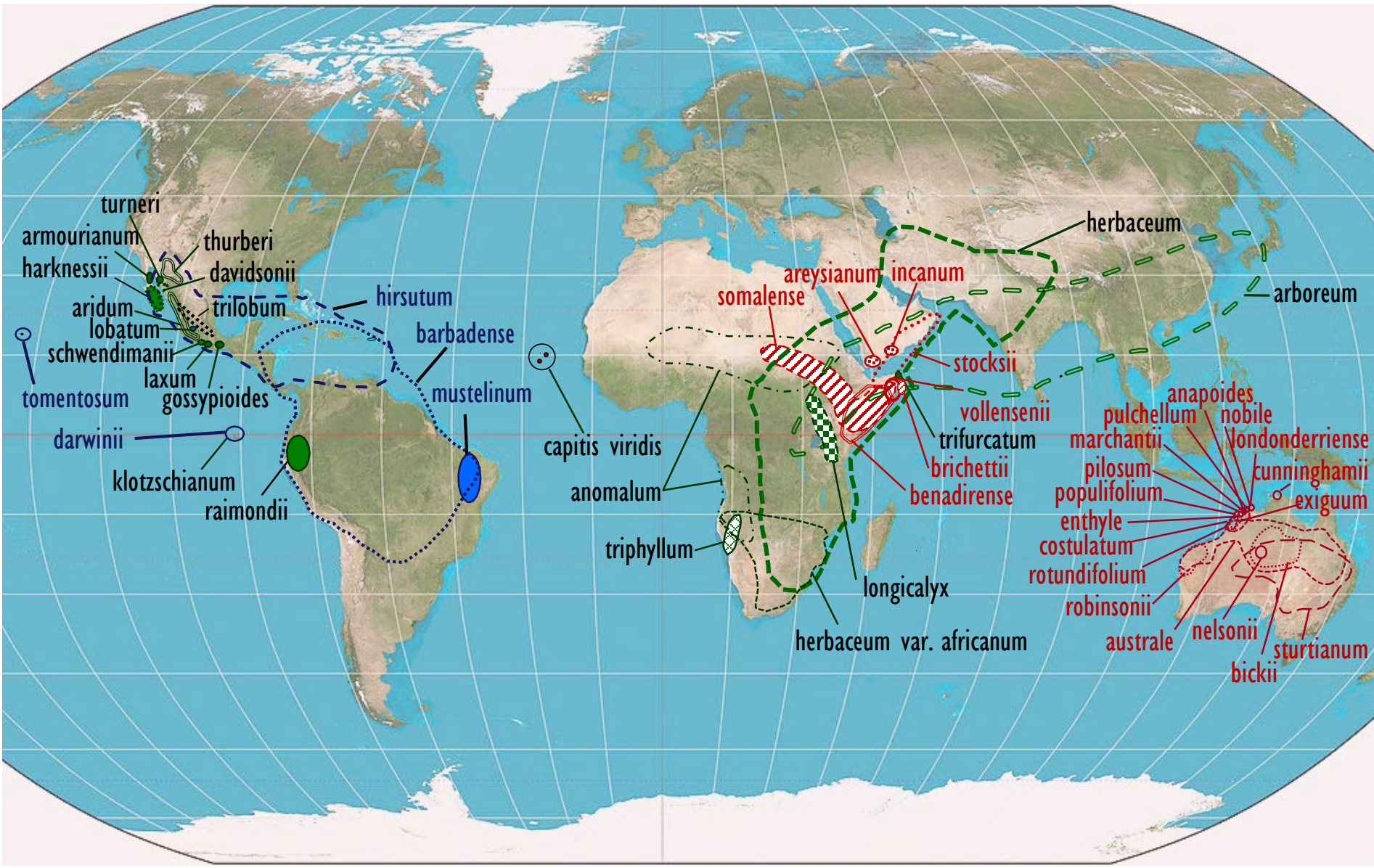
Coker 315



CRB252

1cm



















Cult. AD₁



Wild AD₁



AD₃



C₁

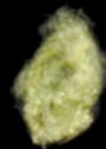
5 mm
—



Cult. A₂



Wild A₁



D₅



D₃



F₁



B₁



Hi! I'm a new species; my name is *G. anapoides*

I have a huge genome and I am a member of the K-genome from NW Australia!

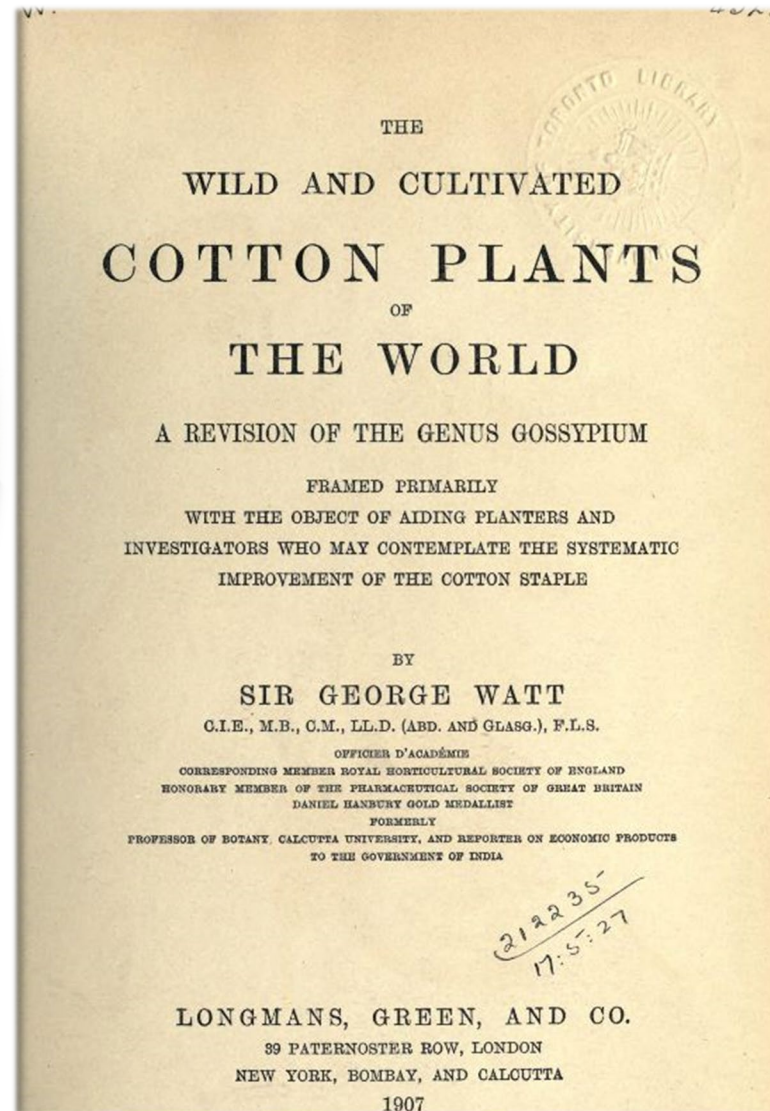
It doesn't rain for 9 months/year, but I don't mind



Sir George Watt
1851-1930



Agostino Todaro
1818-1892



“It would not be far from correct to describe cotton as the central feature of the world’s modern commerce” (Ch. 1)

INTRA-SPECIFIC DIFFERENTIATION IN
GOSSYPIUM HIRSUTUM

J. B. HUTCHINSON

Empire Cotton Growing Corporation Cotton Research Station,
Namulonge, Uganda



Joseph B. Hutchinson
1902-1988



Stanley G. Stephens
1911-1986



Gavriil S. Zaitsev
1887-1929

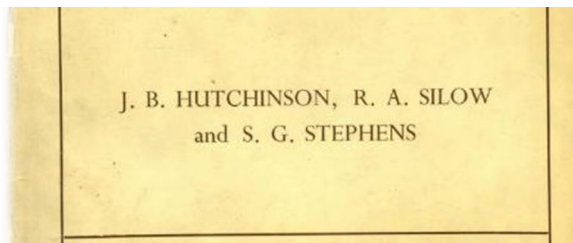
Vol. 100, No. 912

The American Naturalist

May-June, 1966

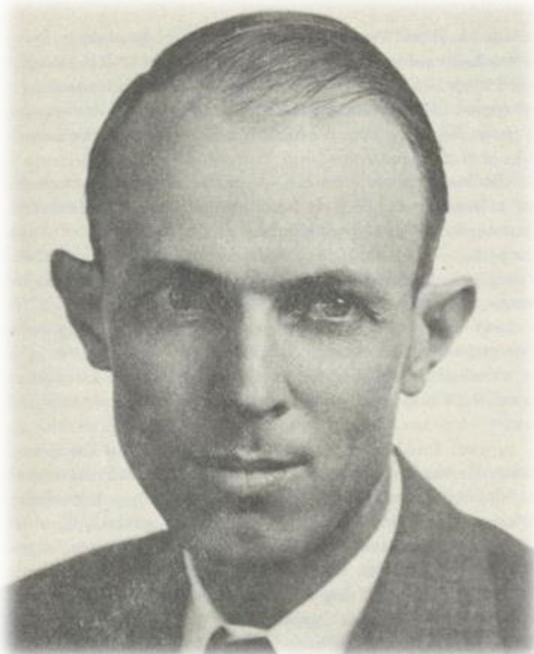
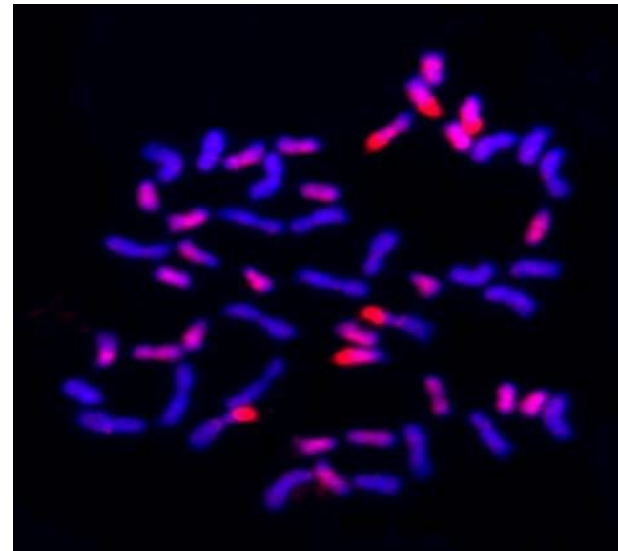
THE POTENTIALITY FOR LONG RANGE OCEANIC
DISPERSAL OF COTTON SEEDS*

S. G. STEPHENS



**Wendel and Goodman, 2011, Nat.
Acad. Sci. Biograph. Memoirs**

- **Denham (1924)**
- **Longley (1930)**
- **Webber (1935)**
- **Skovsted (1933, 1937)**



James Otis Beasley
1909-1943

The American Naturalist, Vol. 74, (1940)

**THE ORIGIN OF AMERICAN TETRAPLOID
GOSSYPIUM SPECIES¹**

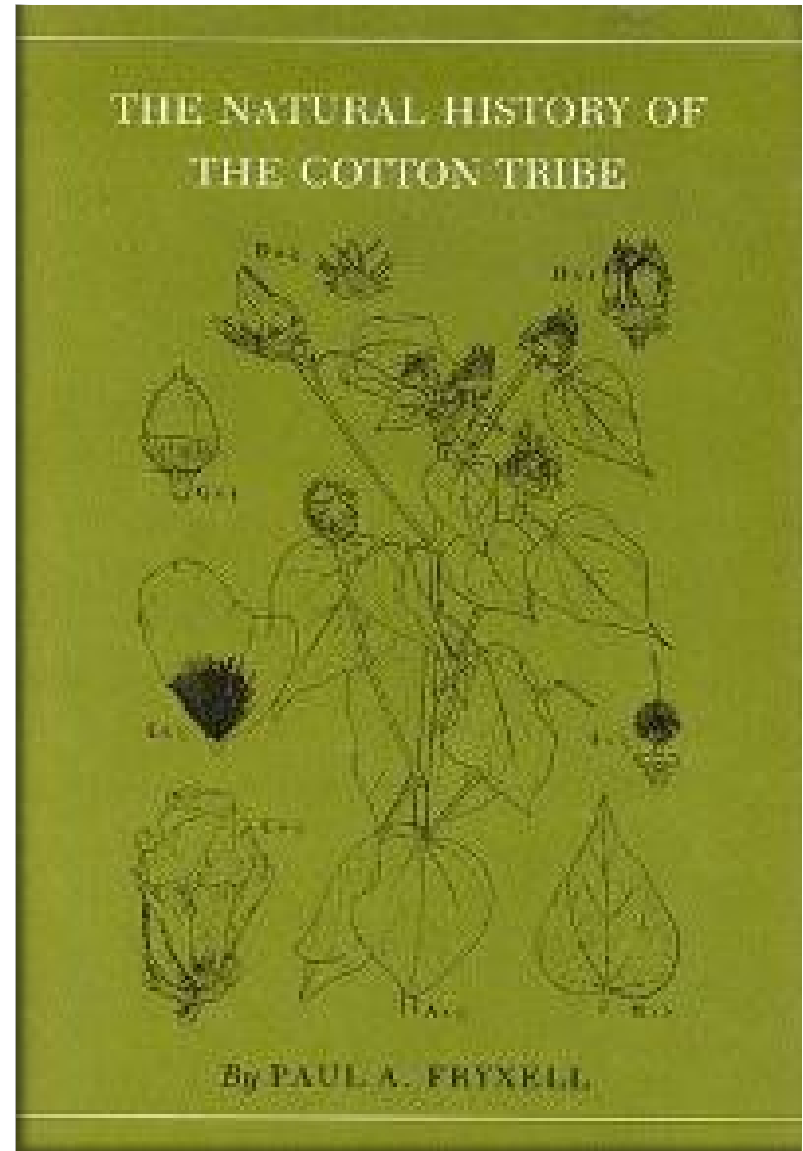
13-chromosome with Asiatic 13-chromosome species. In the present work tetraploids of this type were produced by doubling the chromosome number in hybrids of *G. therberi* Tod. × *G. arboreum* var. *neglectum* Hutchinson and Ghose.

ploid type. These facts leave no doubt that the American 26-chromosome cottons are allotetraploids, with one parent species similar to existing American 13-chromosome species and the other similar to Asiatic 13-chromosome species. The synthesized tetra-

loid can be classified as a separate 26-chromosome species, but



Paul Fryxell

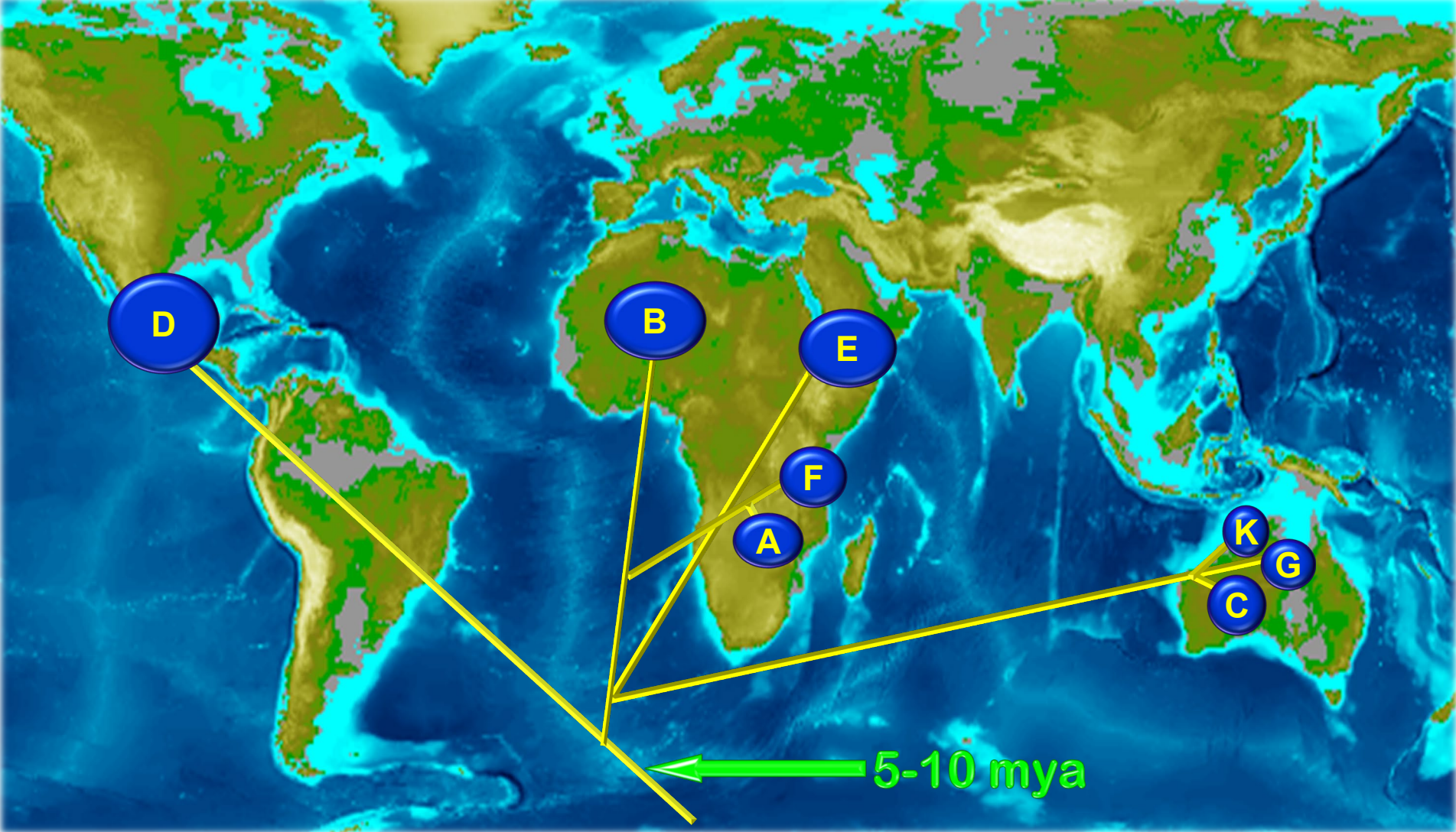




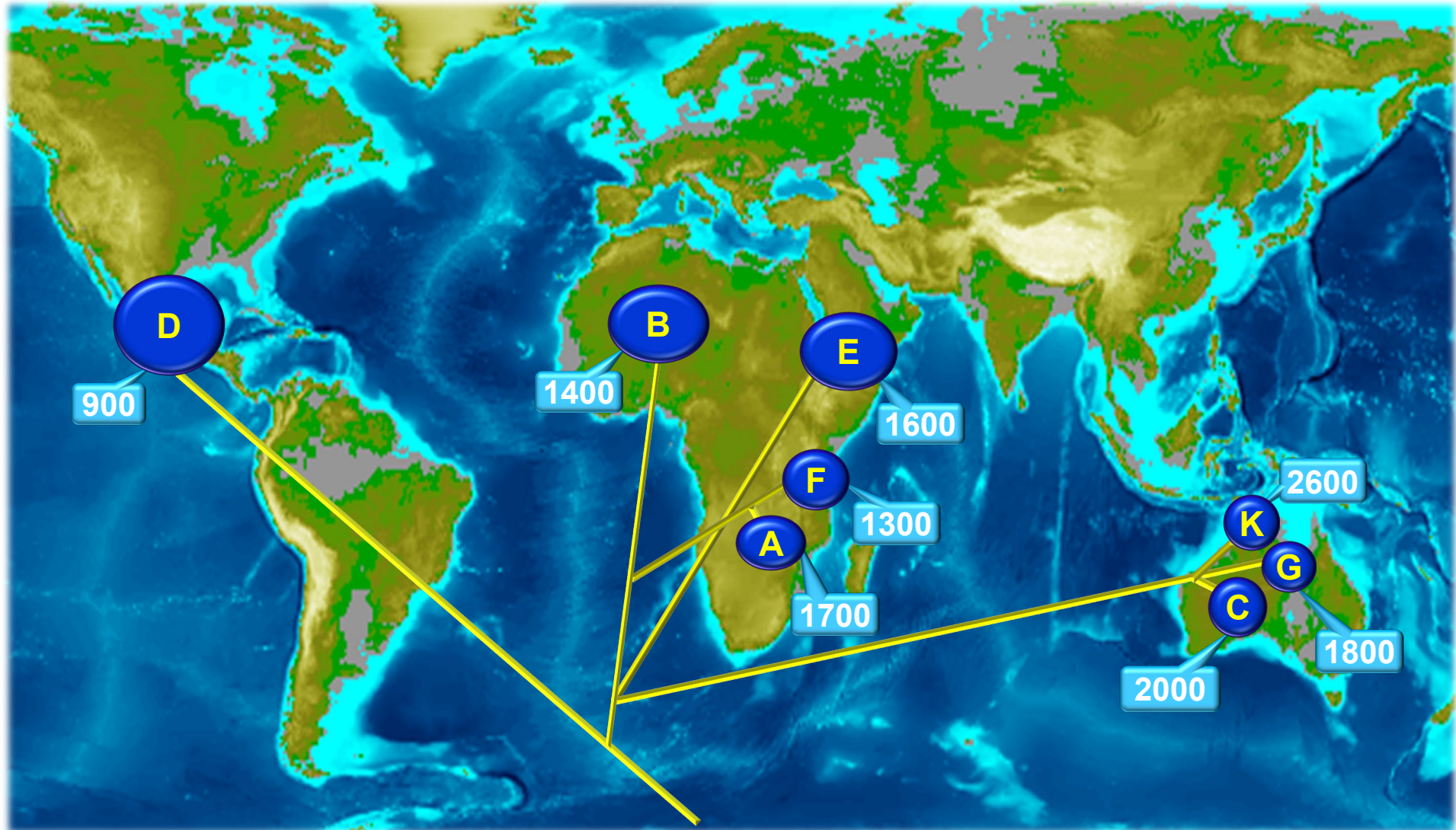
“We were dwarfs on the shoulders of giantswe are carried high and raised up by their giant size”



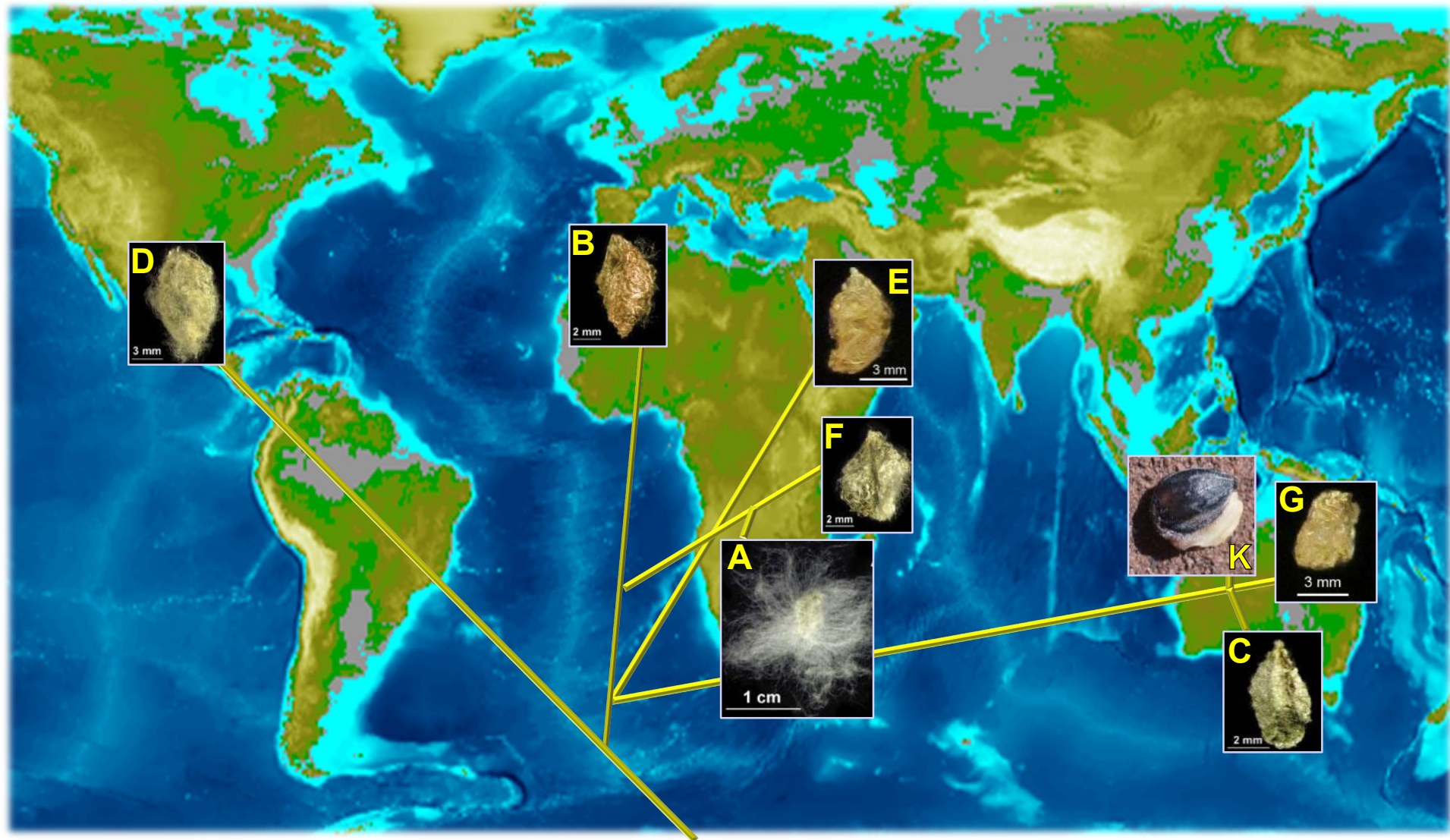
Phylogenetic history of *Gossypium*



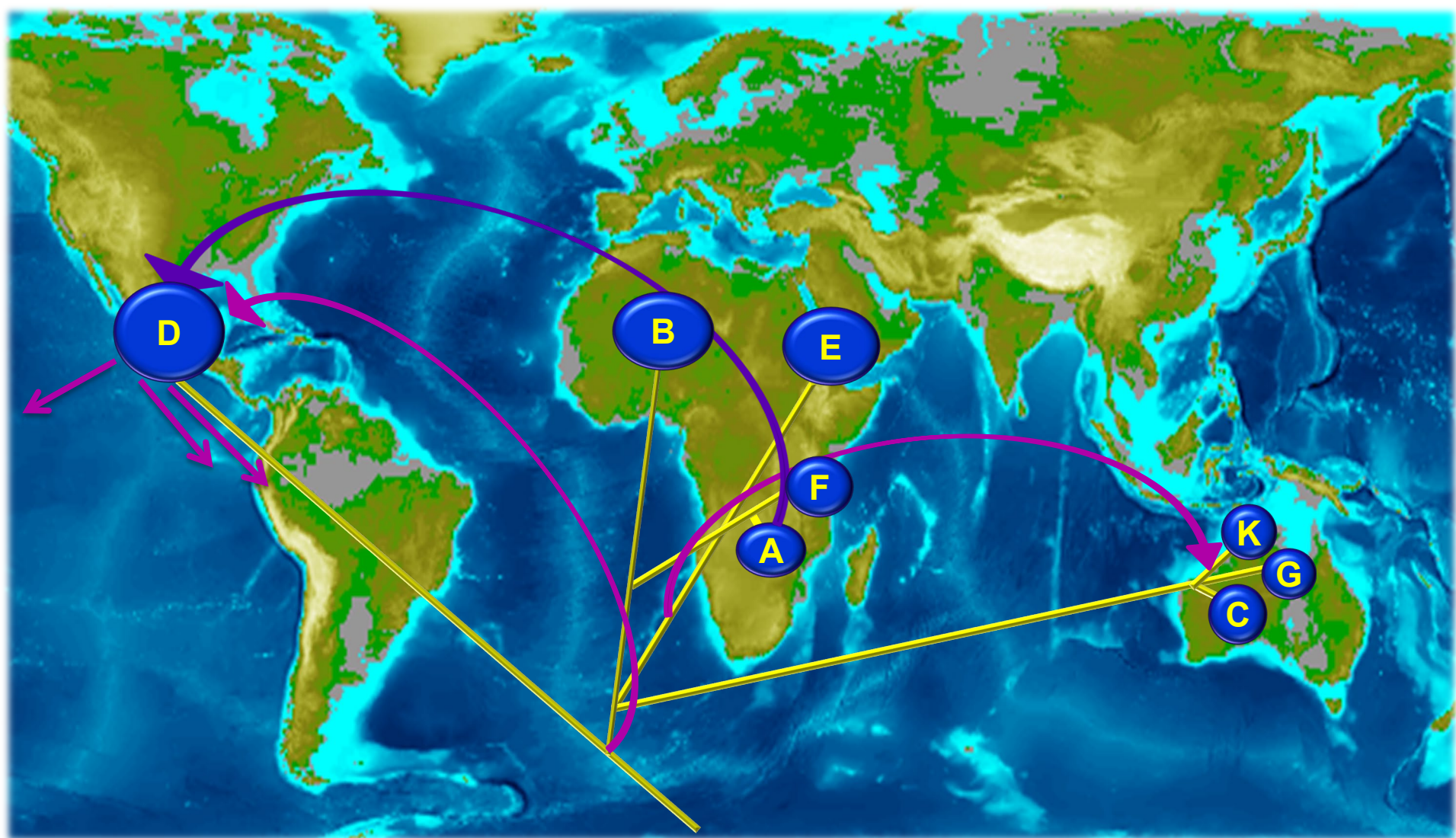
Genome evolution, $n = 13$



Key morphological innovations



Multiple trans-oceanic voyages



AA
2 species
2n = 26
Africa



AADD
7 species
2n = 52
New World



DD
13 species
2n = 26
Mexico

G. tomentosum

G. darwinii

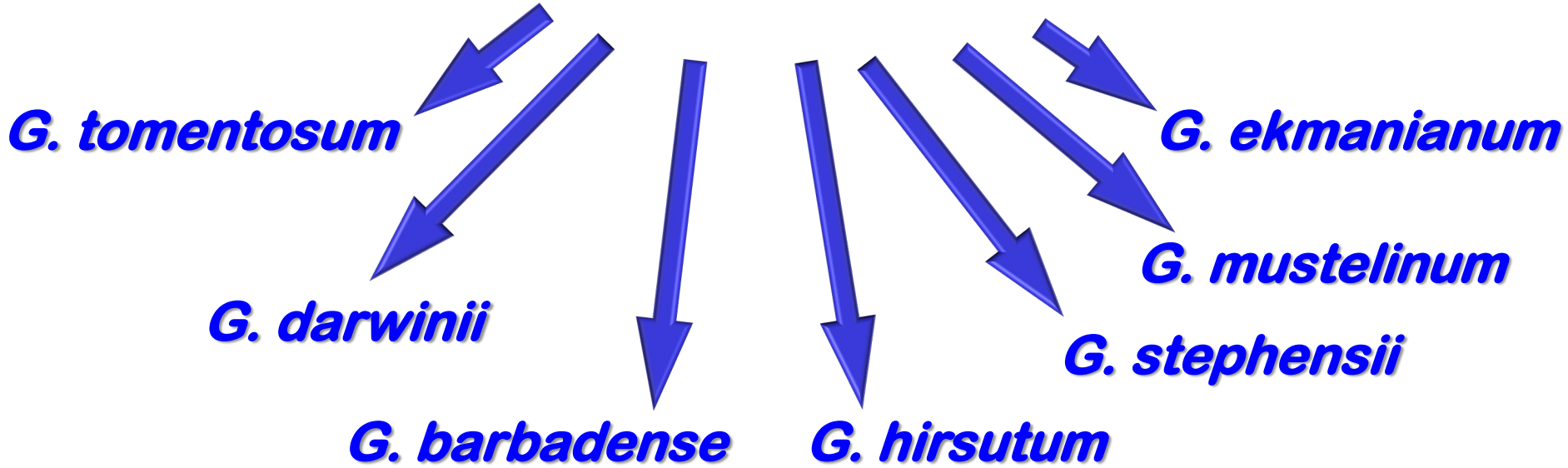
G. barbadense

G. hirsutum

G. ekmanianum

G. mustelinum

G. stephensii







Origin of *G. hirsutum* (upland cotton)










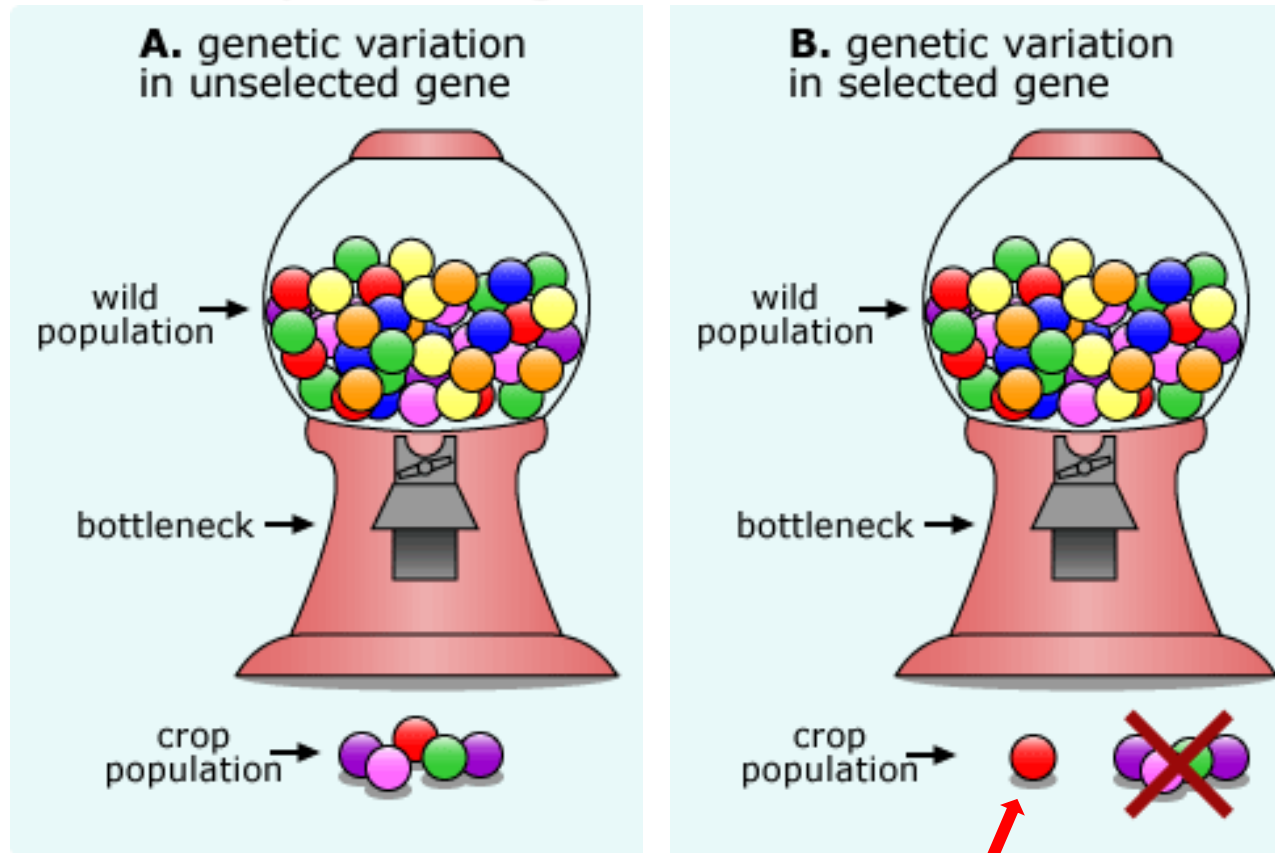


Cotton—one of Egypt's greatest treasures



- 
- 1. Where did all of this happen?**
 - 2. How much diversity was captured in the modern crop gene pool?**
 - 3. What proportion of the total diversity was captured?**
 - 4. What was left behind that might be valuable?**

Sequential genetic bottlenecks

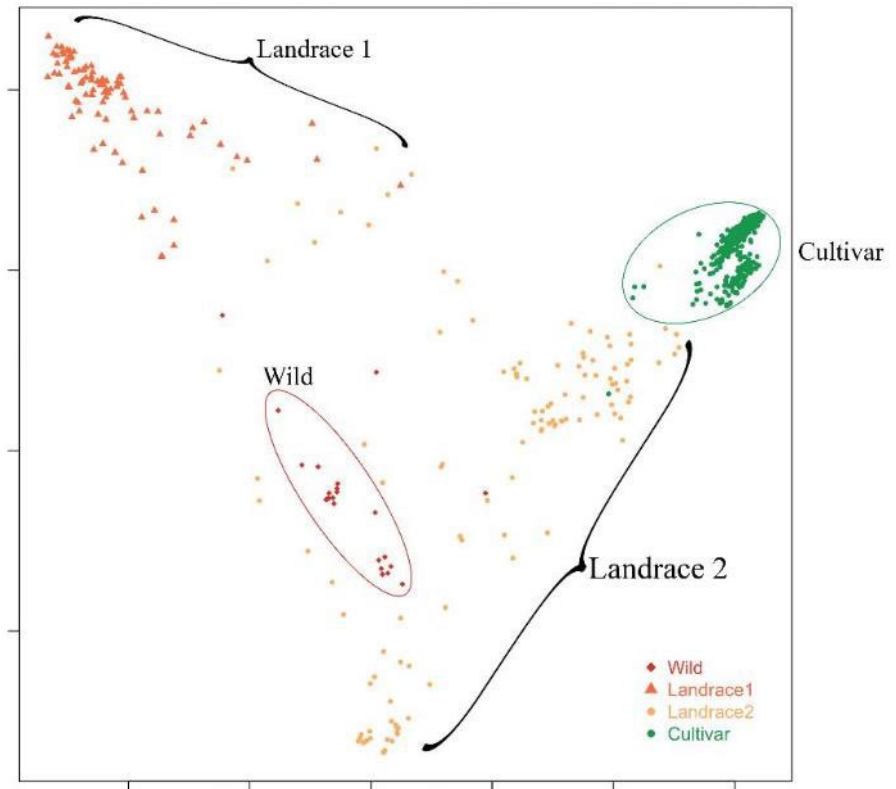
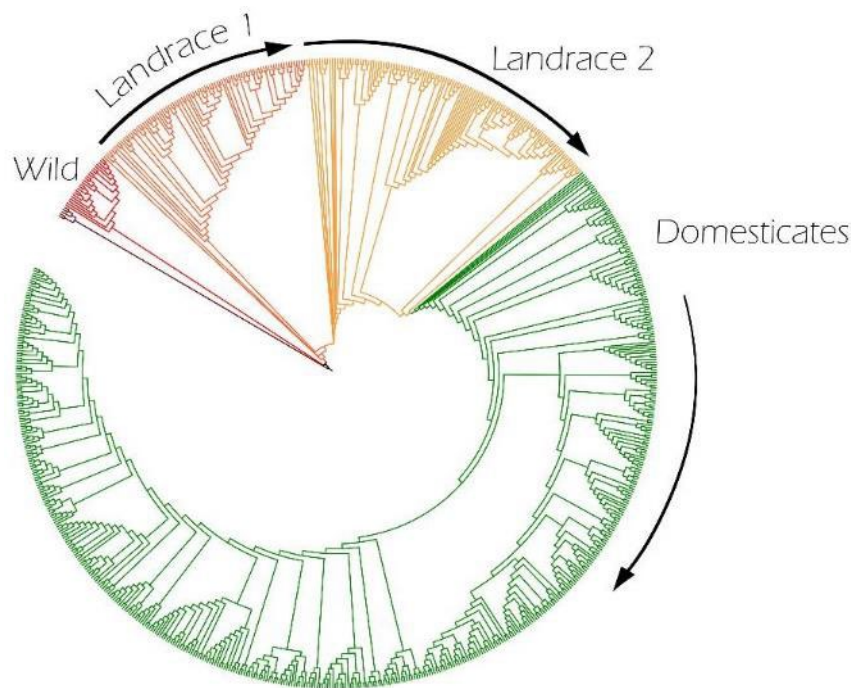


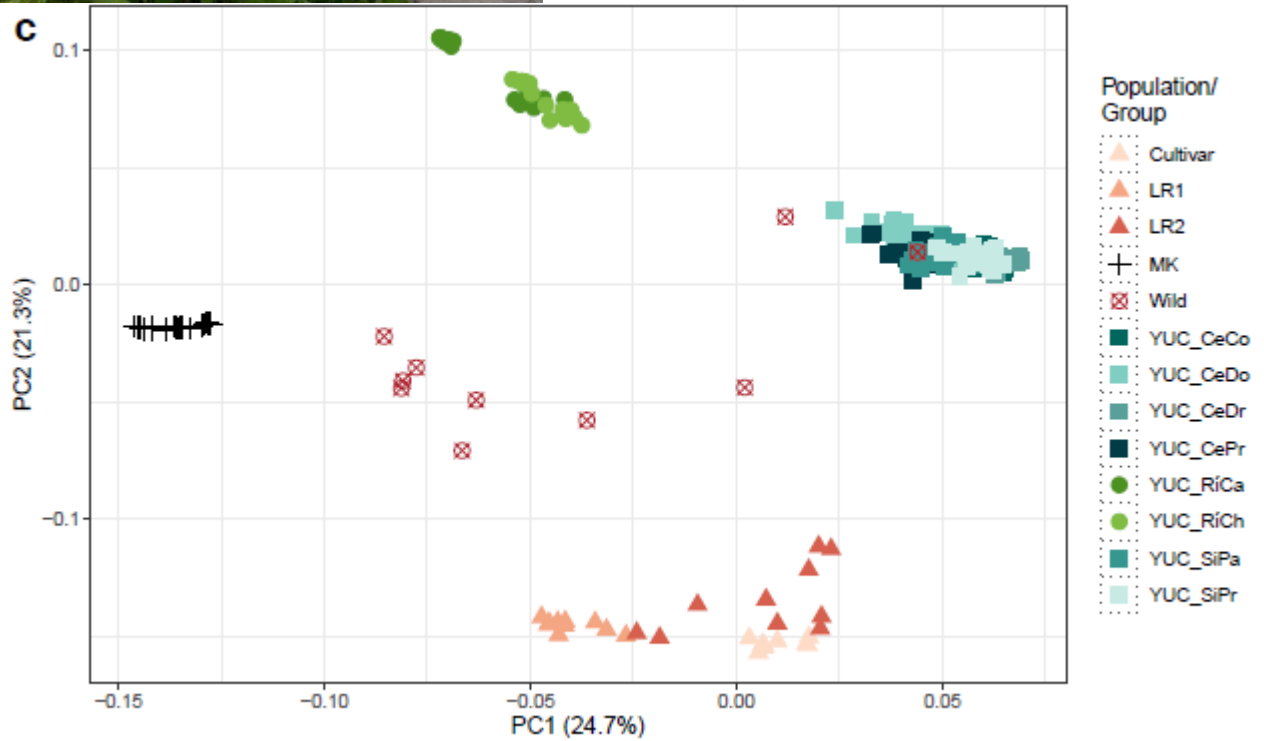
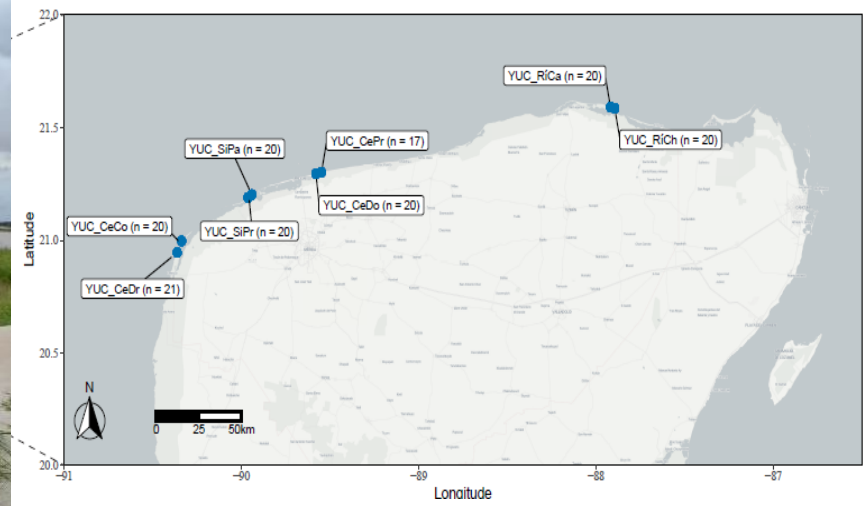
Semi-wild perennials
Feral forms
Landraces
Obsolete cultivars

Modern cultivars

Parallel and Intertwining Threads of Domestication in Allopolyploid Cotton

Daojun Yuan,* Corrinne E. Grover, Guanjing Hu, Mengqiao Pan, Emma R. Miller, Justin L. Conover, Spencer P. Hunt, Joshua A. Udall,* and Jonathan F. Wendel

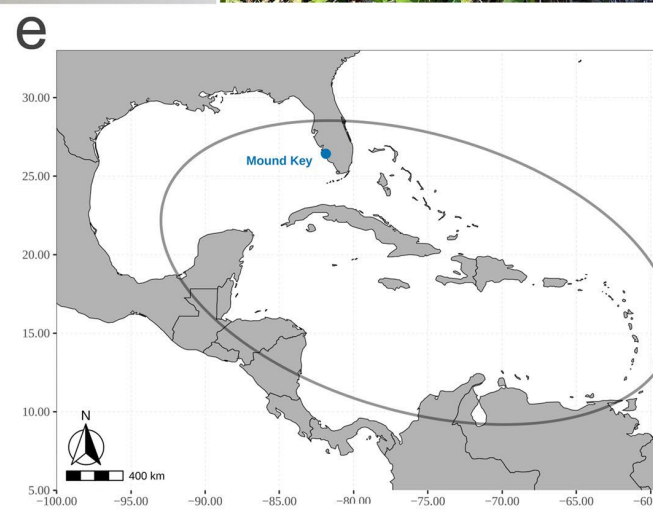
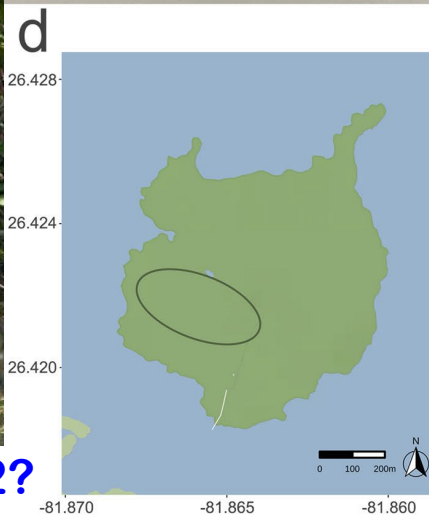
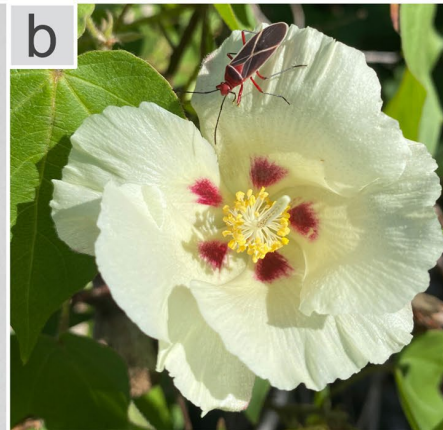
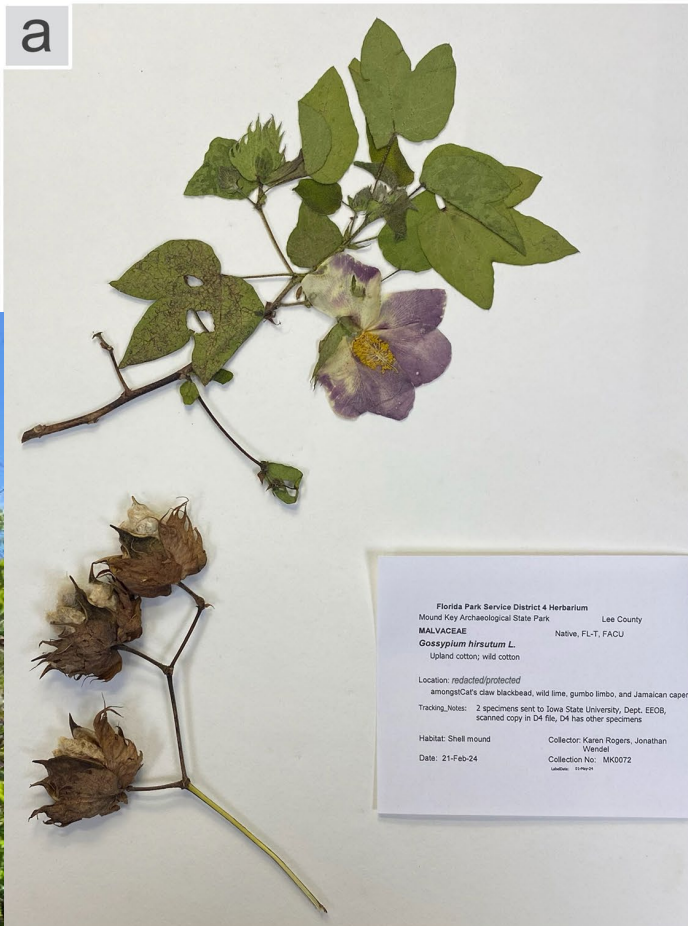






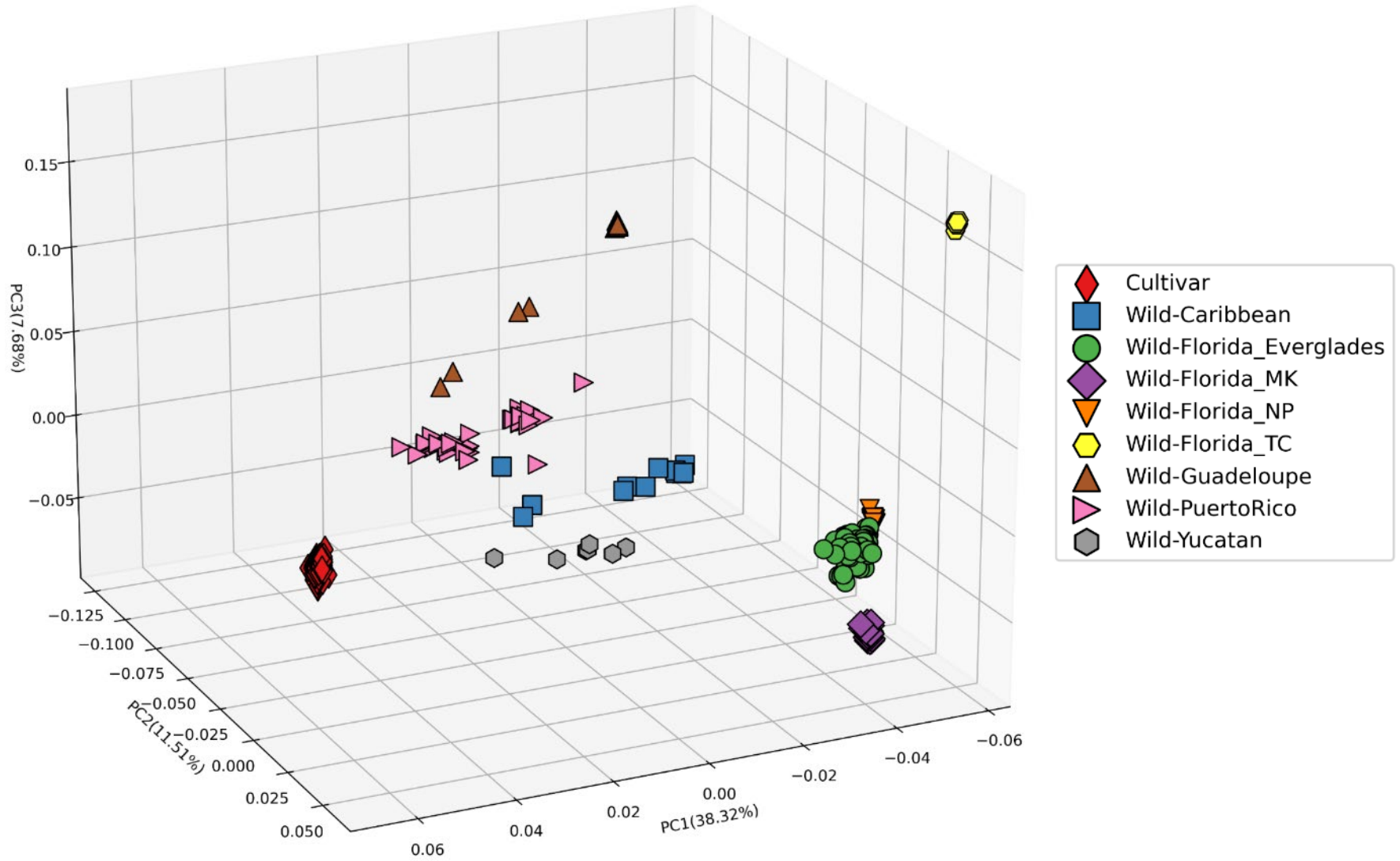
Origin and diversity of the wild cottons (*Gossypium hirsutum*) of Mound Key, Florida

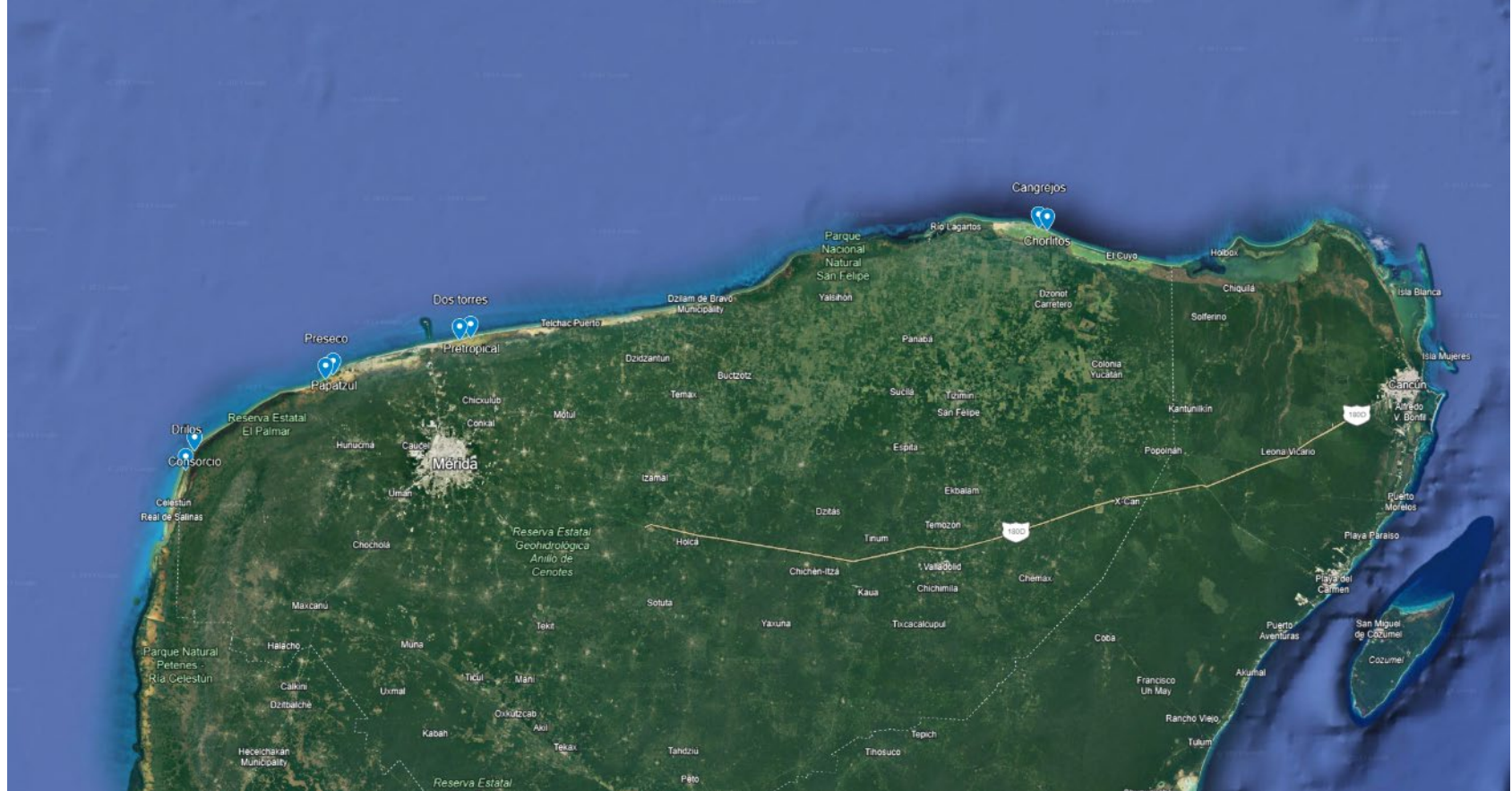
Weixuan Ning¹, Karen M. Rogers², Chuan-Yu Hsu³, Zenaida V. Magbanua³, Olga Pechanova³, Mark A. Arick II³, Ehsan Kayal¹, Guanjing Hu^{4,5}, Daniel G. Peterson³, Joshua A. Udall⁶, Corrinne E. Grover^{1,7} & Jonathan F. Wendel^{1,7}



Remember Hurricane Ian, 9-28-22?

392 genomes...





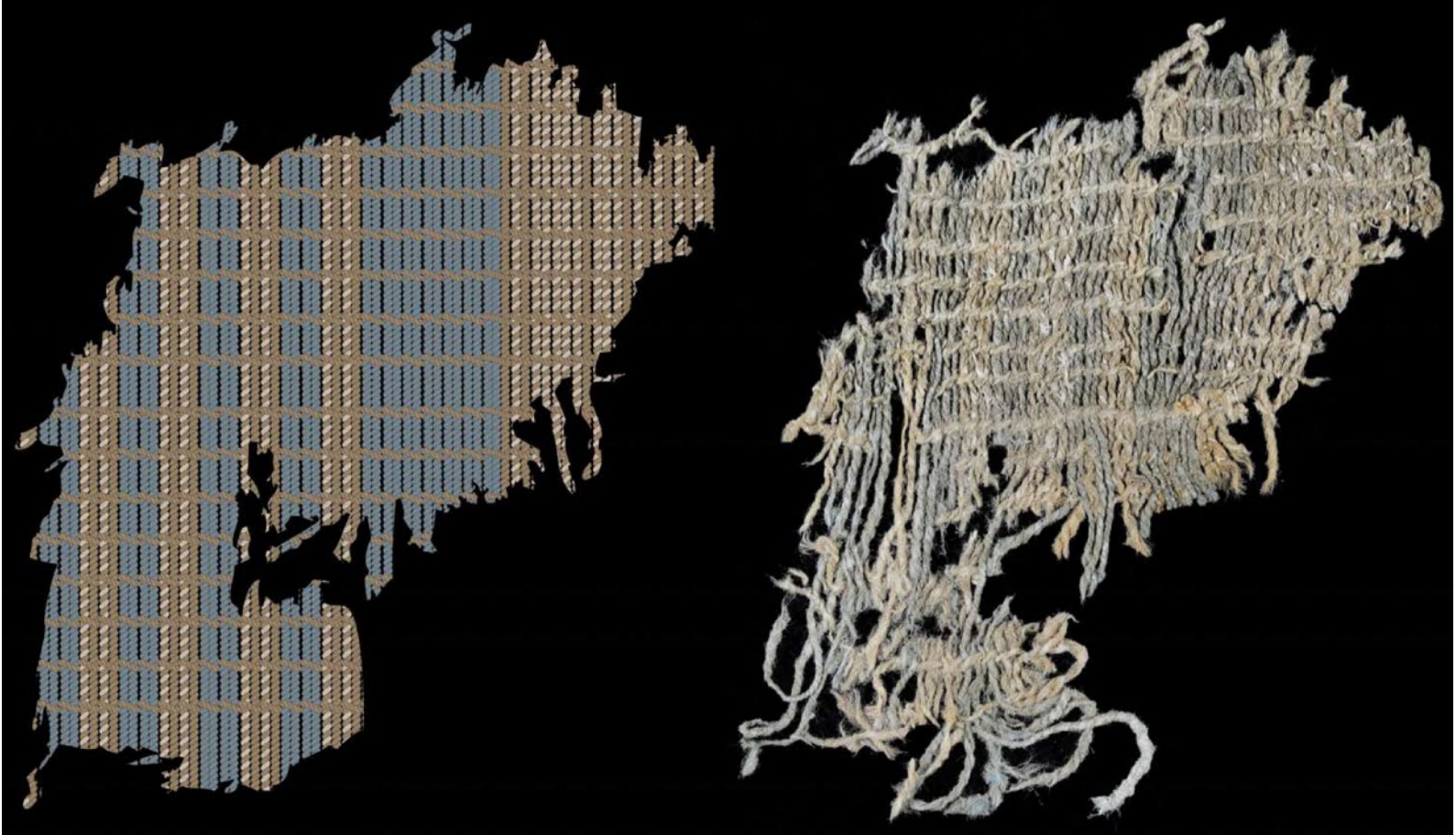




Origin of *G. barbadense* (pima cotton)



6000 year old blue jeans



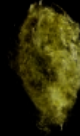
G. raimondii



A



AD

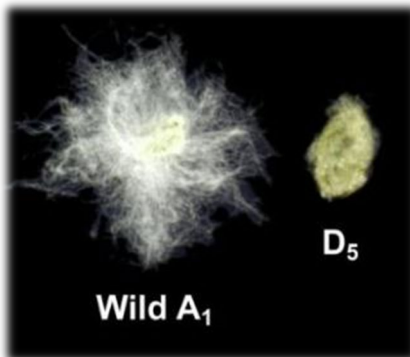


D

Gossypium raimondii



- Not even described until 1932 (by Oskar Ulbrich)
- Work by Harland, Gerstel, Phillips, Stephens, showed that this is among the best models of the D-genome ancestor of the allopolyploids
- Phillips (1966) states that the species was "represented by a relatively few individuals, and that these are confined to a narrow geographical range
- Intentional eradication as a "dangerous plant" (along with many other Malvaceae) by the Peruvian government



Gossypium raimondii



Gossypium raimondii

Collections in Northern Peru

Plant Genetic Resources Newsl., 1985

B.B. Simpson ^{1/}, J.M. Vreeland ^{2/} and R. Ferreyra ^{3/}



James "Mac" McD. Stewart



Ed Percival



Gossypium anapoides
Stewart et al., *Novon*, 2015



Krapovickas, A. & G. Seijo. 2008. *Gossypium Ekmanianum* (Malvaceae), algodónsilvestre de la República Dominicana. *Bonplandia* 17: 55-63.



- First proposed as a species in 1928 by Wittmack
 - Endemic to the the Dominican Republic; “perfectly wild” characteristics
- Reclassified as *G. latifolium* var. *ekmanianum* by Roberty in 1942
- Reclassified as *G. hirsutum* var. *ekmanianum* by Roberty in 1950
- Reclassified as *G. tricuspidatum* var. *ekmanianum* by Mauer in 1954
- Treated as a form of *G. hirsutum* by Fryxell and modern workers

Cotton Collecting on Caribbean Islands and South Florida

J. Schwendiman, ^{1/} A.E. Percival ^{2/} and J.L. Belot ^{3/}

DOMINICAN REPUBLIC (A.S. 1211 to A.S. 1225)

In the Dominican Republic collecting was carried out in only a very limited area, namely the areas bordering the old and new highways (Carretera Sanchez) between Azua and Barahona. A collecting mission was undertaken in this country in 1980 and, in an electrophoretic survey of this material carried out by Bourdon (1984), samples from this area showed a surprising degree of enzymatic variability.

2245	JAMAICA																
2246	JAMAICA	466	4	4	4	4	4	4	4	6	4	6	4	1	4	4	4
2247	JAMAICA	467	4	4	4	4	4	4	4	2	4	N	4	2	4	4	4
2249	GRAND CAYMAN	468	4	4	4	4	4	4	8	2	4	N	4	2	4	4	4
2250	GRAND CAYMAN	469	4	4	4	4	4	4	8	N	2	4	6	5	2	4	4
2252	GRAND CAYMAN	470	4	4	4	4	4	4	2	4	6	4	6	4	2	4	4
2253	GRAND CAYMAN	471	4	4	4	4	4	4	2	4	2	4	6	4	2	4	4
2254	GRAND CAYMAN	472	4	4	4	4	4	5	2	4	2	4	6	4	2	4	4
2255	GRAND CAYMAN	473	4	4	4	4	4	2	4	2	4	4	6	4	2	4	4
2255	GRAND CAYMAN	474	4	4	4	4	5	2	4	2	6	6	5	2	4	4	4
2265	DOMINICAN REP	475	2	4	4	4	4	4	4	5	6	4	4	4	1	4	4
2266	DOMINICAN REP	476	4	4	4	4	4	4	4	4	6	4	6	4	2	4	4
2267	DOMINICAN REP	477	4	4	4	4	4	4	4	4	6	4	6	4	1	4	4
2268	DOMINICAN REP	478	4	4	4	4	4	4	4	4	6	4	N	4	2	4	4
2270	DOMINICAN REP	478	4	4	4	4	4	4	4	4	6	4	6	4	2	4	4
2270	DOMINICAN REP	479	4	4	4	4	4	4	4	4	6	4	6	4	2	4	4
2271	DOMINICAN REP	480	4	4	4	4	4	4	4	4	6	4	6	4	2	4	4
2272	DOMINICAN REP	481	4	4	4	4	4	4	4	4	6	4	6	4, N	1, 2	4	4
2272	DOMINICAN REP	481	4	4	4	4	4	4	4	4	6	4	6	4	1	4	4
2274	DOMINICAN REP	482	4	4	4	4	4	4	8	4	6	4	N	4	1	4	4
2276	DOMINICAN REP	483	4, 2/4	4	4	4	4	4	4	5	6	4	6	4	1	4	4
2277	DOMINICAN REP	484	4	4	4	4	4	4	8	4	2	4	N	5	2	4	4
2278	DOMINICAN REP	485	4	6	4	4	4	4	8	4	2	4	N	4	2	4	4
2280	PUERTO RICO	486	4	4	4	4	4	4	8	4	6	4	4, N	5	2	4	4
2283	PUERTO RICO	487	4	4	4	4	4	4	8	N	6	4	6, N	5	2	4	4
2284	PUERTO RICO	488	4	4	4	4	4	4	8	4	6	4	6, N	5	2	4	4
2285	PUERTO RICO	489	4	4	4	4	4	4	8	4	2	4	N	4	2	4	4

G. ekmanianum: a sixth polyploid species



**Molecular confirmation of species status
for the allopolyploid cotton species, *Gossypium
ekmanianum* Wittmack**

C. E. Grover · X. Zhu · K. K. Grupp ·
J. J. Jareczek · J. P. Gallagher · E. Szadkowski ·
J. G. Seijo · J. F. Wendel *Genet. Res. Crop Evol.* 2015



ATOLL RESEARCH BULLETIN

No. 67

Vegetation and flora of Wake Island

by

F. R. Fosberg

**GOSSYPIUM RELIGIOSUM* L.

Wild Cotton.

A spreading reclining shrub with grayish leaves, light yellow flowers, and diminutive cotton-producing fruits. Bryan reported one clump in 1923, but in 1952 fairly common especially around old Japanese installations on Wake Islet. Native in the Pacific, but rare and known from very few specimens, probably but not certainly an introduced plant on Wake, first found there in 1923. Fosberg 34469. (Christophersen 1931, p. 13, as *G. hirsutum* var. *religiosa* Watt; Drummond-Hay 1939; Bryan 1942, p. 213, also as *G. hirsutum* var. *religiosa*.)

11

forms of the same species from the Caribbean area and from Wake Island. The Wake Island cotton does not resemble closely either the Caribbean or other Pacific forms. The Caribbean forms are much more variable in all

Paul A. Fryxell, 09:42 PM 8/20/98 , Wake Island cotton

Date: Thu, 20 Aug 1998 21:42:41 -0500 (CDT)
To: jfw@iastate.edu
From: pfryxell@mail.utexas.edu (Paul A. Fryxell)
Subject: Wake Island cotton

Dear Jonathan:

A seed sample of the Wake Island cotton is on its way to you. It is not a large sample, but I am sending half to you and half to Ed Percival to put in the germplasm collection -- and presumably be multiplied. The seed comes courtesy of Derral Herbst of the Bishop Museum in Honolulu. I have seen a poor herbarium specimen of this many years ago, and could only learn enough to be intrigued. Derral calls it *G. hirsutum* and it may be kin to the *G. hirsutum*s from Tahiti, but my recollection from seeing the herbarium sheet (collected by the late Ray Fosberg) was that it might show some kinship with *G. tomentosum*. Having living material should put that question to rest. Cheers. --Paul

Paul A. Fryxell
Dept. Botany
University of Texas



US
Smithsonian
Institution

Examined for
Cat. Micron. Pl.

PLANTS OF WAKE ISLAND

Gossypium hirsutum
var. *religiosum* (L.) Watt
Det. F. R. Fosberg

Locality Wake Islet

Occurrence Occasional, especially around
coral sand, gravel, debris old Japanese instal-
lations.

Date April 20-21, 1952

Alt. 1-3m.

Coll. F. R. Fosberg

No. 34469

Remarks Sprawling shrub with elongate
branches; flowers cream-yellow.



Wake Island Cotton: a *seventh* polyploid species

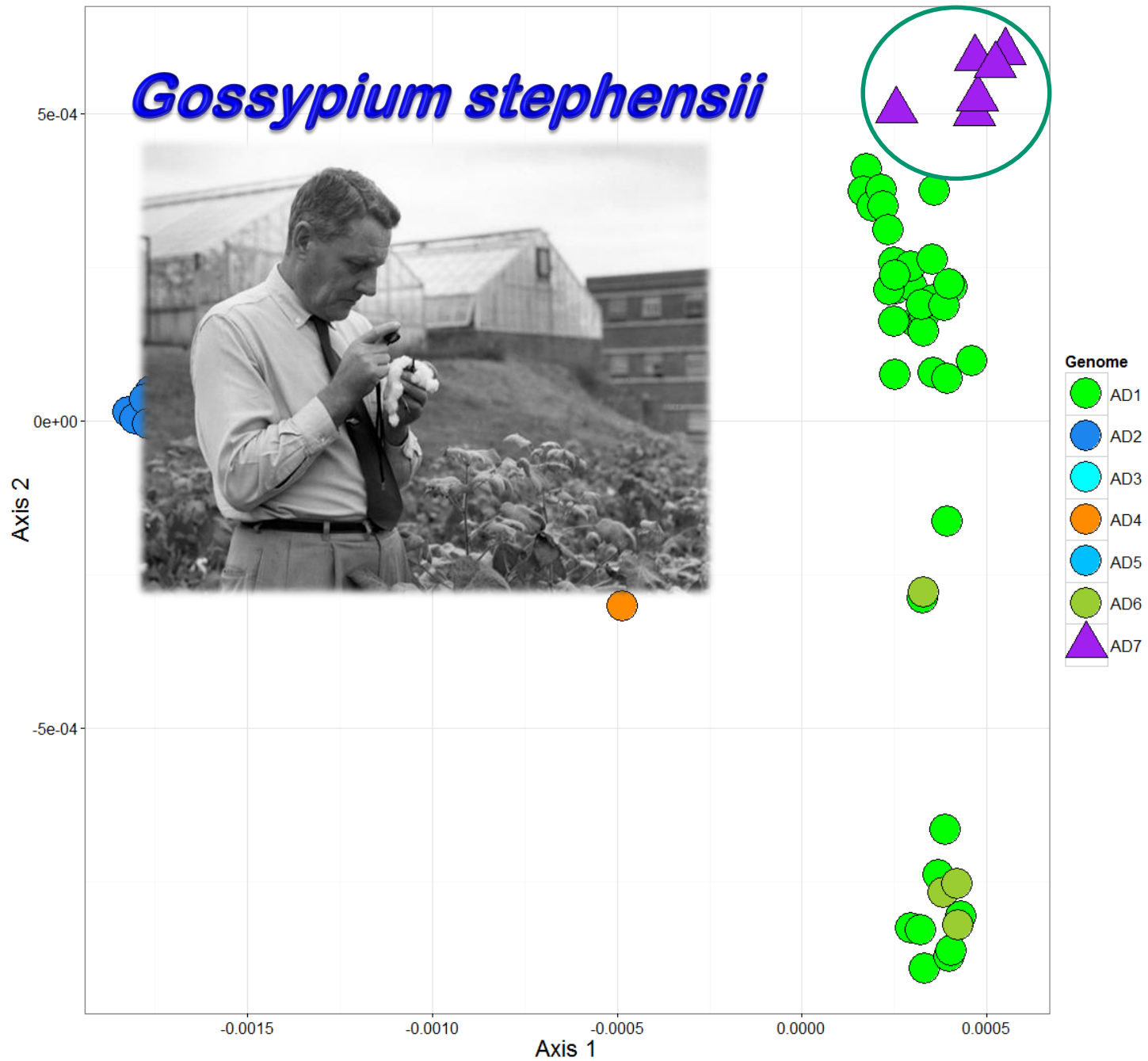


A New Species of Cotton from Wake Atoll, *Gossypium stephensii* (Malvaceae)

Joseph P. Gallagher,¹ Corrinne E. Grover,¹ Kristen Rex,² Matthew Moran,³ and Jonathan F. Wendel^{1,4}



➤ Sequenced ~600 genes in a diverse panel of all allopolyploids



- **We are the beneficiaries of generations of taxonomists, cytogeneticists, plant collectors...**
- **Recognition of the genus *Gossypium*; that is contains more than 50 species**
- **Over the last 5-10 million years, the genus has achieved a global distribution, remarkable history of long-distance oceanic travel, and of polyploidy**
- **Importance of biodiversity, of germplasm banks, and how thin that enterprise is; much remains to be learned, studied, preserved, utilized**

Why diversity matters

Top 10 list

1. *Introgression of traits from wild species*
2. *Gene pools that are unexplored*
3. *History of introgression between AD1 and AD2*
4. *Learn from nature - Wild species and drought*
5. *Learn from nature - G. hirsutum and salt tolerance*
6. *Wild vs. domesticated, twice! Insights into fiber development*
7. *Why does 1+1 not equal 2? Molecular biology*
8. *Transposable elements and traits*
9. *Polyploidy evolutionary genomics, e.g., transcription factors*
10. *Philosophical: So that we know better the world we were born into*

The end..., except...



Many thanks to:

**All of my mentors,
colleagues, and nearly 40
years of students and post-
docs and collaborators**



Many thanks to:

Keith Adams, Wendy Applequist, Ying Bao,
Curt Brubaker, Jeff Chen, Justin Conover,
Rich Cronn, Lex Flagel, Joe Gallagher, Lei
Gong, Corrinne Grover, Candace Haigler,
Jennifer Hawkins, Ran Hovav, Guanjing Hu,
Jinping Hua, Joe Jareczek, Don Jones, Bao
Liu, Rick Masonbrink, Weixuan Ning, Andy
Paterson, Dan Peterson, Ryan Rapp, Armel
Salmon, Joel Sharbrough, Dan Sloan, Mac
Stewart, Josh Udall, Mi-Jeong Yoo, Daojun
Yuan, Maojun Wang, many, many others
(sorry if I missed you!)

