

Description and Analysis of Variation Patterns

Chapter 1

– from Stebbin's 1950 *Variation and Evolution in Plants*

some comments from the “Preface”

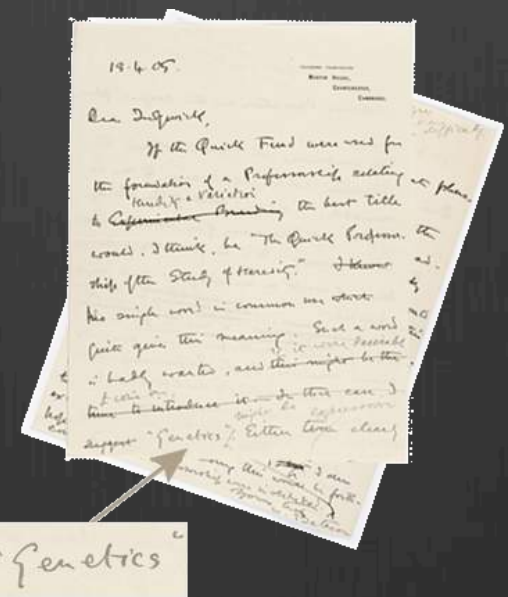
- ⊗ “the last twenty years have been a turning point in the history of man’s knowledge and thinking about organic evolution”
- ⊗ “great advances have made in the fields of genetics, cytology, and the statistical study of populations, as well as in the more traditional descriptive fields of systematics and morphology”

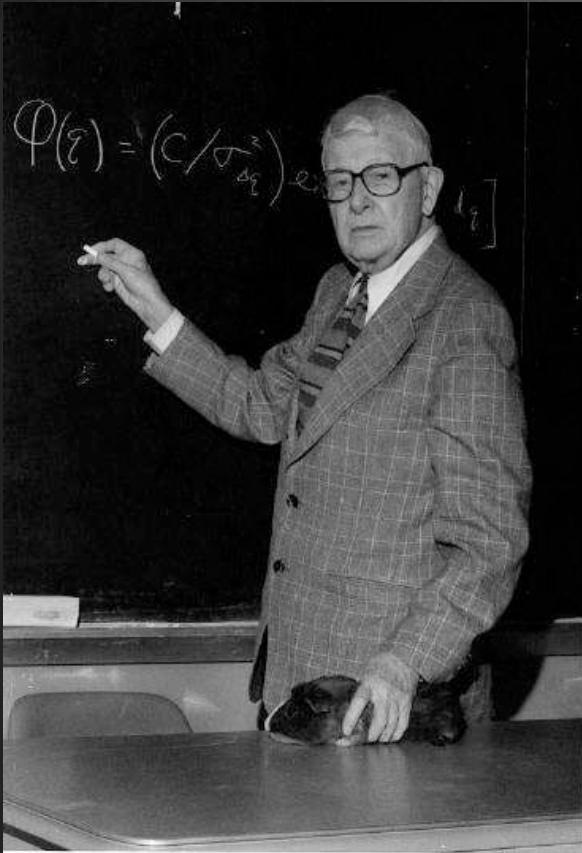


1909 - Wilhelm Johannsen defined 'gene'

... but DNA structure not known until 3 years after Stebbin's book

... although 4 years earlier William Bateson used 'genetics'

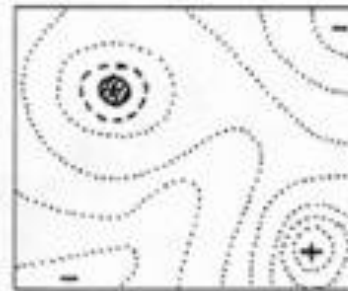




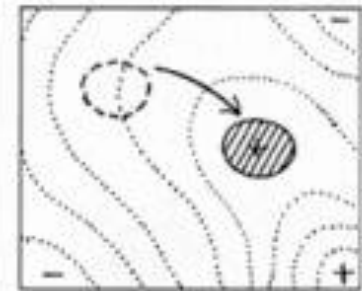
1932 – Sewell Wright introduces
 ‘**shifting balance theory**’



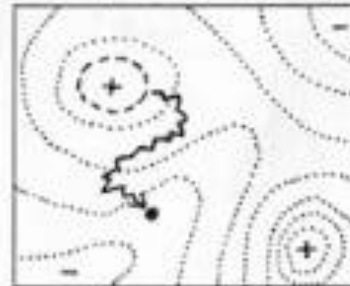
A. Increased Mutation
 or reduced Selection
 $4NU, 4NS$ very large



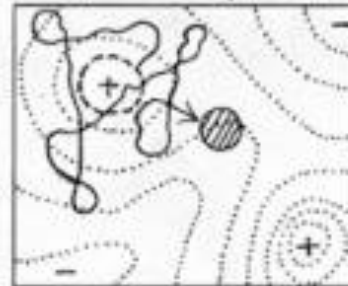
B. Increased Selection
 or reduced Mutation
 $4NU, 4NS$ very large



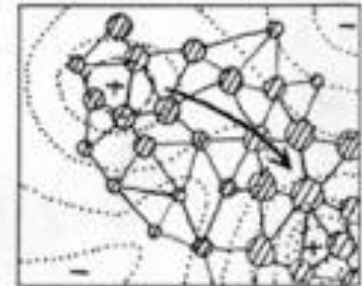
C. Qualitative Change
 of Environment
 $4NU, 4NS$ very large



D. Close Inbreeding
 $4NU, 4NS$ very small



E. Slight Inbreeding
 $4NU, 4NS$ medium

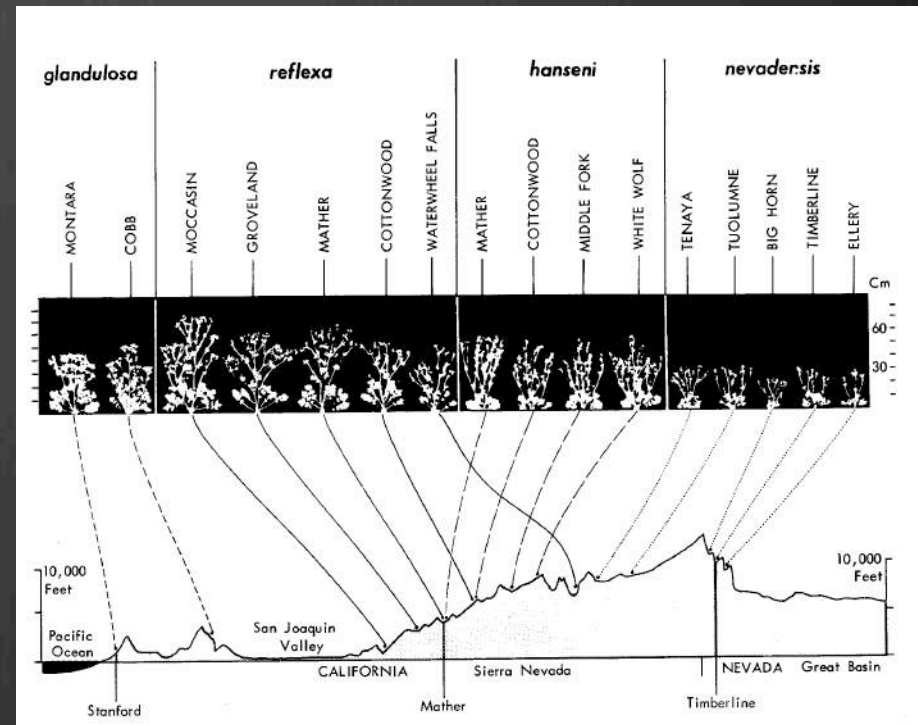


F. Division into local Races
 $4Nm$ medium



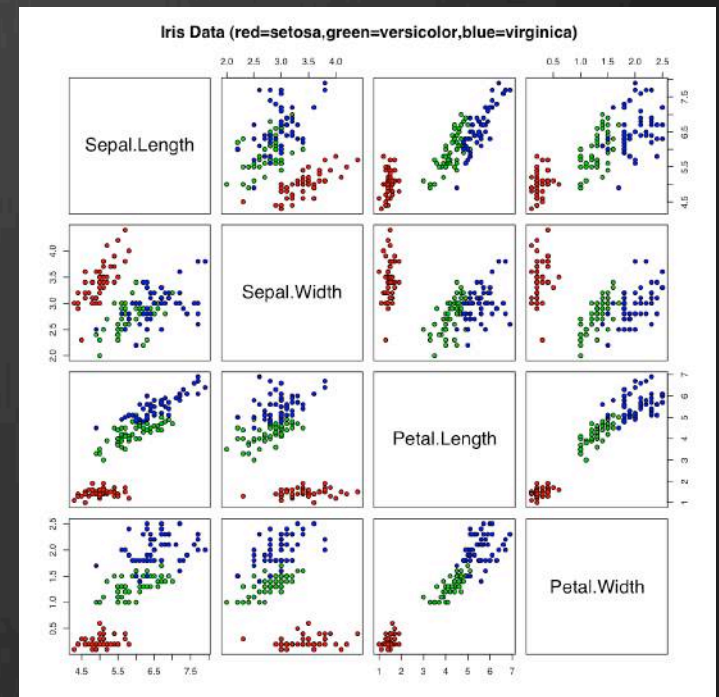
1941+ – Clausen, Hiesey, Keck
 ‘reciprocal transplants’ - ‘ecotypes’
 ‘California Biosystematic School’

Experimental Studies on the Nature of Species

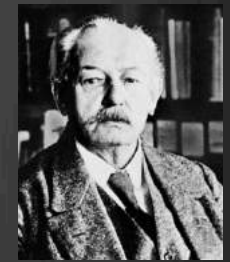




1949 – Edgar Anderson ‘*Introgressive Hybridization*’



1940s on – Carl Epling ‘California Biosystematic School’



Engler



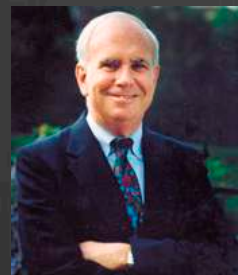
Greenman



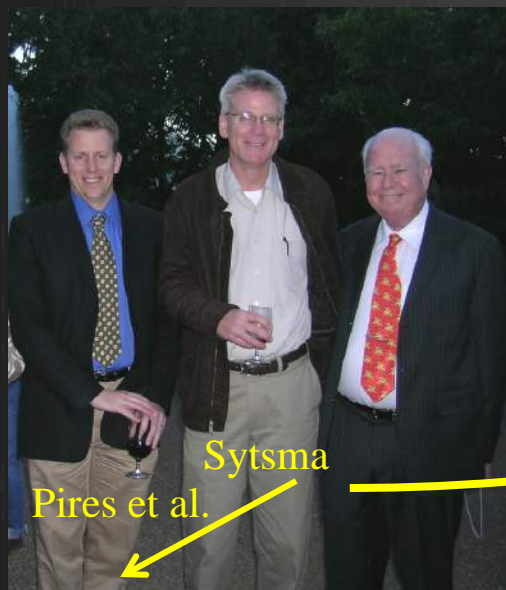
Epling



Lewis

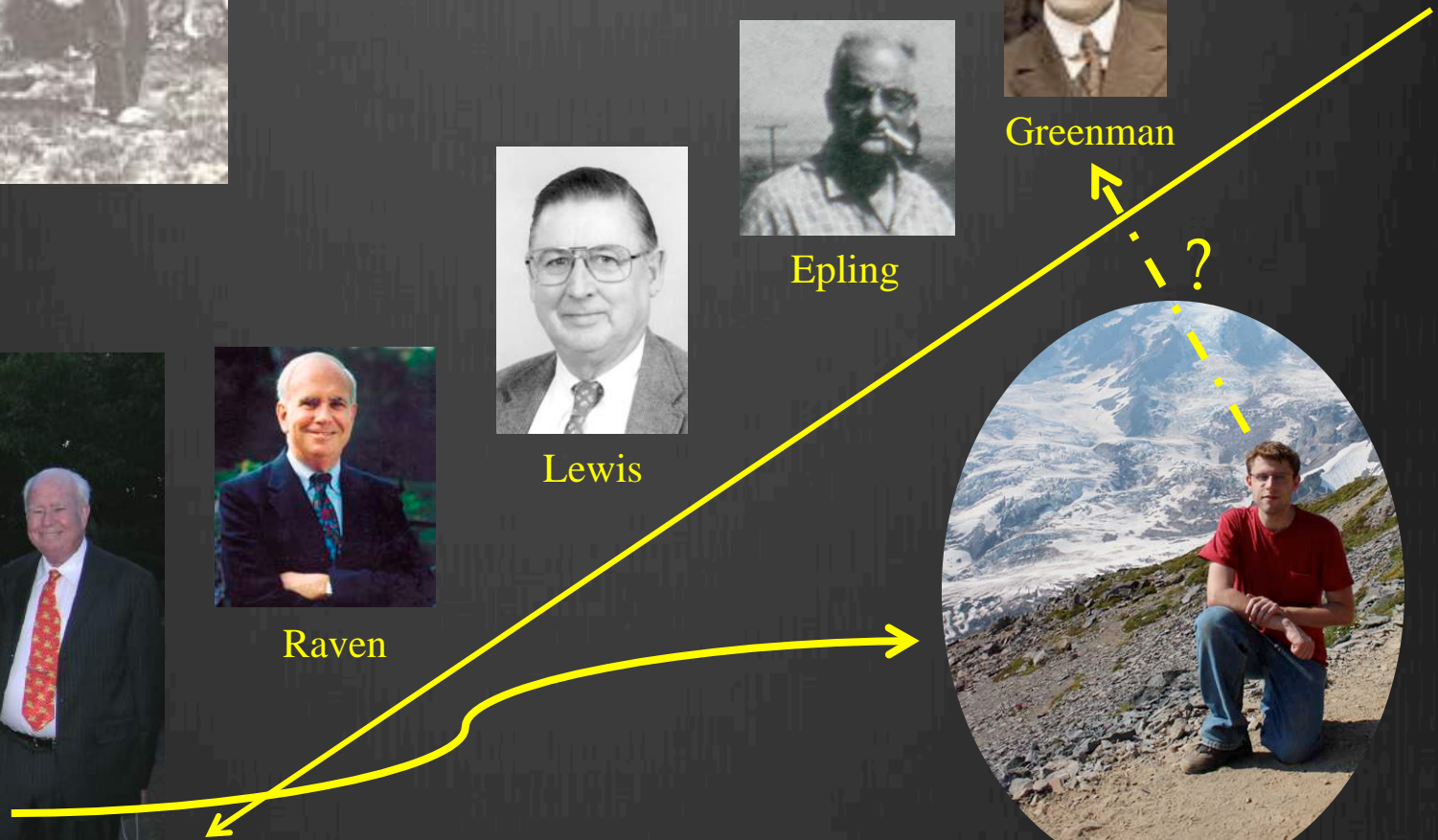


Raven



Sytsma
Pires et al.

reincarnation of Greenman?





1940s on – Carl Epling ‘California Biosystematic School’

1942. Genetics of natural populations. VI. Microgeographic races in *Linanthus Parryae*.

1947. Natural hybridization in *Salvia apiana* and *S. mellifera*.

1947. Actual and potential gene flow in natural populations.

1952. Increase in the adaptive range of the genus *Delphinium*.

“Careful study of this book – and it is assuredly pregnant with opportunity for careful study – can lead only to the realization that it **presents for the first time the grand patterns of evolution in the plant world**, implicit in the facts of systematics, and interpreted now in the light of genetics and cytogenetics”



1940s on – Carl Epling ‘California Biosystematic School’

*“One might wish, however, that the author had placed more emphasis on the **determinants of evolution** at the level of actual inter-breeding”*

Further discourse on “**patterns**” and “**processes**” of evolution

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Chapter 1

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Stebbin's Argument

- ⊗ “two cardinal facts” about organismal diversity in nature
- ⊗ 1. rampant variation is the rule (Darwin's “modification”)
- ⊗ 2. variation is hierarchically arranged (Darwin's “descent”)
- ⊗ Evolutionists, **therefore**, must be familiar with systematics
- ⊗ Systematics, **however**, have not done their work with proper point of view or method

*The great problem in dealing with this variation pattern is **not** acquisition of more data, but rather the **selection of facts to emphasize and their proper analysis***

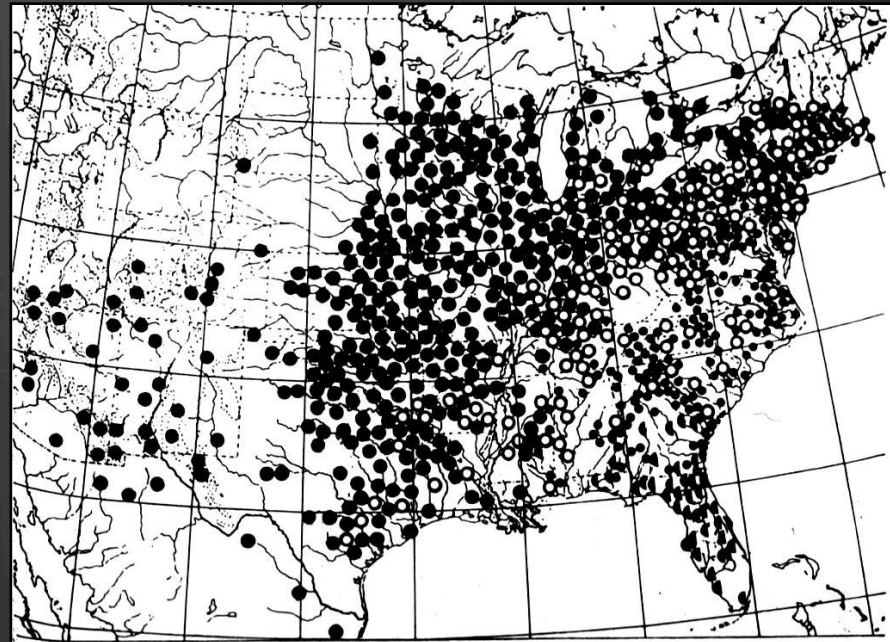
Stebbin's View of Systematics

- 1. Must use as many characters as possible across many individuals/populations



Woodson, 1946

- *A. tuberosa interior*
- *A. tuberosa tuberosa*
- putative hybrid



Stebbin's View of Systematics

- 1. Must use as many characters as possible across many individuals/populations
- 2. Must find ways of estimating variation quantitatively
 - biometry, statistics, "crude" diagrams

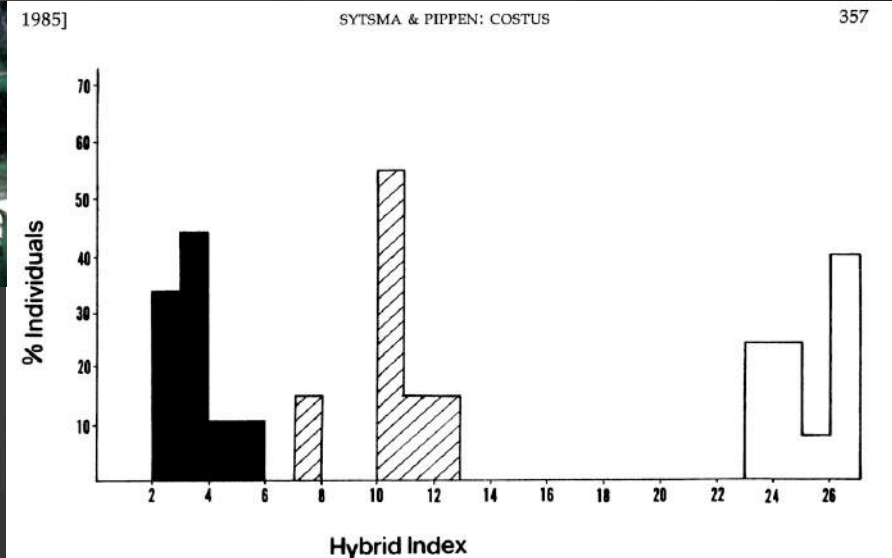
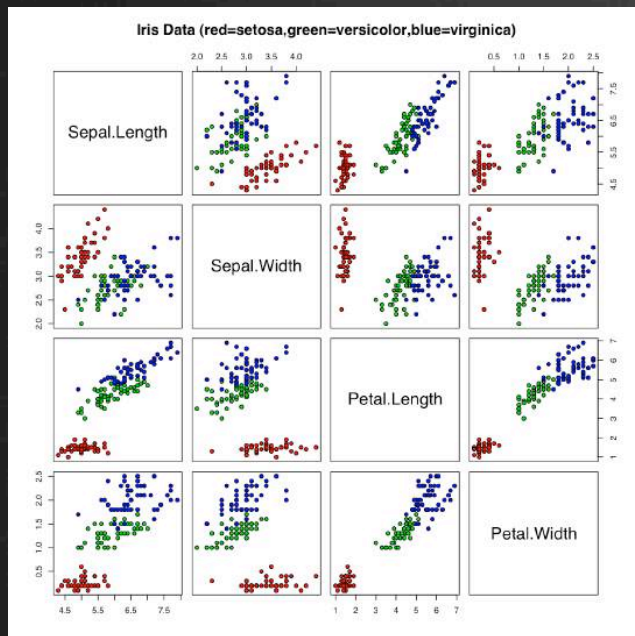


FIG. 6. Histogram of Andersonian hybrid indices for *Costus guianensis* (black, $N = 9$), the putative hybrid (striped, $N = 7$), and *C. pulverulentus* (white, $N = 12$) based on 27 morphological characters.

Stebbin's View of Systematics

- ⊗ 1. Must use as many characters as possible across many individuals/populations
- ⊗ 2. Must find ways of estimating variation quantitatively
 - ⊗ biometry, statistics, “crude” diagrams
- ⊗ 3. To understand evolution in group, must analyze the factors responsible for the its variation pattern
 - ⊗ environmental vs. genetic
 - ⊗ cytology, genetics, ecology

*The modern botanist who wishes to employ systematics as a tool for studying evolution must be **thoroughly grounded** in genetics, cytology, and ecology, and must **integrate the evidence** from all fields*

Stebbin's "bit of advice"

*Your understanding of general principles and hypotheses will be sound only **if you select the best methods** for obtaining facts relating to these hypotheses and are **fully aware** at all times **of the weaknesses** as well as **the strong points** of the methods*

Old and New Evidence

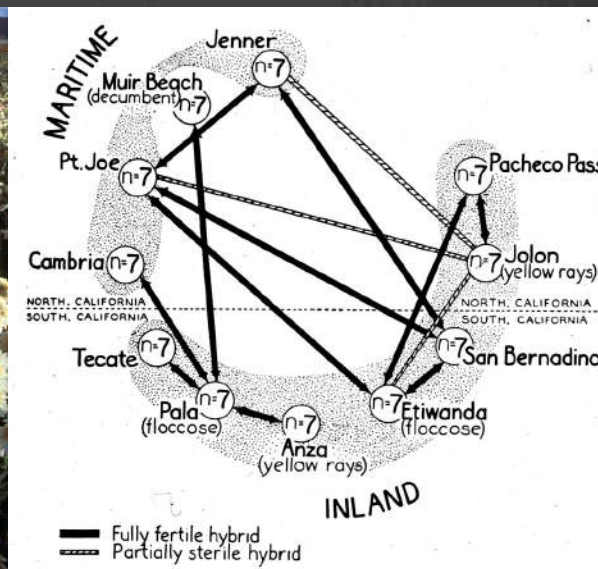
- ❁ 1. Gross morphology
- ❁ 2. Anatomy of organs (including herbarium specimens!)
- ❁ 3. Histology (tissues, pollen)
- ❁ 4. Cytology (different ways & levels)
- ❁ 5. Serology (protein differences)
- ❁ 6. Biogeographic distributions & ecology

Quantitative Methods – Three Approaches

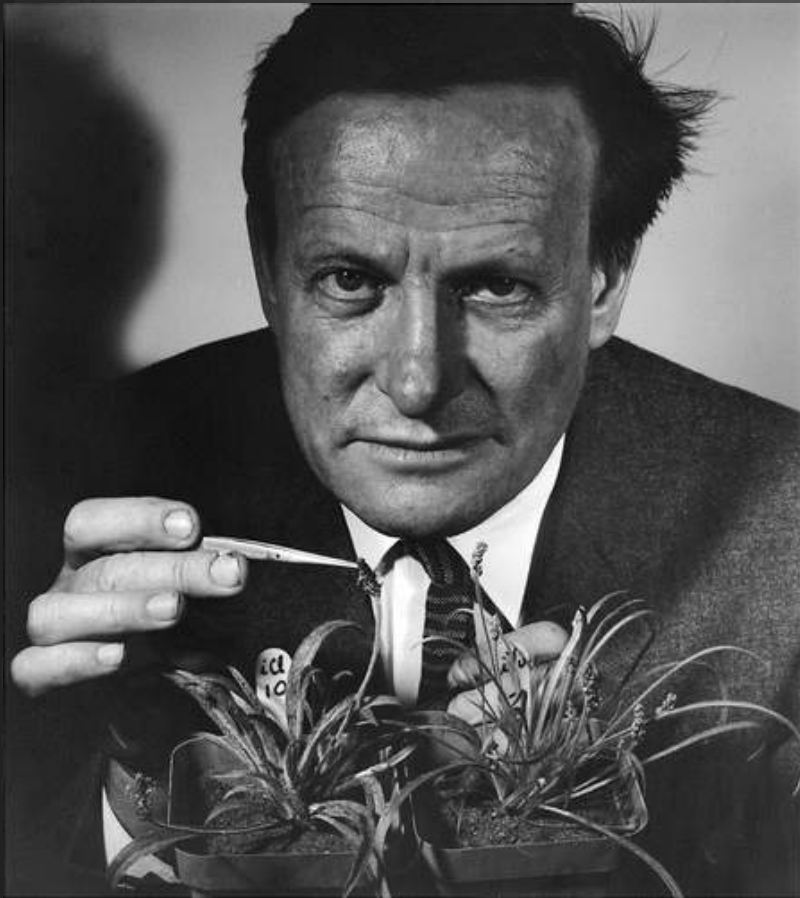
- ⊗ 1. Intensive study of 1-2 characters across many taxa
- ⊗ 2. Interrelationships of characters via histograms, numerical indices, ideographs, correlations, linear discriminant function
 - ⊗ many examples given here
- ⊗ 3. Intensive study of ∞ characters across few taxa
 - ⊗ example of Clausen, Keck, and Hiesey (morphology, physiology, environmental vs. genetic basis of variation)

Analysis Methods – Approaches

- ❁ 1. Common garden transplants (and derivatives)
- ❁ 2. Progeny tests
- ❁ 3. Artificial hybridization followed by cytological, genetic, and morphological studies



Concluding Thoughts



- ❁ 1. Rules of variation
- ❁ 2. Taxonomic categories
- ❁ 3. What is a **species**? What is a **genotype**? What is a **biotype**?
What is a **population**?

1950 – 2015: Change in methods, analyses (& thus questions)?

