The Greatly Exaggerated Rumors of the Death of Biometry

McMaster University Colloquium, March 26, 2021

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Outline

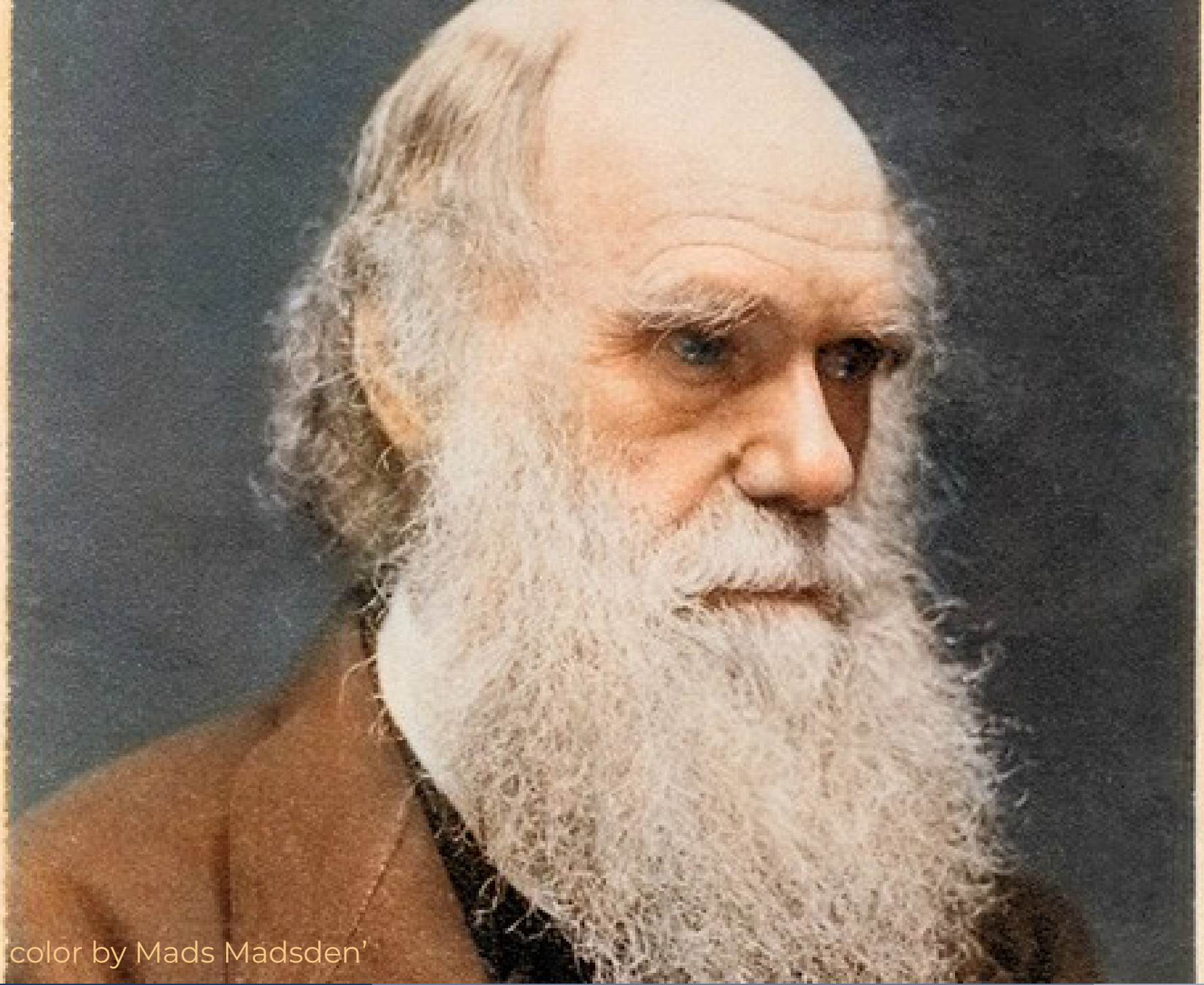
1. A classic history
2. What does it mean to make evolution chancy?
   - 2.1 The biometrical school
   - 2.2 The "interregnum period"
3. Finding common ground: toward the Synthesis

The take-home: A real continuity of philosophical approach – not a story of rupture and revolution – underlies the birth of chance in evolution.

Shameless Plug?

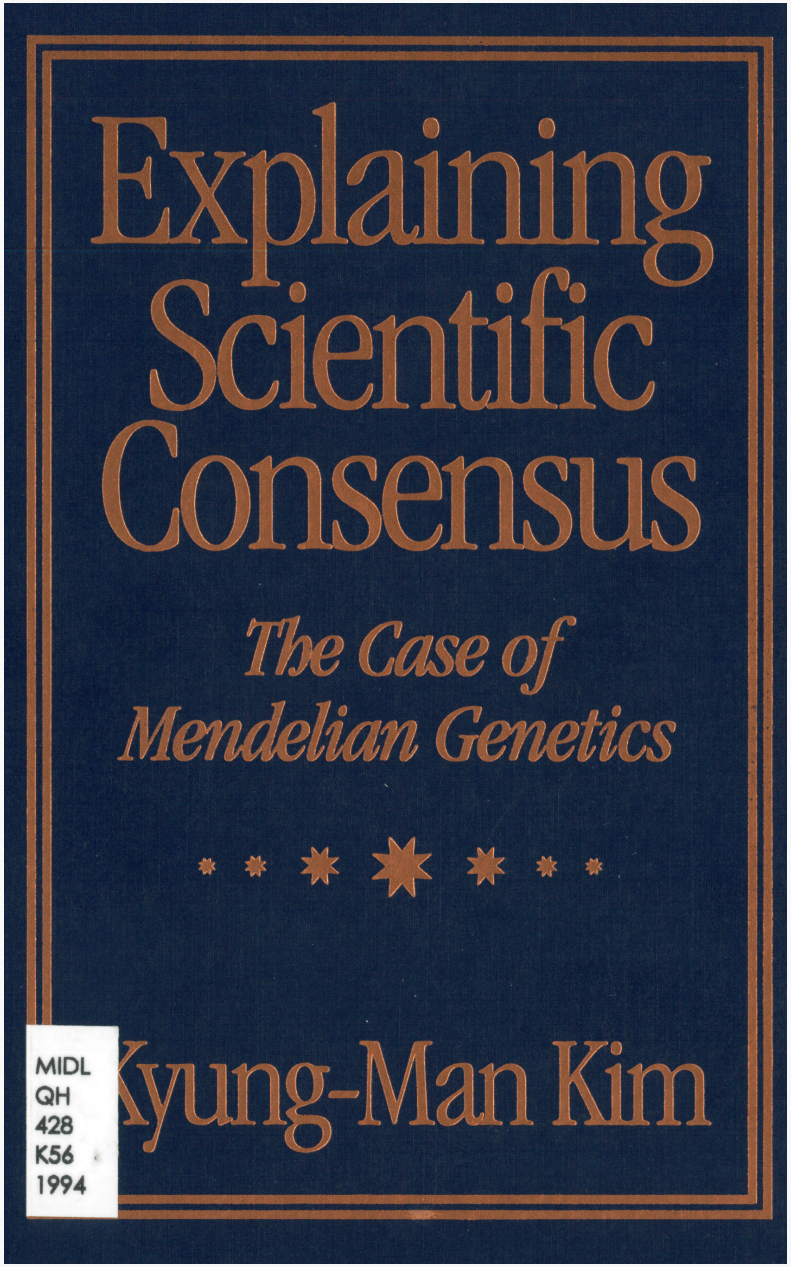
Book project: *A Pompous Parade of Arithmetic*

A Classic History


color by Mads Madsden’

What's the Problem?

Was the triumph of Mendelism really that straightforward?


Explaining
Scientific
Consensus
The Case of
Mendelian Genetics
Kyung-Man Kim
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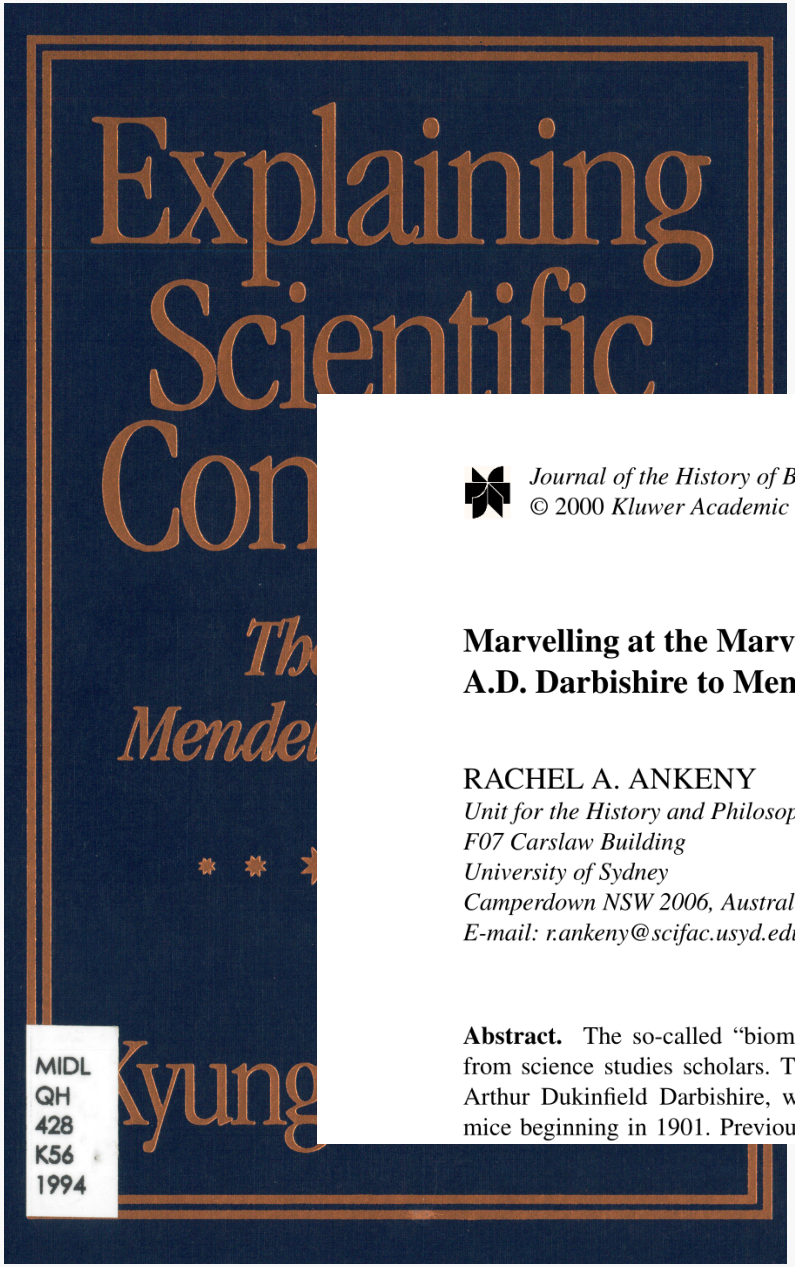

Journal of the History of Biology **33:** 315–347, 2000.

Marvelling at the Marvel: The Supposed Conversion of A.D. Darbishire to Mendelism

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Abstract. The so-called "biometric-Mendelian controversy" has received much attention from science studies scholars. This paper focuses on one scientist involved in this debate, Arthur Dukinfield Darbishire, who performed a series of hybridization experiments with mice beginning in 1901. Previous historical work on Darbishire's experiments and his later

Was biometry really a twenty-five year false start?

[The] personal quarrel [between Bateson and Weldon] certainly delayed the utilization of powerful methods of statistics in much of genetics. (Sturtevant)

There's sophisticated philosophy of science taking place in the biometrical community from the 1880s to the late 1900s!

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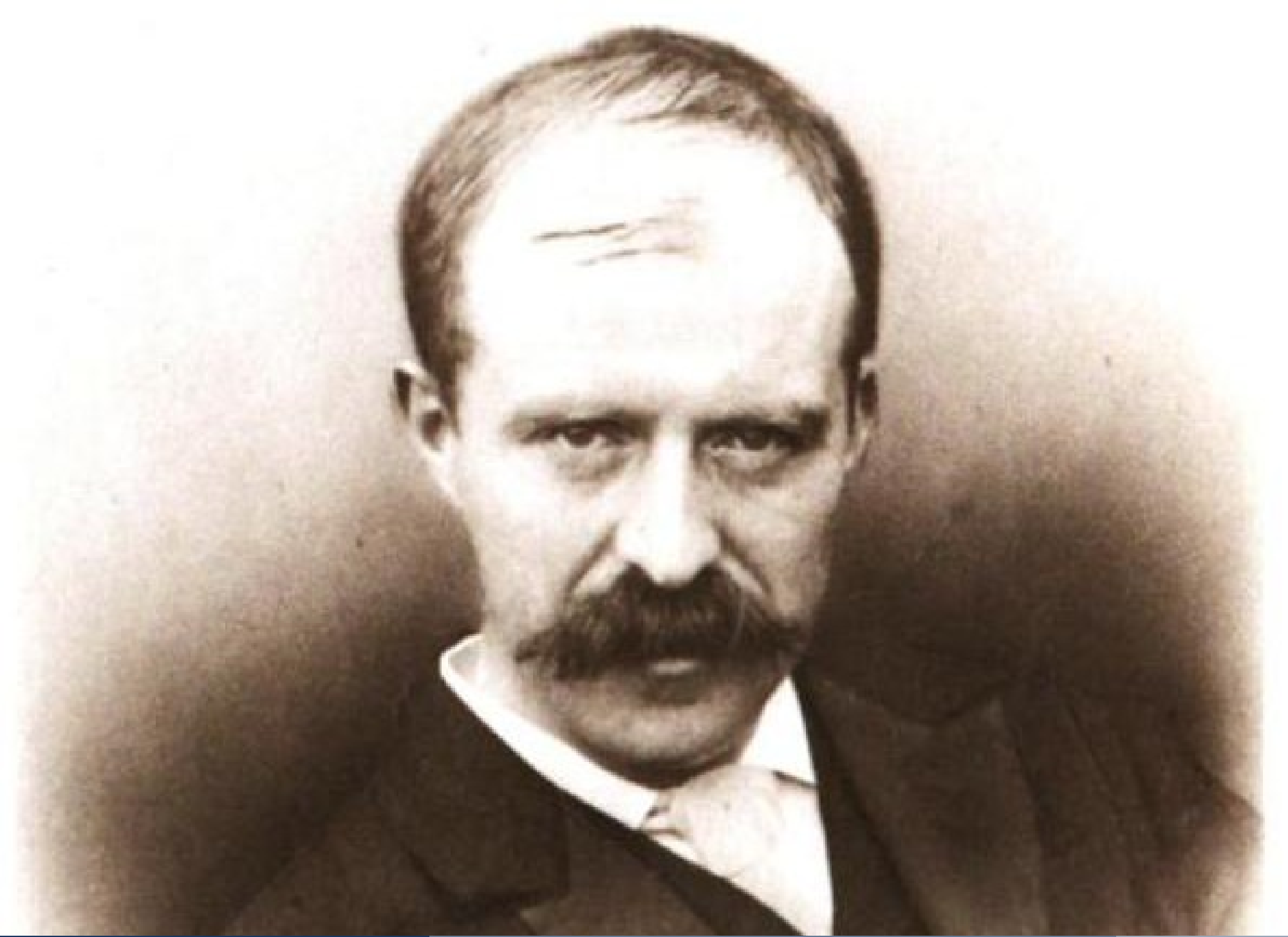
But if it's all abandoned anyway, why bother?

Making Evolution Chancy



The Late-Biometrical View

Weldon was in search of a **statistical** theory which could let us understand the **action of natural selection** across generations, at the **population level,** and which could be harmonized with **Mendelian inheritance,** at least as a special case.

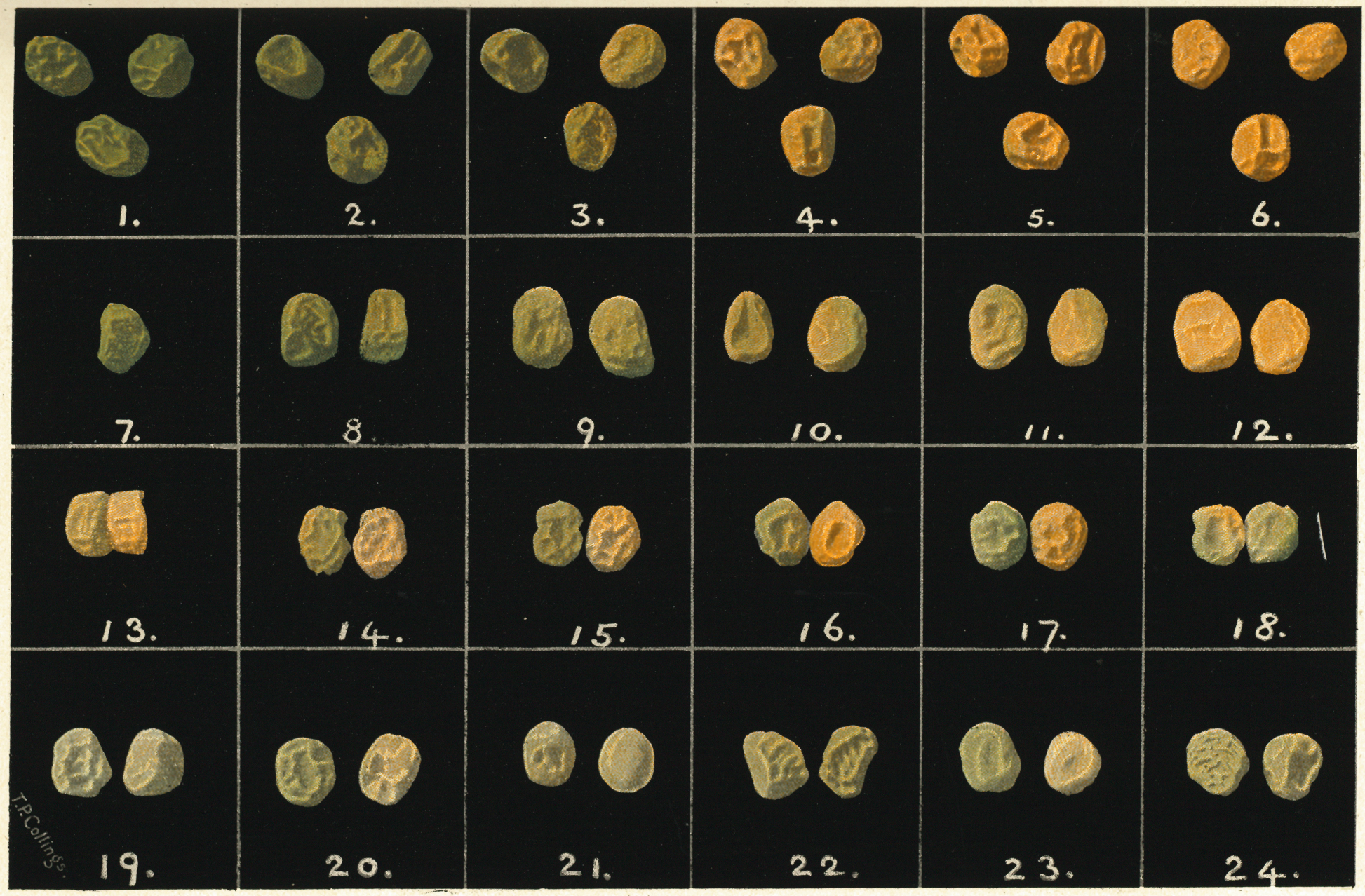
Statistical

Why statistics?

Statistical

Why statistics?

Lots of reasons, but in short: too many counterexamples to Mendelism!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T.P.Collings.

Natural Selection

Always preoccupied by the importance of selection for population change – in particular, because Galton had made a mess of this in his work!

Population Level

Evolution is always a distributional, populational phenomenon for the biometricians.

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Another weakness of the Mendelians: trying to derive too much from a single mating of two parents and their offspring!

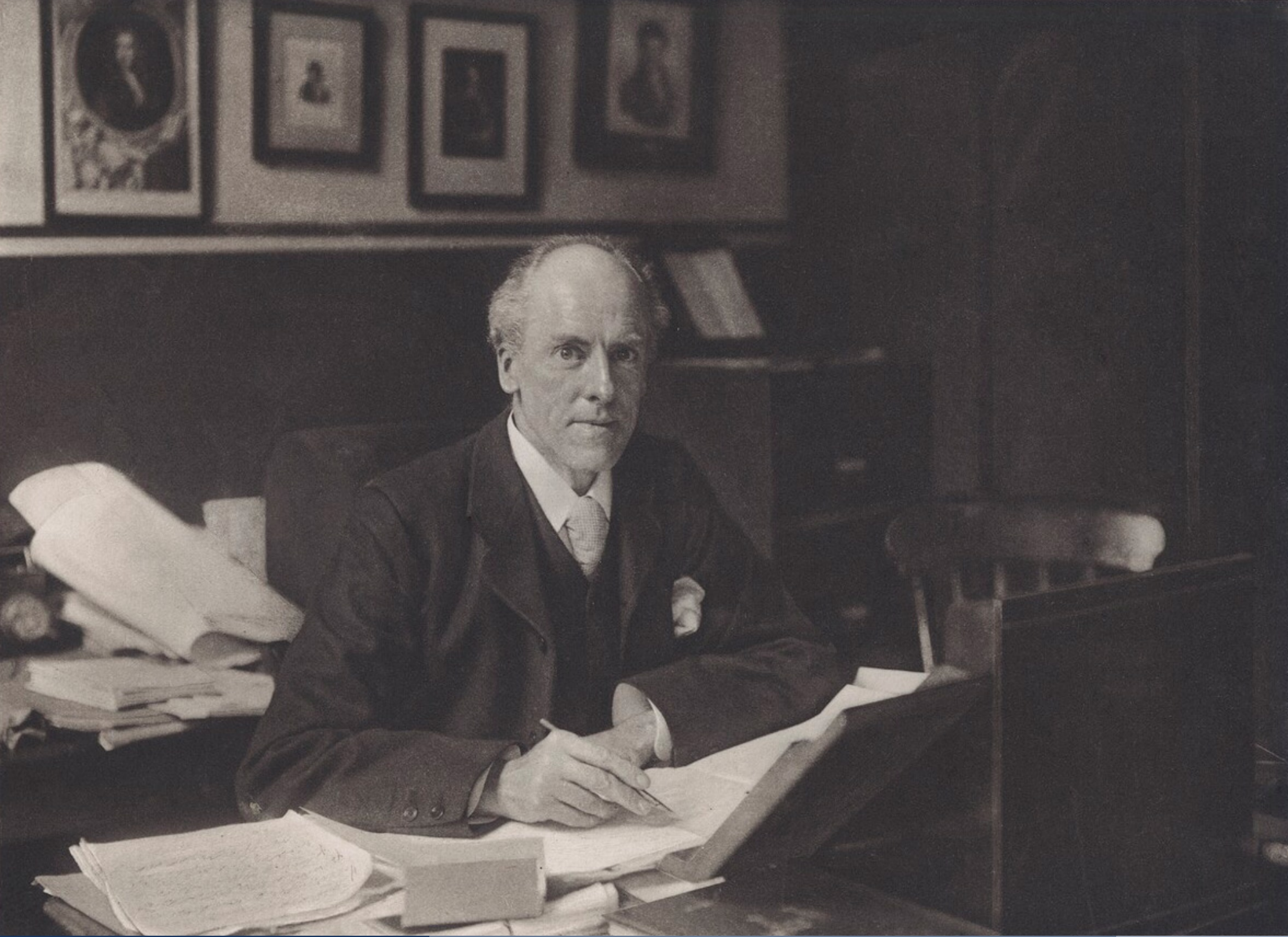
Mendelian Inheritance

But! After about 1903 or 1904, no real opposition to Mendelian inheritance as a pattern in nature, **sometimes.**

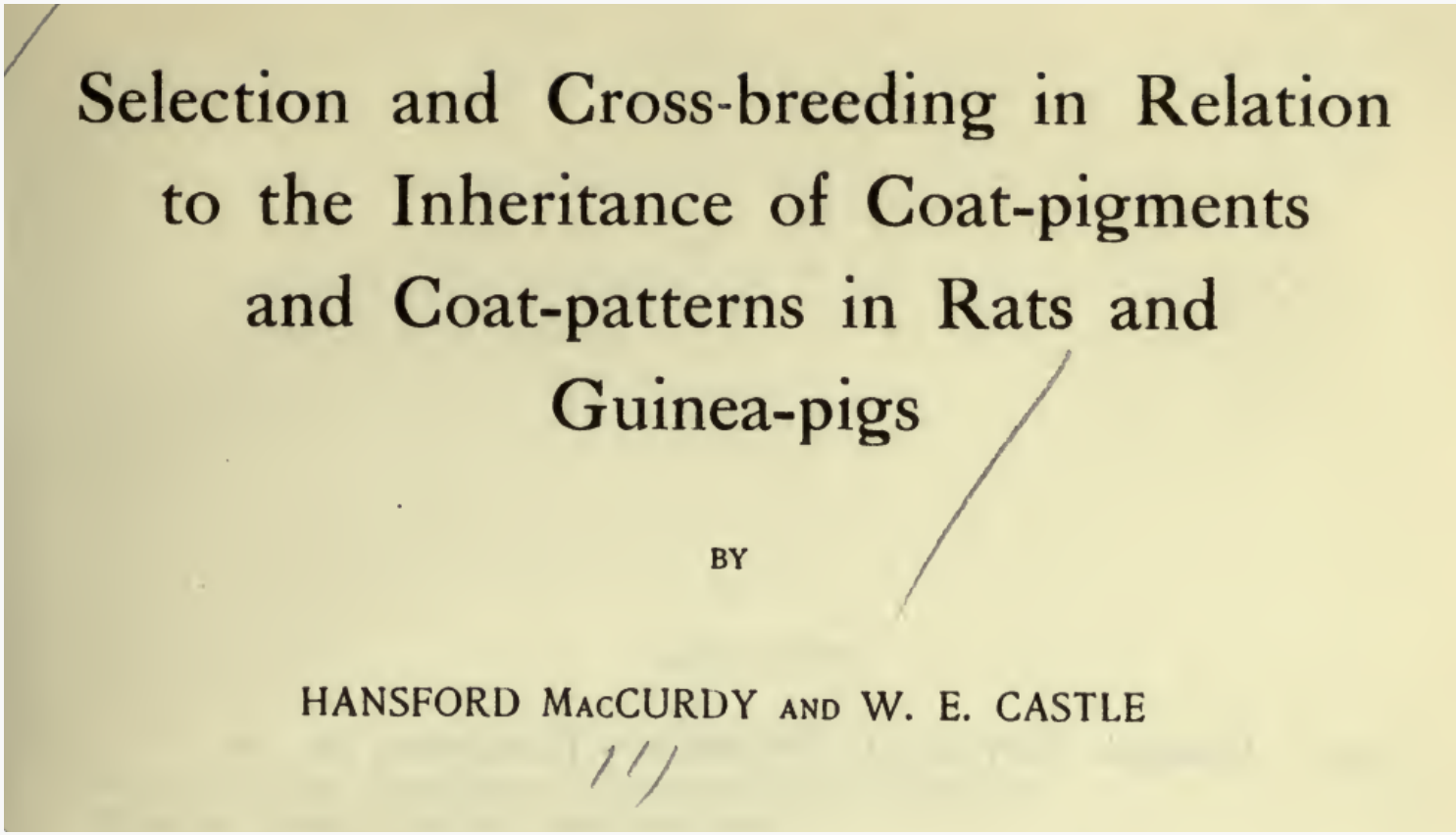
It is easy to say Mendelism does not happen. But what the deuce does happen is harder every day!

Weldon, letter to Pearson, 3 March 1903

After Weldon



Statistics without Statistical Inheritance



Selection and Cross-breeding in Relation to the Inheritance of Coat-pigments and Coat-patterns in Rats and Guinea-pigs

BY

HANSFORD MacCURDY AND W. E. CASTLE

Statistics without Statistical Inheritance

For those, however, who place confidence in **the more precise methods** of statistical analysis devised by Pearson and others, it may be more satisfactory to treat the tables, which have been constructed for the various groups of individuals, as correlation tables, and **derive from them the constants which measure the variability** of parents and children respectively in the several groups, and the degree of correlation between the two. (MacCurdy and Castle 1907, 25)

Statistics without Statistical Inheritance

> This is only possible, however, if the methods that have been – or at least should have been – followed in the research are given special consideration. An essential aspect of these methods is their mathematical character, and can be described as applied mathematics. Familiarity with these methods is absolutely necessary for a real understanding of many hereditary questions. (Johannsen 1909, 1)

Mathematical Inheritance without Statistics

> One must, as a rule, take the series of results as finished products, and make an independent study of them, endeavoring by processes of trial to fit them to some series or to some formula. It is here that there is scope for ingenuity; a given series of results may resist for weeks the discovery of the law that unites them.

Mathematical Inheritance without Statistics

> After a law or regular series is obtained that fits the first five or six generations, the law is applied to give the results for three or four generations more. These results are then tested by the actual detailed working out (symbolic formation of gametes and their mating, etc.).... (Jennings 1916, 62)

Mathematical Inheritance without Statistics

first assortative mating occurs thus when all are Aa).

(17) The population at the beginning consists of AA and Aa in equal numbers. After n assortative matings (including among these the first mating, where all are dominants), the proportions are as follows:

$$AA = \frac{3n+6}{4n+12}\text{; thus } \tfrac{9}{16}, \tfrac{12}{20}, \tfrac{15}{24}, \tfrac{18}{28} \ldots\ldots \tfrac{3}{4}. \quad AA_{72} = .740.$$

$$aa = \frac{n}{4n+12}\text{; thus } \tfrac{1}{16}, \tfrac{2}{20}, \tfrac{3}{24}, \tfrac{4}{28} \ldots\ldots \tfrac{1}{4}. \quad aa_{72} = .240.$$

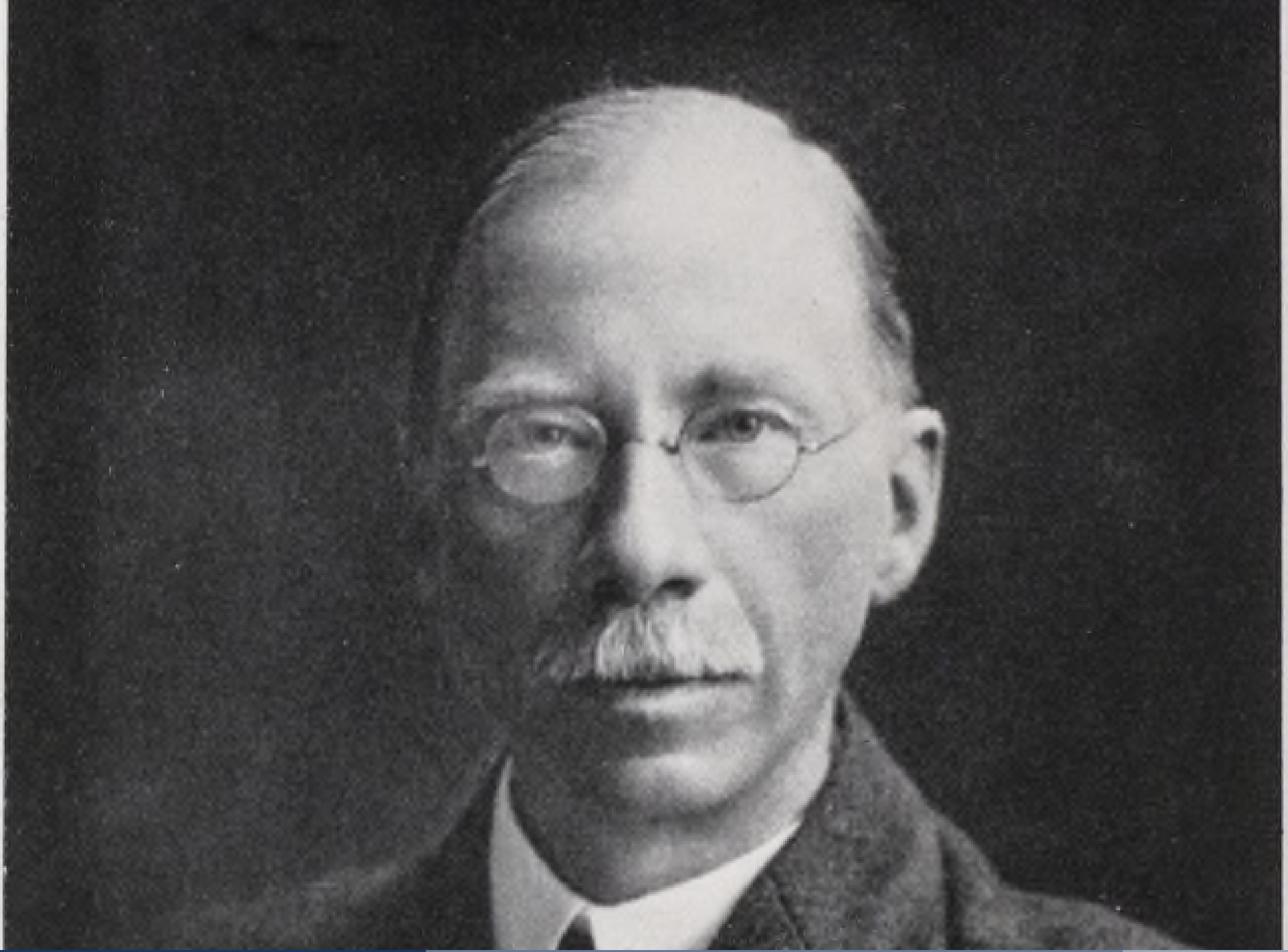
$$Aa = \frac{6}{4n+12}\text{; thus } \tfrac{6}{16}, \tfrac{6}{20}, \tfrac{6}{24}, \tfrac{6}{28} \ldots\ldots 0. \quad Aa_{147} = .010.$$

$$\text{Dominants} = \frac{3n+12}{4n+12}; \quad \text{recessives} = \frac{n}{4n+12}.$$

(18) At the beginning we have aa and Aa in equal numbers. If these

Statistics without Populations

> …when one considers the difficulty of distinguishing the zygotes having various [genotypic] formulae even when dominance is comparatively perfect, he might expect a population of [offspring] individuals with almost continuous quantitative variation if dominance is imperfect or absent. This gives a clue to a Mendelian interpretation of the inheritance hitherto known as blended. (Emerson and East 1913, 14)



A Try at Synthesis

> The value of the work of Mendel and his successors lies not in discovering a phenomenon inconsistent with that law [of ancestral heredity], but in shewing that a process, consistent with it, though neither suggested nor postulated by it, might actually occur. (Yule 1902b, 227)

A Try at Synthesis

> What is required from a physical theory of heredity is that it should assign a meaning to the variations in the constants that do occur, enabling one, given the law of ancestral heredity for an organ, to state the relative influences thereon of the different agencies concerned – selection, in all forms, circumstance, and so forth. (Yule 1902b, 237)

The Textbook Tradition

1. Robert Heath Lock's *Recent Progress in the Study of Variation, Heredity, and Evolution* (1906)
2. J. Arthur Thomson's *Heredity* (1908)
3. Edwin S. Goodrich's *The Evolution of Living Organisms* (1912)

The Textbook Tradition

No evidence of open warfare.

"These variations can often be accurately measured, and the statistical study of variation begun by Quetelet and Galton, and carried on by W. F. R. Weldon, K. Pearson, and others, has yielded many important results." (Goodrich 1912, 29)

The Textbook Tradition

General belief in the desirability of a synthesis.

Developing a new vocabulary "is all the more justifiable since we cannot doubt that all the ordinary phenomena are of a piece, that many of the ordinary modes will be embraced eventually in one general formula – probably some modification of Galton's Law of Ancestral Inheritance, and that others will be embraced in Mendelian formulae." (Thomson 1908, 109)

The Textbook Tradition

Caution against excess.

"Some students of biometry, however, would go very much further than this, for it is their professed position that their own form of study is the only method by which any real advance in our understanding of the processes of evolution can be brought about. This opinion is based upon the assumption, of which proof is wanting, that new species have arisen exclusively through the accumulation by natural selection of variations of a strictly indefinite, fluctuating, or normal kind." (Lock 1906, 74–75)

Common Ground

R.H. Lock

- E.B. Wilson uses Lock's book in lectures at Columbia (and it convinces H.J. Muller to study genetics)
- The Morgan group (Sturtevant and Bridges) discuss the book
- Sewall Wright reads it during graduate school

E.S. Goodrich

- Goodrich is an essential player in the Oxford biological scene for decades (see Morrell's *Science at Oxford, 1914–1939*); this connects him to E.B. Poulton and the Huxleys
- (Aside: Poulton was funded for years by James Mark Baldwin, so there's American connections here, too.)
- Goodrich's textbook becomes recognized as a model for pedagogical clarity and popularization (as does Thomson's; see Bowler's *Science for All*)

Haldane's only formal training in biology comes from attending Goodrich's lectures at Oxford.

R.A. Fisher studies Bateson's textbook, Pearson's articles, and (thanks to the detective work of A.W.F. Edwards) Lock's textbook.

A Pragmatist Connection?

Vicedo (1999) argues that the American side of this tradition – including Jennings and East, discussed here – were all within the orbit of major institutions where pragmatism was developed, and were all interested in social and ethical issues.

Concluding Thoughts

The story of the "death of biometry" is much more complex than it might have seemed; elements of a decidedly *biometrical* perspective persist straight through from 1905–1920.

Concluding Thoughts

Such a narrative can (1) de-emphasize the "revolutionary" novelty of the early Synthesis authors, (2) tell a story of continuity over this period, and (3) help us focus on what it meant to bring chance and statistics to evolution for each of these different authors.

Questions?

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