Darwin's Views of Chance

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Outline

1. Introduction
2. Darwin Before the *Origin*
3. Chance in the *Origin*
4. The later works: *Orchids* and *Variation*
5. A few morals

The take-home: Darwin admitted several clear notions of 'chance' in his work – but always intended to contain and justify them in the context of a deterministic, Newtonian philosophy of science.

Book Project

A Pompous Parade of Arithmetic:
The Rise of Chance in Evolutionary Theory

1. Chance, Variation, and Charles Darwin
2. Galton and Weldon's Early Statistical Work
3. The Pearson-Weldon Collaboration
4. Biometry after Mendel
5. One Route to the Modern Synthesis: Fisher and Wright
6. Another Path: J.B.S. Haldane

If I am as muzzy on all subjects as I am on proportions & chance,—what a Book I shall produce!

Darwin, letter to John Lubbock, 14 July 1857

I fear you must take it as a fact that Darwin had no liking for statistics.

Francis Galton, letter to Karl Pearson, July 1901

Before the *Origin*

From Lyell to Darwin

Darwin's jumping-off point is Lyell on species:

From Lyell to Darwin

Darwin's jumping-off point is Lyell on species:

- Cause of destruction: redistribution of climatic patterns
- Cause of creation: occasional but regular appearance of new species

From Lyell to Darwin

If the existence if species is allowed, each according to its kind, we must suppose deaths to follow at different epochs, & then successive births must repeople the globe or the number of its inhabitants has varied exceeding[ly] at different periods. — A supposition in contradiction to the fitness which the Author of Nature has now established. — (geology notes of 1835)

Notebook Work

From 1835–1838: first formulations of his evolutionary work (e.g., notebook B), *no* discussion of chance

Notebook Work

An habitual action must some way affect the brain in a manner which can be transmitted. – this is analogous to a blacksmith having children with strong arms. – The other principle of those children, which *chance?* produced with strong arms, outliving the weaker ones, may be applicable to the formation of instincts, independently of habits. (N42, November, 1838)

From Notebooks to *Origin*

Only mention in *Sketch* of 1842 or *Essay* of 1844:

> absurdity of habit, or chance ?? or external conditions making a woodpecker adapted to tree (*Sketch*, p. 10, 1842)

Chance in the *Origin*

From Notebooks to *Origin*

But no one I should think could extend this doctrine of chance to the whole structure of an animal, in which there is the clearest relation of part to part, & at the same time to other wholly distinct beings. (book MS, p, 174, 1855)

From Notebooks to *Origin*

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Moreover the causes, which from their extremely complex nature we are forced generally to call mere chance, which produced the first variation in question [leading to an adaptation] would under the same conditions often continue to act.… (book MS, pp. 214–5, 1855)

The *Origin*

[Horticulture] has consisted in always cultivating the best known variety, sowing its seeds, and when a slightly better variety has chanced to appear, selecting it, and so onwards. (p. 37)

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…individuals having any advantage, however slight, over others, would have the best chance of surviving and of procreating their kind…. (p. 81)

The *Origin*

[E]very slight modification, which in the course of ages chanced to arise, and which in any way favoured the individuals of any of the species, by better adapting them to their altered conditions, would tend to be preserved.…
(p. 82)

The *Origin*

I have hitherto sometimes spoken as if the variations – so common and so multiform in organic beings under domestication, and in a lesser degree in those in a state of nature – had been due to chance. This, of course, is a wholly incorrect expression, but it serves to acknowledge plainly our ignorance of the cause of each particular variation.
(p. 131)

The Response

I have heard by round about channel that Herschel says my Book 'is the law of higgeldy-pigglety.' – What this exactly means I do not know, but it is evidently very contemptuous. – If true this is great blow & discouragement (letter from Darwin to Lyell, 10 December 1859)

The Response

…whether it was not allowable (& a great step) to invent the undulatory theory of Light – ie hypothetical undulations in a hypothetical substance the ether. And if this by so, why may I not invent hypothesis of natural selection … & try whether this hypothesis of natural selection does not explain (as I think it does) a large number of facts? (letter from Darwin to Henslow, 8 May 1860)

Chance after the *Origin*

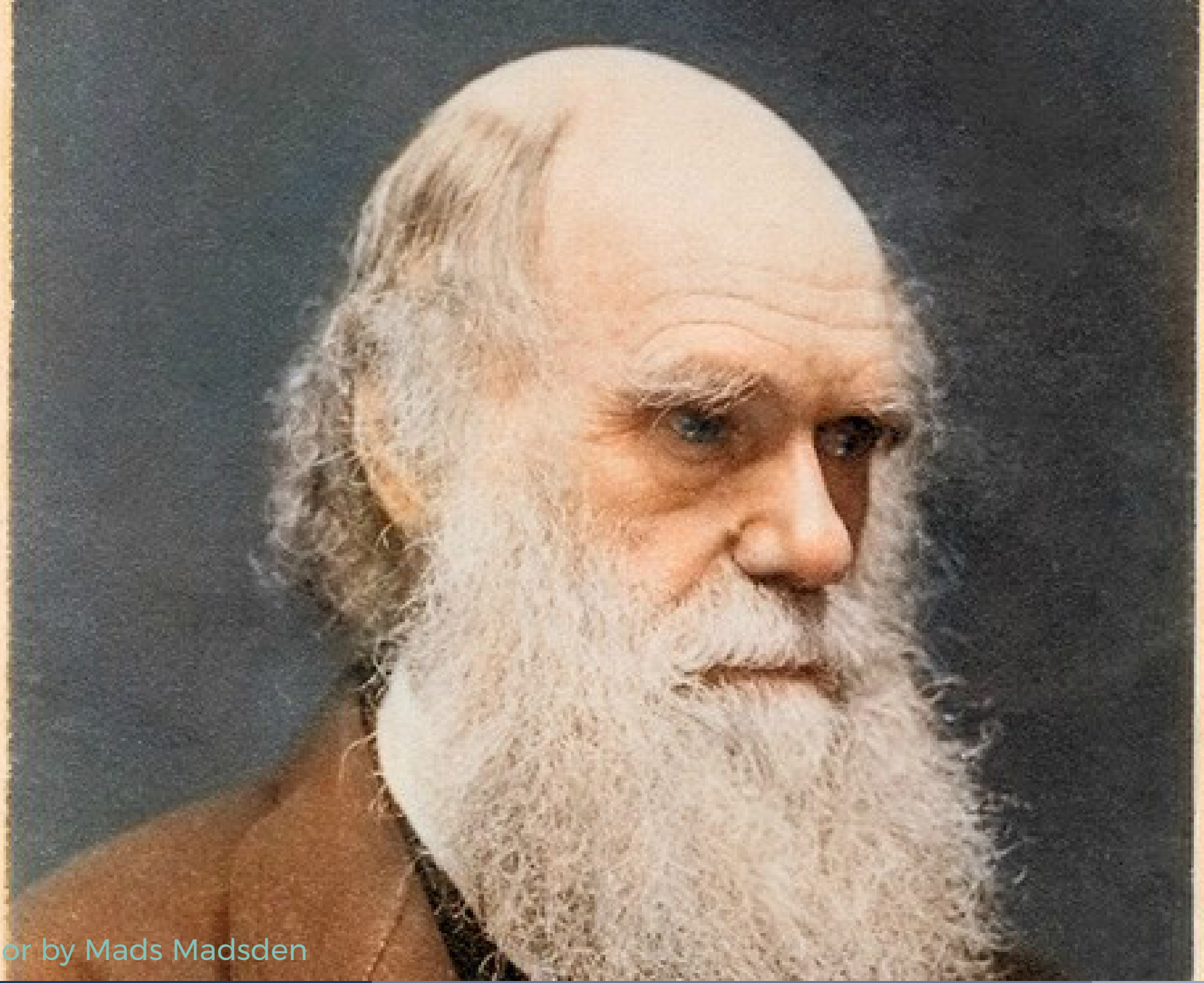
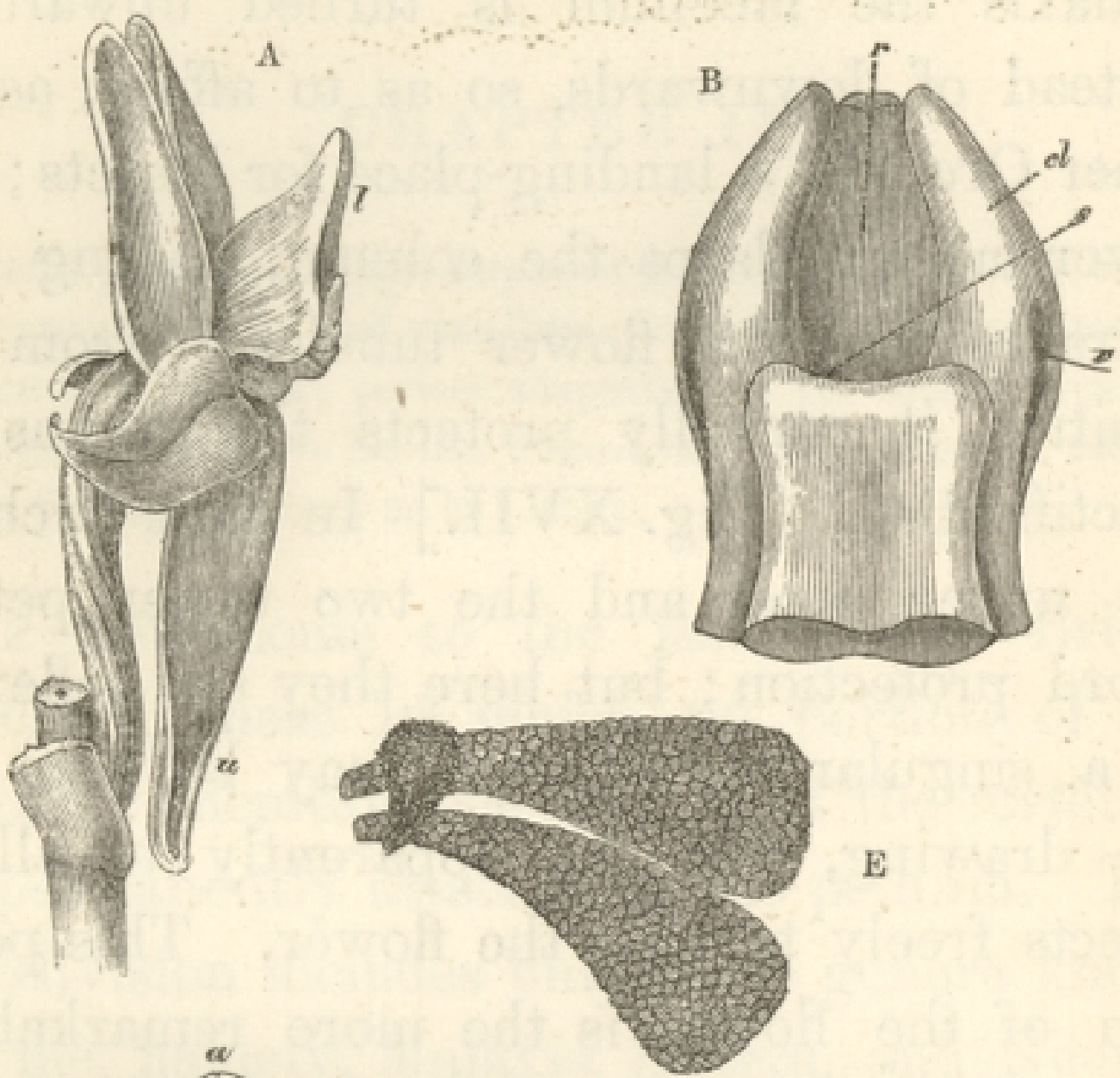

color by Mads Madsden

Fig. XVII.



p. 132

Malaxis paludosa

As all the parts of a flower are co-ordinated, if slight variations in any one part are preserved from being beneficial to the plant, then the other parts will generally have to be modified in some corresponding manner. But certain parts may not vary at all, or may not vary in the simplest corresponding manner.

Malaxis paludosa

[The modification] might simply be effected by the continued selection of varieties which had their ovarium a little less twisted; but if the plant only afforded varieties with the ovarium more twisted, the same end could be attained by their selection until the flower had turned completely round on its axis.… (*Orchids*, pp. 349–50, 1862)

Tinkering and Constraint

The flowers of Orchids, in their strange and endless diversity of shape, may be compared with the great vertebrate class of Fish, or still more appropriately with tropical Homopterous insects, which seem to us in our ignorance as if modelled by the wildest caprice. (*Orchids*, p. 285, 1862)

Definite Variation

[Variations which] act in a definite manner on the organisation, so that all, or nearly all, the individuals thus exposed become modified in the same manner. (*Variation*, 2:345, 1875)

Indefinite Variation

But a far more frequent result of changed conditions, whether acting directly on the organisation or indirectly through the reproductive system, is indefinite and fluctuating variability. (*Variation*, 2:345, 1875)

[These variations] may be considered as the indefinite effects of the conditions of life on each organism, in nearly the same manner as a chill affects different men in an indefinite manner, according to their state of body or constitution. (*Origin* 6e, 6–7, 1876)

Summing Up

Incidental Uses of Chance

- Law of large numbers
- Opposition to design/intent

Central Uses of Chance

- Ignorance of causes that leads to the characterization of indefinite variation
- Nature of selection as a tendency toward improvement, not a guarantee

But!

Always governed, constrained, and limited by natural selection!

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Intended to fit squarely within a Newtonian (really, Herschellian) philosophy of science

Questions?

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Accident vs. Design

The shape of the fragments of stone at the base of our precipice may be called accidental, but this is not strictly correct; for the shape of each depends on a long sequence of events, all obeying natural laws; on the nature of the rock, on the lines of deposition or cleavage, on the form of the mountain, which depends on its upheaval and subsequent denudation, and lastly on the storm or earthquake which throws down the fragments. But in regard to the use to which the fragments may be put, their shape may strictly be said to be accidental. (*Variation*, 2:427, 1875)

The Law of Large Numbers

In a population consisting of "sixty millions, composed, we will assume, of ten million families, each containing six members," then "the odds will be no less than 8333 millions to 1 that in the ten million families there will not be even a single family in which one parent and two children will be affected by the peculiarity in question." (*Variation*, 1:449, 1875)