#### December 6th, 2022 ACCADEMIA NAZIONALE DEI LINCEI «Meeting on the occasion of the bicentenary of Gregor Mendel's birth»

### MENDEL, DARWIN AND GENETICS: AN HISTORICAL PERSPECTIVE

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- Certainly, not the European center of science
- Poor Slesian family, Augustinian monk in St. Thomas, Bruno
- Studies of mathematics, statistics and botany (Doppler)
- Teacher of experimental physics



The many sides of Gregor Mendel

#### **Gregor Mendel was many things!**



He crossed fruit trees and vines (winning prizes for **new varieties of apples and pears**)

He succeeded in **crossing tropical bees and Mediterranean bees** (honorary fellow of National Beekeeping Society)

March 30, 1868 he was elected abbot

He joined the Liberal Party, antagonizing many monks and the Catholic Church. Rebellion against unfair taxes from the Austro-Hungarian Empire.







### He turned to **meteorology with great** success

In Mendel's official obituary (January, 1884) his meteorological studies are quoted as more important than those on the hybridization of plants!





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### The missed manuscript

A manuscript, lost and found... («Experiments on Plant Hybridization»,

8 February and 8 March 1865) 24,000 pea plants grown up to 1868!



40 reprints



Gregor Ministels. [Herzeland as been Filingun anna 5. franna 28. Arring 1859]

Entertente Beneckingen

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Disappeared 1945-1988 (2010, dispute: Mendel's relatives VS Augustinian order; 2012 Mendel Museum in Brno) Mendel and Darwin: Lost in translation In the very same years (January 1863 to May 1865) another naturalist was working on the same issue: the nature of heredity

February 1865: Darwin is reading W.C. Spooner's tract on «blended characters»

May 1865: first manuscript on the «provisional hypothesis of Pangenesis» sent to Huxley.

1868-1875: *The Variation of Plants and Animals under domestication* (vol. II, chapter XXVII).

Variation: «the other side of my long argument»

Inheritance <u>of</u> variation: the fuel of natural selection (inheritance and variation as antagonistic forces; «any variation which is not inherited is unimportant for us»)



Blending inheritance (the norm) VS inheritance by separation or segregation (anomaly to be explained) things that came out of that Commission's report? This, namely, that most of the teachers of Science in the Army Schools received notice to quit. England, on the high authority of Lord Northbrook, did not want a Scientific Army.

All this by the way. We have referred to these instances, in order to show that the various departments of the Administration want scientific control here as is in France—that M. Deville's suggestion is of value here as there.

Now, assuming that the suggestion is a vital one, or even that it is an important one, and that it is good for England as for France, and we shall gladly open our columns to a discussion on these points; the question arises—is it possible to adopt it here?

We are met at once by the different conditions of the French Academy of Sciences, and our own Royal Society. The Academy is a large paid body; our Royal Society is a small unpaid body, and the work, which M. Deville considers so necessary for the regeneration of France,

### Galton is checking blending inheritance...

tions, calls into her councils her men of Science, and becomes a Science-aided State. EDITOR

#### PANGENESIS

TN a paper, read March 30, 1871, before the Royal Society, and just published in the Proceedings, Mr. Galton gives the results of his interesting experiments on the inter-transfusion of the blood of distinct varieties of rabbits. These experiments were undertaken to test whether there was any truth in my provisional hypothesis Mr. Galton, in recapitulating "the of Pangenesis. cardinal points," says that the gemmules are supposed " to swarm in the blood," He enlarges on this head, and remarks, "Under Mr. Darwin's theory, the gemmules in each individual must, therefore, be looked upon as entozoa of his blood," &c. Now, in the chapter on Pangenesis in my "Variation of Animals and Plants under Domestication," I have not said one word about the blood, or about any fluid proper to any circulating system. It

#### April 27, 1871]

#### NATURE

fusion and cross circulation on a large scale in rabbits, and have arrived at definite results, negativing, in my opinion, beyond all doubt the truth of the doctrine of Pangenesis." If Mr. Galton could have proved that the reproductive elements were contained in the blood of the higher animals, and were merely separated or collected by the reproductive glands, he would have made a most important physiological discovery. As it is, I think every one will admit that his experiments are extremely curious, and that he deserves the highest credit for his ingenuity and perseverance. But it does not appear to me that Pangenesis has, as yet, received its death blow; though, from presenting so many vulnerable points, its life is always in jeopardy; and this is my excuse for having said a few words in its defence. CHARLES DARWIN

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#### London, South Kensington, Summer 1862, 20 miles





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#### Darwin did not read Mendel, but...

a) Mendel did not send to DW his paper (just 4 / 40 reprints found; Swiss botanist Karl von Nägeli in Munich does not react)

b) DW did not subscribe to the proceedings of the Brünn Natural History
Society (the issue of the Proceedings was included in the Royal Society Catalogue in London in 1879)

c) Mendel never cited in DW published works and correspondence. BUT, two secondary sources from hybrid plants experts (in DW library):

- 1) Botanist Heinrich Hoffmann (1869) quoting Mendel, but superficially, and DW did not annotate the references to Mendel (pp. 136-138: DW and Mendel quoted together about genus *Pisum*!);
- 2) Physician Wilhelm O. Focke (1881): good description of Mendel's work, but pp. 108-110 remained uncut in DW copy! (then DW sent his copy to G. Romanes for an article in the Encyclopaedia Britannica).



### Mendel read Darwin (before publishing his seminal paper in 1865), but...



Both of them corresponded simultaneously with Carl W. Von Naegeli since 1867...



- Mendel's notes on the *Origin*: most about evolution VS religion (acceptance)

- Mendel never thought to work on Darwin's problem about heredity

- His focus: Technical problems about breeding in botany

- He had doubts about the universality of his results (*Hieracium*)



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### 2. Even if Darwin had read Mendel...



**BioMed** Central

Opinion Why didn't Darwin discover Mendel's laws? Jonathan C Howard

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#### a) Novelty of Mendel's statistical method.

b) Inheritance by blending and pangenesis (gemmules)

c) The nature of variation in DW: abundant, continuous and small quantitative variations (VS unit characters and big variations, «sports»), giving differential fitness by infinitesimal differences.

«Quantitative variation is the last place where clean Mendelian inheritance can be seen» (multiple allelic systems; sensitivity to environmental variables, etc.)

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#### Darwin and the peas

Notebook E (1838): «Do races of peas become intermixed & gardener have hybrid seedlings?»

Darwin to Wallace, February 6, 1866: «My dear Wallace, ... I do not think you understand what I mean by **the non-blending of certain varieties**. I crossed the **Painted Lady** and **Purple sweetpeas**, which are very differently coloured varieties, and got, even out of the same pod, **both varieties perfect but not intermediate**. These cases are in appearance so wonderful, but I do not know that they are really more so than every female in the world producing distinct male & female offspring.»







"Now I crossed the peloric snapdragon (*Antirrhinum majus*) with pollen of the common form; and the latter, reciprocally, with peloric pollen. I thus raised two great beds of seedlings, and not one was peloric. ... I carefully examined the flowers of ninety plants of the crossed *Antirrhinum* in the two beds, and their structure had not been in the least affected by the cross, except that in a few instances the minute rudiment of the fifth stamen, which is always present, was more fully or even completely developed. It must not be supposed that this entire obliteration of the peloric structure in the crossed plants can be accounted for by any incapacity of transmission; for I raised a large bed of plants from the peloric Antirrhinum, artificially fertilised by its own pollen, and sixteen plants, which alone survived the winter, were all as perfectly peloric as the parent-plant. Here we have a good instance of the wide difference between the inheritance of a character and the power of transmitting it to crossed offspring. The crossed plants, which perfectly resembled the common snapdragon, were allowed to sow themselves, and out of a hundred and twenty-seven seedlings, eighty-eight proved to be common snapdragons, two were in an intermediate condition between the peloric and normal state, and thirty-seven were perfectly peloric, having reverted to the structure of their one grandparent." (Variation, 1868, Vol. II, p. 46)

Dominance in F1 + Ratios in F2: 2.4 to 1 (in other cases 2.6 to 1)



## A single observation is not enough!

Peloric

### Wild type

Darwin noted the near-complete dominance of the wild type and the segregation of the recessive allele in the F2. This floral trait, determined by a single recessive allele, could have given Darwin the Mendelian ratios if he had pursued his breeding experiments.

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Nature of the Offspr	ring from Illegitimately fertil Plants.	ised Din	norphic
	- <u>* +</u>	Number of Long- styled Offspring.	Number of Short- styled Offspring
Primula veris	Long-styled form, fertilised by own-form pollen during five successive generations, pro- duced.	156	6
yy yy • •*	(Short-styled form, fertilised by) own-form pollen, produced . }	5	9
Primula vulgaris	Long-styled form, fertilised by own-form pollen during two successive generations, pro- duced.	69	0
Dominant form			- 10
Primula auricula	Short-styled form, fertilised by own-form pollen, is said to produce during successive generations offspring in about the following proportions	25	75

DW, The different forms of flowers on plants of the same species, 1877



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### A posthumous rediscovery

Mendel sent a copy of his paper to bacteriologist M.W. Beijerinck, who sent it to Hugo De Vries in 1900. Hugo De Vries met DW in London, Summer 1878. October 1881, De Vries to DW: «I am studying the causes of variation in plants and I am very interested in Pangenesis"



Material (and variable) bearers of hereditary qualities (+ A. Weismann)

«Pangene, 1889» to «genetics / gene» (1905 William Bateson – 1908 Wilhelm L. Johannsen)



+ Carl E. Correns (student of Nägeli; experiments 1892-1900)

#### + Erich von Tschermak

(Vienna, his grandfather Eduard Fenzl was Gregor Mendel professor of botany) REDISCOVERY OF MENDEL'S LAWS (1900)



How to connect variation and natural selection?

Focus on mutations of large effect and large-scale discontinuous variation as driving forces in evolution

MACROMUTATIONISM – SALTATIONISM (anti-Darwinian approaches, missed encounter again...)

### MODERN SYNTHESIS: A POSTHUMOUS MEETING



Consistent theoretical framework: at the end, the posthumous reunion!



palazzodelle esposizioni

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### And many other stories...

The great book of life from Mendel to genomics

DNA

February 10 – June 18, 2017



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