INHERITING ERASMUS' WORRIES ON HEREDITARY ILLS: THE PATHS OF HEREDITY WITHIN THE DARWIN FAMILY

CARLOS LÓPEZ-BELTRÁN*

> When we hear it said that a man carries in his own constitution the seeds of an inherited disease, there is much literal truth in the expression.
>
> CHARLES DARWIN

The concept of heredity became a center of biological theorizing during the nineteenth century. In its development a trajectory can be traced from its being a secondary, open ended, "soft" concept that captured a set of accidental peculiarities, to its becoming a strictly structured, controlling notion that defines a deterministic view of life, particularly of human beings and their capacities. Biological heredity began as a human concern and never really stopped being one. The existence of diseases that are communicated through reproduction from parents to offspring was a main theme in its emergence. Families worried about their physical heritage. The Darwins were among those worried British families that ended up playing a major role in the configuration of heredity as a biological and cultural resource. Three of its members can be seen as representing different stages of the complex process of the forging of heredity.

The eighteenth century French physician and historian of medicine Pierre-Joseph Amoreux saw that two parallel developments were responsible for a surge in interest in hereditary transmission of disease among medical men after the seventeenth century. One was the growth of urban populations in Europe; the other European worldwide explorations of increasingly remote places. Through these events European physicians were brought into contact with a much

* Instituto de Investigaciones Filosóficas, Universidad Nacional Autónoma de México.

wider variety of human groups and with their peculiar endemic (regional) maladies. and on the other hand, with a collection of constitutional ailments that different classes, racial groups, or families developed with higher frequency than others in urban concentrations. Hereditary transmission seems, at some point, to have become the most economical way of describing and explaining the very complex patterns of occurrence of certain diseases, either ethnic or urban.

ERASMUS DARWIN'S HEREDITY

As Philip K. Wilson has shown,[1] Erasmus Darwin (1731-1802) had a lifelong preoccupation with hereditary disease. This interest he shared with many physicians of his generation, especially in France.[2] In his posthumous poem *The Temple of Nature* (1803) doctor Darwin wrote:

> The clime unkind, or noxious food instills
> To embryon nerves hereditary ills;
> The feeble births acquired diseases chase
> Till death extinguish the degenerate race.
> .....
> E'en where unmixed the breed, in sexual tribes
> Parental taints the nascent babe imbibes;
> Eternal war the Gout and Mania wage
> With fierce unchek'd hereditary rage;
> Sad Beauty's form foul Scrofula surrounds
> With bones distorted, and putrescent wounds;
> And, fell Consumption! thy unerring dart
> Wets its broad wing in Youth's reluctant heart.[3]

These couplets reflect the poet-physician's view of how hereditary diseases work as a negative trend against the general current of improvement and perfection on which life is embarked, and particularly as a menace to lineages and families that are stricken as they tend to

[1] Wilson, 2007
[2] López-Beltrán, 2007
[3] E. Darwin, 1803, canto II, IV, pp.163-166, 177-184.

perish. The typical hereditary diseases —gout, mania, scrofula and consumption- which were among the most feared by Europeans of the time, are given in these verses a will of their own, as if their purpose were to invade and take root in the generational movement of the families or nations in order to destroy them. This kind of fears were never too far from the minds of all the medical and natural historian attempts to understand the mysteries of resemblances between parents and offspring or between different members of the same families or groups, nations or races. The two main questions that made this maintenance of resemblances a crucial phenomena were then the worrying existence of family-linked diseases and the physical and "spiritual" differences perceived among the various human groups. Resemblances include thus both the normal and the pathological and keep both particular and general features through the generations within family lines.

Erasmus Darwin makes use of the association of the hereditary with the deviant common in the late eighteenth century.[4] It evoked pathology, deviations from the type, and degeneration. It was associated with the maintenance of variations within given genealogical lines, whether families, tribes, or nations. E. Darwin wrote for one of the additional notes to this long poem a short essay explicating these few verses[5]. "All the families —he writes— both of plants and animals appear in a state of perpetual improvement or degeneracy, it becomes a subject of importance to detect the causes of these mutations." Degeneracy (or negative variation) E. Darwin identifies with "hereditary disease." External influences ("the clime unkind or noxious food") disrupt the normal conformation of the plant or animal, and once in it, such disease tends to pass (through generations) to the subsequent generations using the internal, self-replicating habits that constitute "the hereditary." Symmetrically, we learn in other parts of E. Darwin's oeuvre, positive variations are incorporated and subsist into the future, transforming and perfecting the types of individuals, families, groups or species.

Wilson would show that E. Darwin "had considerable experience with diseases that appeared in the same family —his family."[6] One particular worry was related to his certainty that his first wife, Mary

[4] López-Beltrán, 1994.

[5] E. Darwin "Hereditary Diseases," additional note XI, 1803...

[6] Wilson, 2007, p. 35.

Howard (Charles Darwin's grandmother) was the hereditary victim of her father's alcoholic intemperance, which made her weak and liable to transmit her depravities to their offspring.[7] The destiny of a family was to him linked to these physical inheritances. He wrote, for instance: "As many families become gradually extinct by hereditary diseases, as by scrofula, consumption, epilepsy, mania, it is often hazardous to marry an heiress, as she is frequently the last of a diseased family."[8] The notion of hereditary defects as produced externally and eliminable from the lineage gave options, however, for families to adopt to improve themselves and to survive.

Sex, according to Erasmus Darwin, is the only remedy against the eventual destruction that degeneracies bring to any genealogical line once they have set root on it. Organisms without a sexual mode of reproduction are, therefore, more prone to hereditarily perpetuate and aggravate any induced flaw, and become extinct.

It is, he writes, the "greater similitude of the progeny to the parent in solitary reproduction [that] must certainly make them more liable to hereditary diseases; if such have been acquired by the parent from unfriendly climate or bad nourishment, or accidental injury."[9]

The use of the adjective "hereditary" did not carry in E. Darwin nor in many of his contemporaries a strong explanatory weight. "Hereditary," however, had powerful "moral" connotations. Good or bad human qualities were said to run in families, groups, nations, and the metaphor of heredity was used in theological, ethical and social disputes with some regularity. Despite E. Darwin's declared intention of giving in his work and notes an objective account of Nature's ways, the poet (and prophet) in him eclipses the naturalist, as he exploits the metaphorical strength of the term, plants and animals becoming a mere mirror for his "apocaliptic" concerns: Families (or genealogies) made peculiar by transmissible physical and moral characters, ill or good, erupting in them from the outside by some kind or other of influence (curses or blessings), these themes provide a powerful storyline that has been repeatedly used in traditional literature. Darwin the physician and naturalist informs his ethical narratives by drawing analogies from other organisms, plants and animals, wild or domesti-

[7] Wilson, 2007, pp. 35-36.

[8] E. Darwin, 1803, Additional notes, p. 45, 1803, cited by Galton on the interleaf of his copy of *Hereditary Genius*, 1869.

[9] E. Darwin, 1803.

cated. The structure that he, alongside some of his contemporaries, gave to the emerging concept of heredity determined the shape it would have in the other, non-pathological realms, and not the other way round. The idea of variation itself was highly "pathologized" in most medical minds. For instance, hereditary pathologies were seen as the source of variation between races within the human species. Degeneration, in its Buffonian sense, was associated to deviation from the healthy original stocks. The idea that these distortions of human (and animal) constitution could start by accidental individual occurrences that somehow managed to root themselves into the constitution and use the generation process to be passed from parents to offspring both fascinated and mystified late eighteenth century thinkers. Especially for its consequence that whole genealogical lines (families, groups, nations, races) could be in the end marked (tainted) by such accidents. The hygienist stance however dominated Darwin and his peers, as they believed that it was within the medical profession's power to change the conditions of life and slowly erradicate the origin of hereditary ills. Families had to be careful but hopeful.

CHARLES DARWIN'S HEREDITY

Erasmus Darwin's famous grandchild also gave a major role to hereditary transmission of physical properties. Charles Darwin (1809-1882) partially based his argument for natural selection on the idea that physical and behavioral variations which give or withdraw advantages to organisms are hereditary to an important extent. Linked to hereditary phenomena was his provisional hypothesis of pangenesis, published in *The Variation of Animals and Plants under Domestication* (1869). But Darwin's engagement with heredity predates and overflows pangenesis.

Darwin's family was very close-knit and endogamous. Given its social and economic status as industrial landlords, meritocratic, and provincial, they considered good breeding as a social responsibility. Consanguinity was a worry. There were several marriages among relatives and a constant fear for them was damaging their children by transmitting weak constitutions and hereditary ailments. Charles Darwin, who married his cousin, suffered from strange "constitutional"

ailments most of his life, and he often blamed himself for transmitting his bad physical organization to his children. As Janet Browne wrote, "Hereditary disease naturally bothered him too. While he was ill, Darwin lingered on the topic with morbid unease... his children's disorders seemed to him as variants of his own." Browne added that Darwin "was never quite sure if reproduction between might inadvertently bequeath to the offspring a series of innate weaknesses, infertility or a tendency towards disease."[10] Theorizing about heredity was not only a scientific issue for him. Pangenesis was a way out of his familial worries.

Darwin always worked by compiling thousands facts he collected from everywhere. He built his theories upon those facts brought to him by from books, letters or personal observations. They came from natural settings, farms, hospitals, migration offices or his backyard. The details and consequences of sexual reproduction was a natural stage for his research on heredity. He started rereading his grandfathers' works, which touched all sorts of reproduction. He helped himself to the works of breeders and horticulturalists around the world. He became a keen reader of French medical literature on hereditary disease and degeneration. He wanted to understand the connection between the physical features of parents and those of the offspring; its similarities and differences; he wanted to know how in reproduction variations occur that take a deep root in hereditary constitution. "Changes in the conditions of life" was a phrase he wished to understand, as he saw in that a main causal input for variation and hereditary change.

Between 1839 and 1855 Darwin wrote his observations in notebooks. While searching for hereditary phenomena he found instruction in medical literature and the criteria suggested by physicians for picking put "the hereditary." Phenomena like "latency," "predispositional causation" and "homochrony" were seen by him as an important sign of a special kind of causality. He carefully observed hybridization, crossbreeding, regeneration, and similar phenomena related to the acquisition or loss of the normal form.

In his notes Darwin seems to believe physicians and breeders on the strength and scope of heredity. He understands the paradoxes brought in by the multiple exceptions to transmission. He accumulates pedigrees, clinical cases and unusual hereditary stories. He

[10] Browne, 2002, p. 279

searches for a material ground, a physiology, a process in which the apparent dispersion and confusion of data dissolve. He creates the hypothesis of Pangenesis which apparently comes to him at the end of the 30s. It is a re-discovery, or re-deployment of an old idea. Characteristic particles (gemmules) form the entire body gather together in the reproductive organs and form the seminal matter that comes together for the formation of the new being in sexual reproduction. These gemmules carry a memory of resemblance and variation resulting in the phenomena of hereditary transmission. He grows fond of the theory and after publication defends it aggressively.[11]

Darwin resisted the temptation to postulate unobservable principles and anchored heredity and variation to a hypothetical physiological focus; his speculations were tied to sets of singular observational facts. For him the solution to irregularity of hereditary transmission was a combination of internal (physiological) and external influences. Such dialectic defines a predispositional (probabilistic) behavior of hereditary phenomena. The variation allowed (and probably preordained) by dispositional internal arrangements and triggered by external changes. The latent heredities revealed through atavistic reversions were also the result of predisposition. In his vision the course of potential elements carried through the generation by means of "reproduction" faces each time different (internal) conditions of the body in the environment (external), and thus shaped —directed — form inside and outside, producing bodies which are consequence of equilibrium of tendencies to change and conservation. These tendencies are not, as in Prosper Lucas' case, real Newtonian forces but "appearances" or tendencies product of the accruement of particular internal and external causes. Once again the minor causes, which add up their effects through cycles and repetitions, are the ones that provoke great transformations.

A proper historical reconstruction of the concept of biological heredity needs to pay attention to relatively marginal practices. I have focused on the struggle to define hereditary diseases during the eigteenth and nineteenth centuries. Other practices like stockbreeding and horticulture were also crucial as they paid close attention to individual variation. The perseverance through the generations of typical features of a species was not a salient explanatory target for naturalists

[11] Browne, 2002, pp. 274-321

before the nineteenth century, as most systems of generation took it for granted. Neither was the continuous appearance of individual variations and idiosyncratic features. The domain of heredity, as Darwin worked its way into it, melded both set of phenomena and aimed at explaining them in a unified way. In Charles Darwin's views, in its first formation the organism received a set of causal dispositions that were not absolutely in control. Less malleable than his grandfather's notion, his hereditary influence was more dialectical than his cousin's.

FRANCIS GALTON'S HEREDITY

Francis Galton (1822-1911) is eminent for having "hardened" heredity and established clear criteria for investigating transmission independently of other phenomena. Erasmus Darwin was also Galton's grandfather.

Galton was also obsessed with genealogy, family reckoning, and hereditary transmission of ills and goods within lineages. His research on hereditary transmission famously began by trying to establish the objectivity of the claim that talent (or genius) ran in families. He was also very aware of the evil side of familial heritage, and when young was even scared and anxious about it. There is a probability that his ironical decision not to have children (if it was a decision) was related to this kind of worries. Revisiting in his research an old theme treated by his grandfather Erasmus, Galton "found a very simple, adequate, and novel explanation, of the common extinction of peerages." He argued that "a considerable portion of the new peers and of their sons had married heiresses" and his

> statistical lists showed, with unmistakable emphasis, that these marriages are peculiarly unprolific. We might, indeed, have expected that an heiress, who is the sole issue of a marriage, would not be so fertile as a woman who has many brothers and sisters. Comparative infertility must be hereditary in the same way as other physical attributes, and I am assured it is so in the case of domestic animals. Consequently the issue of a peer's marriage with an heiress frequently fails, and his title is brought to an end."[12]

[12] Galton, 1869, p. 132.

This is a theme that Charles Darwin discussed repeatedly in relation to lineages of species with more or less fecundity.

Throughout his career Francis Galton pulled the discussion of historical hereditary variation out of the domains of geography, climate, physiology, medicine, animal breeding and physical anthropology, and placed it in a more abstract, statistical, rarefied domain of character and population averages. For many early nineteenth century naturalists each species was seen as consisting of a constant genealogical flow with two concentric but independent streams: a core one that provides the main structure and that is unaffected by innovation or variation; and an external (multiply caused) which pushes out (via innovation) to change and innovate, and that preserves these variations (through heredity) in such a way as to form stable subspecific groupings. Accidental trait variation could be induced externally (climate, food, disease) and become hereditary. The longer a trait has been within a group the firmer it becomes and the more likely it will be that a member of the genealogical line will receive it. This creates a sort of separation between the sets of characters that the race, the national group and the family impose over the newly forming being. Racial characters are more strongly "pushed" than national, and these more strongly than "familial." Sometimes the father's characters are more strongly pushed than the mother's, and vice versa. But all the subspecific characters are liable to be affected by change. This liability increases of course with the superficiality (or individuality) of the trait.

This typological metaphor is that ancestral heredity creates the races, the varieties, the nations, the family... And each parent's (male and female) types exert differential forces (of heredity) over the new individual at the moment of its first formation that are counterbalanced by physiological, climatic, nutritional and other disturbing influences. This is a strongly compelling narrative. It allows for a picturing of both constancy and variation, as it makes the individual the product of a compromise, of a resultant of forces. It has also room for accounts of hybridization and of selective breeding. The dialectic of external influence and internal hereditary preservation managed to broadly save the appearances.

Francis Galton arrived to heredity through his interest in ethnology, product of his trips and observations in Southern Africa. The focus of his initial attention was the set of physical and moral char-

acteristics of the different human races. He became convinced that most of the differences were rooted in the physical constitution, even the moral and psychological ones. The family and the nation, as sub-racial ethnological categories around which clusters of characteristics could be held together, as also relationship between individual genius and national character, were at the forefront of his early reflections. George H. Lewes, who Galton enthusiastically read and assimilated in that period, had adapted for British empirical taste Prosper Lucas' theoretical construct that made families, nations and racial groupings dependent on a kind of historical sub-types. He wrote that "unless parents transmitted to offspring their organisations, their peculiarities and excellencies, there would be no such thing as a breed, or a race. The cur would run the same chance as the best-bred dog of turning out valuable."[13]

But more than an analogy from the domesticated beasts what Galton aimed at was to fortify the induction that supports the belief in the natural superiority of some human breeds over others. Transforming ethnology into an exact science or mathematizing genealogy could be adequate descriptions of Galton's early moves in the field of heredity.

Francis Galton's early hereditary research took its cue from the connection between constructing racial groups and genealogical groups not any more upon stories and anecdotes, or by simple iteration of single cases, but by using a more general approach.

Constitution of men affects all their capabilities, physical and mental. There is a definite limit for each individual beyond which no amount of exterior cultivation (exercise or education) would take him. And that limit is fixed by the ancestral influences of race, nation and family. If differences between individuals could be associated to differences between families, and these to differences between nations, and these to differences between races, then things would be simpler. The genealogical approach could help in the task. Though the numbers of our ancestors grows exponentially ("in the space of little more than six centuries every one of us can boast of the astounding number of five hundred and twenty-four thousand two hundred and eighty-eight ancestors") and thus a localized following of any influence becomes impossible after a few generations, a careful investi-

[13] Lewes, 1859, p. 87.

gation could be made into the number of generations that one has to go back before there is a too weak and diluted influence.

Heredity under Galton became a different kind of genealogical business. Its role was to create workable descriptions and concepts of supra-individual levels, of genealogically linked groups that have a corporate individuality. The title of Galton's first exposition of his theory of heredity model, "On Blood-relationship" is explicit about it, as are both the methods and the kinds of lateral questions that Galton addresses in his two previous hereditary works, "Hereditary Talent and Character" (1865) and "Hereditary Genius" (1869). The fate of noble families and the irrationality of life peerages; the weakening of hereditary influence after more than three generations; the dangers of marrying heiresses; and of course the advantages and possibilities of promoting a breeding betterment of humans.

Galton's genealogical approach was particulate and representational: the struggle for influencing the constitution of the future generations is transformed into a probabilistic process in which all previous generations participate, but with declining influence, as their contribution to the "stock" of elements transmitted is halved with each generation.

This idea is, in essence, what came to be known as Galton's "Ancestral Law of Heredity." Galton managed with his scheme to forward the idea that the reality of the genealogical groups that so obsessed his contemporaries, like breed, race, nation, family, class, and the like, was of a different sort, it was a statistical one. He eventually constructed this fact by cleverly using Quetelet's "normal" distribution curve as a criterion for having an unmixed population, individuals belonging to the same genealogical group, statistically but nevertheless real.

As it is well known, Galton came eventually to regard the science of heredity as "concerned with Fraternities and large populations rather than with individuals," and with the "statistical resemblance between successive generations." This perception and his imaginative power led him to introduce, in only a few years, into the field of heredity a set of very powerful statistical tools for inductive inference, but his racial and family oriented class-ridden motivations where never very far from the surface.

"The idea of investigating the subject of hereditary genius —Galton wrote— occurred to me during the course of a purely ethnologi-

cal enquiry, into the mental peculiarities of different races; when the fact, that characteristics cling to families, was so frequently forced on my notice as to induce me to pay attention."[14] And he clarifies that "the natural ability this book mainly treats is such as a modern European possesses in much a greater average share than men of the lower races."[15]

The laws of heredity he discovered enable "successive generations to maintain statistical identity."[16] It has been shown how Galton searched tenaciously for ways of untangling heredity from other possible influences. He experimented with sweet peas but as he himself wrote, "it was anthropological evidence that I desired, caring only for seeds as means of throwing light on heredity in man."[17] And any challenge to his having demonstrated, through twins studies and exhaustive questionnaires to eminent men of science, the absolute preeminence of heredity, made him very upset. The crucial set of exclusions and "methodological" isolations of heredity as a potent, dominant, cause of natural capacities and radical natural difference led him to resist in several fronts competition from rival projects.

Galton completed the theoretical isolation of the germ, of the first formation, of the embryo, from external, non hereditary input.

Galton fell in love with his discoveries of statistical reasons for having identifiable genealogically built up races and their stability. The exceptionality and ephemeral nature of genius, and its surrounding islands of family excellence, made him happy. At the same time he was fascinated by the backward pull of the mediocre population center that would always eventually inevitably dilute excellence in those genealogical lines (but others will jump forward to take their place). The narrative line of the rise and fall of a family is of course not a novelty with Galton. Neither its causal support on natural heredity. It is the smart retelling of such known tale in a statistically complex fashion, the invention of a paraphernalia of Queteletian distributions, ancestral inheritance by degrees, each with a more mediocre center, and a swamping effect of the collective that accounts for his imaginative powers. In Galton's developed views of

[14] Galton, 1869, p. 23.
[15] Galton, 1869, p. 27.
[16] Gilham, 2001, p. 200.
[17] Gilham, 2001, p. 205.

natural heredity[18] his cousin's Natural Selection kept loosing explanatory territory. As is well known, he became increasingly convinced that a small (fluctuating) variation was useless as a source for evolution, that is, for any significant displacement of the population average, and accumulation of variation in a desired direction. The statistical regression rule would always work against selection and deter its effects. Sports, that is large variations due to a structural reorganization, were the only way to break the backward pull. When Galton argues the case for sports as the real effective input for evolution under natural selection (natural selection would increase the number of favorable sports once they spontaneously occur) he revealingly makes a "methodological" move. Such move gives away the rhetorical character of his complex statistical construction. While he has painstakingly achieved an abstract description of hereditary transmission through the generations that purifies (or isolates) hereditary factors in their independent effects, claims that population level attributes, like "generational" centers, are responsible for regression, and that it is only by statistically revealing the accumulated effect of a multitude of causes that one achieves true objectivity, generality an lawfulness.

Galton's "populational" thinking is the creation of an alternative fictional space where peculiarities (hereditary variations/factors) travel across the generations from collective entity to collective entity, in which the elements that constitute an individual body (or its embryo at least) are a sample, a result of a selection or representation of a transgenerational collective entity, in which individual peculiarities and variations are not important for what they do as part of a singular body. Identity and individuality are not ontologically (or ethically) relevant. A genius is a representative of his race, group or family; it is the exceptional product of its collective being. An effect of a rarefied set of the best hereditary factors of the group. The mirror image of this claim is, of course, the existence of sets of families within which the worst hereditary elements were carried though the generations. The Darwins were worried about their familial physical legacies. But through their influence, powerful statement began to worry about a construct they made partially possible: the physical hereditary legacy of the race.

[18] Galton, 1889.

With Galton we have the completion of the familial (and the century's) route that began with his Erasmus' views of heredity as a set of external perturbations of form, through Charles' mixed set of hereditary influences to a fully fledged, internal and deterministic view of heredity.

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