

Forging Heredity:

From Metaphor to Cause, a Reification Story*

Carlos López-Beltrán†

An Adjective Becomes a Noun

THE TERM 'heredity' was brought into the English language to match the French use of 'hérédité'. This happened between 1860 and 1870, when a noun was needed to refer to the maturing domain of scientific enquiry that had come to crystallize around the set of phenomena that were previously loosely clustered around the adjective 'hereditary'. French physicians had been using 'hérédité' in such a specialized sense for several decades, and 'heredity' seemed a good option (instead of 'inheritance' or 'heritage', for instance) because it could be both directly related to the widespread French noun and to the adjective 'hereditary', which had long been in use in a similar sense, originally brought into English medical parlance by physicians translating from the Latin adjective *haereditarius*.

The adjective 'hereditary', in the natural sciences, is an ancient borrowing from the legal and social sense, based on the straightforward analogy between handing down property or titles to descendants and transmitting physical or moral qualities to them. Although in everyday language the metaphorical (analogical) use of the adjective has been common and widespread in most Western languages for centuries,¹ the first consistent technical borrowing of the adjective was done by physicians when they categorized a set of diseases as 'hereditary'.

*This paper originates from the author's Ph.D. thesis, 'Human Heredity 1750–1870: The Construction of a Domain' (King's College London, 1992).

†Instituto de Investigaciones Filosóficas, National University of Mexico (UNAM), Ciudad Universitaria, México DF 04510, Mexico.

Received 14 August 1992; in revised form 27 April 1993.

¹Any sort of similarities or coincidences between parents and children, in physical appearance, abilities or disabilities, patterns of behaviour, etc., could be said by the ancients to be 'hereditary' in both ancient Greece and Rome. See B. David, 'La Préhistoire de la génétique: conceptions sur l'hérédité et les maladies héréditaires des origines aux XVIIIe siècle' (Medical thesis, Broussais, Paris, 1971), and C. Zirkle, 'The Early History of the Idea of the Inheritance of Acquired Characters and of Pangenesis', *Transactions of the American Philosophical Society* 38 (1946), 91–151. An insightful 'deconstruction' of the early concept of heredity as based on a metaphor was done by J. A. Thomson, in his Introduction of *Heredity* (London: John Murray, 1908).



Pergamon

Stud. Hist. Phil. Sci., Vol. 25, No. 2, pp. 211–235, 1994.

Copyright © 1994 Elsevier Science Ltd

Printed in Great Britain. All rights reserved

0039-3681/94 \$7.00+0.00

There is within the Hippocratic–Galenic tradition a persistent and pervasive attention to the fact that disease, or a disposition (propensity) to it, can be causally transmitted from parents to their offspring. The old coinage ‘hereditary diseases’ (Greek *Nosoi kleromixai*; Latin *haereditarii morbi*) has been in use in several European languages, in and outside specialized contexts, at least since Hippocrates and Aristotle. But it has been partnered with similarly technical nouns (‘heredity’, ‘inheritance’, ‘heritage’) only for over a century. The *Oxford English Dictionary* provides a good evidence of this. While it quotes sixteenth, seventeenth and eighteenth century uses of ‘hereditary’ in relation to diseases,² the first biological use of ‘heredity’ or ‘inheritance’ which it gives comes from the 1860s.

The French noun ‘hérédité’ was the first to establish itself as a strong, explanatory scientific term. It was championed by a whole generation of French physicians who had decided that ‘the hereditary’ could and should play more than a secondary role in the understanding of mankind’s past and present conditions, and in the shaping of the future one. After 1830, ‘hérédité’ stormed through their writings and became the emblem of their new, brash, post-enlightened and post-revolutionary approach.

In his autobiography Francis Galton tries to pass himself off as responsible for the introduction of ‘heredity’ into English. He mentions having been criticized by some of his contemporaries for coining the gallicism ‘Heredity’ during the late 1860s.³ R. S. Cowan has argued that this choice of a neologism by Galton signals an intention of putting some distance between his research project and previous ‘pre-scientific’ ones, including French medical hereditarianism.⁴ The fact is that both Spencer and Darwin used the word several years earlier⁵ and Galton almost certainly took it from them. They in turn had been driven to its use by exposure to French authors, principally, I believe, Prosper Lucas.⁶ Contrary to what Cowan tries to show, the use of ‘heredity’ instead of ‘inheritance’ was not at first of any importance, and both terms could

²Morley, 1597: ‘The fault which like unto a hereditaire [gallicism?] lepresie in a mans bodie is incurable’; Misaurus, 1699: ‘I have heard you confess that yours is a hereditary gout’. *Oxford English Dictionary*, 2nd edn, vol. 7 (1989), p. 544. This medical origin of heredity as a biological concept was perceptively noticed by the historian Emanuel Rádl, who wrote that ‘before Darwin’s time’, biologists left the work on the problems of hereditary transmission ‘to their medical friends’. Ch. 12 (‘Human Heredity’) of *The History of Biological Theories* translated from the 1909 German text by E. J. Hatfield (Oxford: Oxford University Press, 1930), p. 242.

³‘It seems hardly credible’, Galton wrote in 1908, ‘that the word heredity was then [in 1869] considered fanciful and unusual. I was chaffed by a cultured friend for adopting it from the French’. F. Galton, *Memories of my Life* (London: Methuen, 1908), p. 288.

⁴R. S. Cowan, ‘Francis Galton’s Statistical Ideas: The Influence of Eugenics’, *Isis* 63 (1972) 509–528. See also her thesis *Sir Francis Galton and the Study of Heredity in the Nineteenth Century*, *The History of Hereditarian Thought*, vol. 3 (New York: Garland, 1985).

⁵See ‘Heredity’ in *Oxford English Dictionary*, 2nd edn, vol. 7 (1989), and in *The Century Dictionary*, vol. 3 (1889).

⁶The marginalia in Darwin’s copy of Lucas’s *Traité de l’Hérédité Naturelle* (1847–1850) (in the University Library, Cambridge) are full of occurrences of ‘heredity’, instead of ‘inheritance’, which Darwin used regularly in his published works.

have been, and were, basically interchangeable. What was important in the 1860s was to have a noun where there was none before. More recently F. Churchill has described how in Germany, after 1880, the need for a noun that emphasized the focus on hereditary transmission mechanisms made theoreticians use ‘Vererbung’ instead of ‘Erbrecht’ or ‘Erblichkeit’.⁷ He also indicates, with some surprise, that in German dictionaries none of these nouns appears to have received any attention, in their biological sense, before the last decades of the nineteenth century. But this is far from being exceptional, because only in France did biological ‘hérédité’ become a focus of general attention early on in the century. Contrary to what Churchill states, British Cyclopaedias and Dictionaries, both medical and general, did not have entries under ‘heredity’ or ‘inheritance’ until the very last decades of the nineteenth century, when most of them were written by the Scottish physician J. A. Thomson.⁸ The first time the *Encyclopedia Britannica* commissioned an article on ‘heredity’ — from Peter Chalmers Mitchell — was very late: 1911.⁹

Such delay in both Germany and Britain contrasts sharply with the situation in France, where after 1830 no medical dictionary, and after 1850 almost no general one, failed to include an entry under ‘hérédité’. French medical men were the first to adopt and popularize the noun in its specialized sense. ‘Hérédité’, with its ontological and causal implications, spread from medical to broader circles through the increasing weight it received as an explanatory resource in the technical, programmatic and propagandistic texts of post-revolutionary French physicians. Alienists, criminologists, hygienists, and other socially oriented branches of the medical profession found the shift from an adjectival approach (‘héréditaire’) to a substantive one (‘hérédité’) a very attractive move.¹⁰

The popularity of the subject of hereditary diseases grew steadily among French medical students after around 1815, as can be seen by the increasing number of final dissertations on the subject in both Paris and Montpellier. But the crucial moment is signalled, I believe, when after 1830 such dissertations, ever on the increase, switched their adjectival formulations in their titles (and treatments) from variations of ‘les maladies héréditaires’ to a substantive ‘L’Hérédité dans les maladies’.¹¹

⁷F. Churchill, ‘From Heredity to Vererbung: The Transmission Problem 1850–1915’, *Isis* 78 (1987) 337–364, see p. 338.

⁸From 1885 to 1900, Thomson contributed articles under the head ‘Heredity’ for *Chamber’s’s*, *Blackie’s* and *Nelson’s* Cyclopaedias, and the *Encyclopaedia Medica*.

⁹11th edn, vol. 13, pp. 350–354

¹⁰For a recent sociological analysis of this phenomenon in post-revolutionary French psychiatry, see D. Pick, *Faces of Degeneration: A European Disorder c. 1848–c. 1918* (Cambridge: Cambridge University Press, 1989), and I. Dowbiggin, *Inheriting Madness: Professionalization and Psychiatric Knowledge in 19th-Century France* (California: University of California Press, 1991).

¹¹Evidence for this and other claims in this paper have been gathered by the author in an exhaustive, annotated bibliography on the theme of hereditary diseases from 1590 to 1870. This was added as ‘Appendix 1’ (henceforth App1) to C. López-Beltrán (*op. cit.*, note * above).

This change from adjective to noun points to a change from analogy (or metaphor) to a direct, ontological commitment to the reference of the concept. In other words, a reification process that perhaps began many centuries earlier (with the Greek medics' adoption of 'hereditary') came with such a shift to a conclusion. To describe the major features of such a reification process, from 'the hereditary' as a metaphor to 'heredity' as an explanatory biological concept that implies a particular kind of independent causation (mechanism, force), and to show how the discussions around hereditary diseases within the French medical community played a crucial role in the process, are the aims of the present paper.

'The Hereditary': An External Boundary for Generation Theories

The empirical facts that from antiquity were considered as having a 'hereditary' character can be divided into three categories: the resemblances between parents and offspring that give a 'family air'; the strange combinations of characteristics that are the product of hybridizations; and the familial pattern of occurrence that certain deformities and diseases adopt. For the sake of the argument, but following closely an association made by many antique and post-Renaissance authors, I will refer to them collectively as 'the hereditary' (from now on without the quote marks).

The close associations between these sets of phenomena were recognized and handed down within the Hippocratic and Aristotelian traditions. The hereditary was eventually identified with all the characteristics of the constitution or temperament of the body that were in some way or other affected by the parents' constitution — characteristics that existed, actually or potentially, in the new being since its first rudiments. The transmission or at least the causal relation between parents' and offspring's bodily features, and its consequences, was presupposed. The hereditary was thus not limited to the pathological, although the adjective does appear more frequently related to disease or deformity. In almost any cultural tradition it is possible to find some kind or other of wisdom as a product of the observation of the patterns of similarity between the generations and within familial groups.¹² Dissimilarity is the contrasting and also striking companion to such patterns. The detailed and sometimes stubborn manner with which all sorts of features are sometimes preserved through several generations contrasts acutely with the fact that only some, but not all, the descendants inherit them and in a somehow haphazard way. The close observation of patterns of resemblance and dissimilarities within families and broader genealogical groups produced, as always, paradoxical views. For a philosophical scheme, the hereditary was not easy to assimilate. The capriciousness and irregularities of family resemblance could not be readily

¹²See David, *op. cit.*, note 1, pp. 12–19.

accommodated to, for instance, Aristotelian typologies of characters and causes. That sometimes secondary (accidental) features were at least as persistent and predictable in their genealogical behaviour as those characters that were considered as more essential was bad enough. But that undesirable deformities, defects, illnesses, etc. seemed often to follow the same paths and patterns mystified the natural philosopher (Aristotle) and the physician (Hippocrates) alike.

Their attempts at providing coherent physical and metaphysical accounts of the human (and animal) existence faced both authors with the facts of the hereditary, especially when describing their views on 'generation'. For them, as for the eighteenth-century theorists long after them, the hereditary — the facts of resemblance, hybridization and familial diseases — constituted a part of the phenomena they were supposed to 'save' with their theoretical schemes.

A puzzling related phenomenon was the existence of relatively stable subgroups within the boundaries of a species; and in the particular case of humans, the hereditary physical and moral characteristics that made — and preserved — the differences between human groups (nations, races) and the way in which they could be 'mixed' in the individuals produced by their interbreeding.

Under what has been called an essentialist view of biological species, the homogeneity of the genealogical groups through the generations is to be assumed, and all the inner (specific, group, familial) irregularity, variation and diversification becomes a surprising irregularity in need of explanation. In that sense, most features of a given organism should in principle resemble closely those of its parents, and any dissimilarity should be accidental. Following Doctor Henry Holland, Darwin described the situation as follows: 'the real subject of surprise is . . . not that a character should be inherited, but that any ever fail to be inherited'.¹³

The makers of systems have always found the irregularity and unpredictability of the hereditary a pain. At least since Empedocles's time, for anybody in the business of fashioning an account of human (and animal) generation, the paradoxes of resemblance and variation were a serious stumbling block. Aristotle's view of the male seed as the only causal contributor to the shape (form) of the body of the offspring had to find ways to by-pass the empirical evidence of female transmitted characteristics, such as resemblance to mothers, hybridization, etc.¹⁴ The most convincing account of the irregular mixtures of

¹³C. Darwin, *The Variation of Animals and Plants under Domestication* (London: J. Murray, 1868), vol. 2, p. 2; H. Holland, *Medical Notes and Reflections*, 3rd edn (London, 1855; 1st edn 1839), p. 14.

¹⁴Aristotle's difficulties with the hereditary have been described by J. Morsink ('Was Aristotle's Biology Sexist?', *Journal of the History of Biology* 12 (1979), 83–112), by M. Boylan ('The Galenic and Hippocratic Challenges to Aristotle's Conception Theory', *Journal of the History of Biology* 17 (1984), 83–112) and by Jacques Roger (*Les Sciences de la vie dans la pensée française du XVIII^e siècle* (Paris: Armand Colin, 1963), pp. 81–91).

resemblances to both parents was given by the views of generation that Boylan calls 'dual seed theories'.¹⁵ Some kind or another of dual seed theory was maintained, in various fashions, by amongst others Empedocles, Democritus, Pythagoras and Epicurus. But by far the most influential version of a dual seed theory was the one put forward by Hippocrates and re-shaped centuries later by Galen. It became the standard view of generation for most medical men.

Since offspring of crossings between both similar and different types can, and often do, resemble both male and female parents; since any kind of characteristic (vague as a family air or precise as an extra finger, essential or accidental) could apparently be hereditarily transmitted; and since there seemed to be a sort of combinatorial, or at least commingling process, for the reassortment of the parts, properties and characteristics of the parents in the production of each new organism, the hypothesis that came to be known as 'pangenesis' was the natural complement to that of the dual seed (or double semen, or two fluids).¹⁶ Both seeds are thought, under such a view, to be the product of a separation, in the gonads, of parts or particles coming from all over the body, in such a way that each and every part is represented in it. Conception was then thought to be a getting together of the two seeds, and a process of bargaining between the male and the female parts (which was conceived in widely differing ways — lawful and unlawful) decided in what kind of a combination or mixture the offspring would result.¹⁷ In all likelihood, the fact that double-seminal views of generation explained with more ease the irregularities of the hereditary was the main reason for the medical men's fidelity to such a view. They could not dismiss the evidence of hereditary transmission as insignificant due to its accidental character, because it seemed to them a recurrent feature of the day to day facts they faced during their practice: the undeniable familial patterns of certain diseases.

Given the strength of the Hippocratic–Galenic tradition in Western medicine, the double seminal account of generation, with its hereditary empirical support, came to have a deep and lasting influence on Western science. All the way up to the end of the eighteenth century, parallel to the discussions on preformation and epigenesis, medical men maintained a relatively independent approach to generation and the hereditary, only touching the mainstream discussion in isolated cases when medics turned natural philosophers, as with Harvey or Haller. The Hippocratic solid–humoral physiology, with its conception of the body's properties and dispositions based on the theory of

¹⁵Boylan, *op. cit.*, note 14. Others call these hypotheses 'of double semen', 'double seminal', 'of double semence', and 'of two fluids'.

¹⁶Democritus (in David's French translation, *op. cit.*, note 1): 'La sémence . . . est constituée de tous les éléments du corps et surtout des principales parties (os, chaire, veines). Les parties du foetus communes aux deux sexes proviennent aussi bien du père que de la mère: le liquide séminal répandu par le deux sexes est élaboré dans les testicules chez les mâles et des organes analogues chez les femelles.'

¹⁷See Boylan, *op. cit.*, note 14; David, *op. cit.*, note 1; Zirkle, *op. cit.*, note 1.

temperaments (or constitutions), provided the frame for such long-standing tradition. Within it, humoral or humoral–solid causal 'mechanisms' were possible as bearers of the hereditary influence through the generations. Temperaments themselves were considered to have a strong hereditary character, as a product of a mixture of the initial humours, or semens. The unstableness of the hereditary, its irregularity, was easily relatable to the character of the influences: fluid, soluble, miscible, etc.¹⁸

For centuries, most Aristotelian theorists of generation considered the hereditary accidental and irrelevant for their pursuits. It was not until the eighteenth century brought to a head the strongest discussions on generation that the role of the hereditary began to be emphasized to defend or criticize the alternative views. There had been since the first years of the seventeenth century, for some reason, a reawakening of the interest among medical men in the issue of hereditary diseases, and several authors, important and marginal, had published treatises on the subject.¹⁹ The evidence collected in them, and the other sets of facts belonging to the hereditary, were recognized early in the eighteenth century by several authors as damaging for the preformationist orthodoxies. Hereditary transmission of characteristics, i.e. a sort of causal link between the bodily properties of different — though related by parentage — organisms, was in principle repulsive to the idea of pre-existence, and, although to a lesser degree, that of preformation. The fact that most hereditary observations pointed towards a contribution from both parents made for a stronger threat.

Chambers's 1738 dictionary mentions, in its entry for 'Generation', that Sir John Floyer 'starts a difficulty, which seems to press equally against each system (ovism & animalculism), taken singly'. Floyer's difficulty is the fact that mules (which he classifies as monsters) partake of the characteristics of both horse and ass, and that the defenders of both systems artificially choose the characters that favour their view as important for the determination of the origin of the foetus, making secondary the characters conveyed by the sex opposite to the one they favour.²⁰

When Diderot was preparing his *Éléments de Physiologie* in the 1750s, he decided to assign a special weight to the hereditary in the evaluation of the

¹⁸The importance of their observations in this area was enhanced when they had to deal with nobility and Royal families (as the most prominent of the profession tended to do). Discussions for instance about the suitability of certain marriages etc. had for a long time been related to medical opinions about the hereditary character of certain good or evil qualities, and in many cases they could become matters of state. An example is Lyonnet's (1643) *Treatise on Hereditary Disease*, which was mainly written to appease King Louis XIII. Other royal physicians interested in hereditary diseases were: Jean Fernel (1497–1558), doctor of Diane de Poitiers and Henri II; André du Laurens (1550–1509), physician of Henri IV; Luis Mercado (Mercatus, 1513–1599), doctor for both Felipe II and Felipe III; in England, Henry Holland (1788–1873) was the physician of Queen Victoria for some time.

¹⁹See App1, note 11.

²⁰See 'Generation' in *Chambers Dictionary* 2nd edn (1738), vol. 1.

several systems of generation he intended to describe there. The difficulty that preformationist views had in dealing with 'hereditary diseases [maladies héréditaires]; resemblance to parents; sireing of she- and he-mules'²¹ was particularly highlighted by him in those notes. He was probably following here the trails of both Maupertuis and Buffon, who had famously, a few years earlier, used resemblance to both parents, transmission of polydactily, mules, and other hereditary cases as evidence against preformation, and for a new kind of double seminal, successionist system of generation based on some organizational natural principle.²²

Diderot, in his adjudicator's stance, knew well that even if the double seminal views could account with more ease for the hereditary, they had serious problems of their own when facing actual, anatomical observations and detailed physiological questioning. He wrote, for instance: 'Dans ce système *placenta*, et enveloppes impossibles à expliquer.' This is the kind of criticism that both Haller and Bonnet would forcefully make, just a few years later, against double seminal, successionist (epigenetic) positions.

What is important to point out now is the different character of the empirical facts that posed problems for the competing approaches to generation. While detailed observation of the organs of generation and the development of the embryo strongly backed the preformationist (especially the ovist) position, dual seminal accounts were favoured by what may be called 'genealogical' observations: that is, the observation of the patterns of similarity and difference in organisms with a genealogical relation. While the first kind of observation implies a focus on the individual, its origin and its characteristics, the second one implies a higher level, comparative perspective.

The latter kind of observation is the basis, of course, of the claims for the existence of a hereditary relationship between different organisms, and/or between their characteristics. It presupposes that the focus of attention is a more or less well defined characteristic of which similitude or dissimilitude could be claimed between two related individuals. What kind of characteristics could be a candidate for genealogical observation could vary widely: from very

²¹See 'Génération', ch. 24 of Diderot's *Éléments de Physiologie*, ed. Jean Mayer, L. Marcel Didier (Paris: Soc. des Textes Françaises Modernes, 1964), pp. 182–185.

²²Maupertuis, *Vénus Physique* (Paris, 1744); Buffon, *Histoire Naturelle* (Paris, 1749). See also M. H. Hoffheimer, 'Maupertuis and the Eighteenth-Century Critique of Preexistence', *Journal of the History of Biology* 15 (1982), 119–144. I use *successionist* following Antoine Louis's (note 47) term when referring to the belief that each new organism was organized anew at each conception, and thus creation is successive and not simultaneous, as in pre-existence. A common usage at the time to refer to this view was 'epigenesis', but several historians have argued that such use is confusing as it doesn't distinguish between the hypothesis of instantaneous organization and development (epigenesis in its modern sense). Successionist includes both the latter and opposes only pre-existence. See P. J. Bowler, 'Preformation and Pre-existence in the Seventeenth Century', in *Journal of the History of Biology* 4 (1971) 221–244. See E. Gasking, *Investigations into Generation, 1651–1828* (London: Hutchinson, 1967), and Roger, *op. cit.*, note 14, for elucidations of the different eighteenth-century generation theories.

general and vague resemblances of shape, form, or aspect, to precise characters like an extra digit, a big mole on the cheek or a crooked nose, and on the pathological side from general tendencies, to unhealthiness to precise ailments that develop in the same manner and age in related individuals.²³ The genealogical approach to evidence and observation opens up the possibility of setting exterior limits to physiological speculation, in contrast to the interior limits set by dissection and microscopy. The gathering of convincing cases of hereditary transmission of a wide range of different characteristics, and the progressive closing of alternative avenues of dealing with them (such as their ascription to chance, or their sheer irrelevance), was one of the central themes of the eighteenth-century debates around generation. Bonnet's very complex and sophisticated ovism, in which many elements of the dual seminal views were incorporated, was in a sense a product of the strains put on to it by the external, hereditary, evidence.²⁴

When Maupertuis decided, in the first anonymous version of his *Vénus Physique*,²⁵ to use the hereditary as his main weapon against preformation and preexistence, he was not making the breakthrough that many historians of genetics have suggested.²⁶ The double seminal view of generation, as transmitted by many generations of physicians, implied from its beginnings a strong reliance on the hereditary. However, one of Maupertuis's main contributions can be said to have been his restating of the dual seminal hypothesis along the lines of a mechanistic approach (which, like Buffon shortly after, he called Newtonian), in which he tried to visualize a way in which particles from the two fluids (semens) could both be mixed and interact in such a way as to produce organization, differentiation, etc. His solution of postulating a special force was

²³By the beginning of the twentieth century, after the works of Darwin, Galton, Weismann and Mendel, amongst many others, the idea of a hereditary character acquired a different sense, related to what we call Genetics. Its previous, mainly physiological sense, is lost to most modern thinkers, who would have to avoid their usual anachronistic (genetic-like) approach when looking at hereditary transmission in pre-Darwinian times. This point has been very forcefully made by Berthélemy-Madaule with respect to Lamarck and the transmission of acquired characters. See her *Lamarck the Mythical Precursor: A Study of the Relations between Science and Ideology*, trsl. H. H. Shank (Boston: MIT Press, 1982), ch. 4, p. 72.

²⁴For Bonnet's theory of generation see his *Considérations sur les Corps Organisés*, and P. Bowler, 'Bonnet and Buffon: Theories of Generation and the Problem of Species', in *Journal for the History of Biology* 6 (1973), 259–281 and Roger, *op. cit.*, note 14, ch. 14, p. 712.

²⁵Originally, and revealingly, called *Dissertation Physique à l'Occasion du Nègre-Blanche* (Paris, 1744) and motivated by a desire to explain the existence of albino individuals among human blacks.

²⁶Maupertuis has anachronistically been taken to be another mythical precursor by many authors, since Hervé's reappraisal of his work ('Maupertuis génétiste', *Revue Anthropologique* 12 (1912), 217) and Bentley Glass, 'Maupertuis, Pioneer of Genetics and Evolution', in B. Glass, D. Temkin and W. L. Strauss Jr (eds), *Forerunners of Darwin 1745–1859* (Baltimore: Johns Hopkins University Press, 1959). I. Sandler has written a thesis showing what should have been obvious, but wasn't: that Maupertuis was no geneticist, but a sharp eighteenth-century thinker. See her 'Pierre Louis Moreau de Maupertuis: A Precursor of Mendelian Genetics?' (unpublished Ph.D. thesis, University of Washington, 1979) and her 'Pierre Louis Moreau de Maupertuis: A Precursor of Mendel?', *Journal of the History of Biology* 16 (1983), 101–136.

also his weak point, as the strongest attacks on his position (by Haller, for instance) were focused on it.

With hindsight, however, what seems most important and surprising, in his compact and clear argumentation in the *Vénus Physique*, is the restructuring and hardening of the external bounds that the genealogical (hereditary) approach to observation made to preformationism through the explicitation of its causal logic. A simple probabilistic argument with the very well chosen example of polydactyly of the Ruhe family in Berlin²⁷ strengthened enormously the case of the double seminal view. He closed for its opponents some traditional evasive routes, like 'chance' coincidences, or the vagueness of the inherited characters. To defend *exclusive* maternal or paternal influences over the embryo's formation became more difficult after that. By focusing on a very distinct and unmistakable character, whose inheritance was seen as improbable (as a monstrosity), and proving its transmissibility by both the paternal and the maternal routes, Maupertuis tidied up the act of the defenders (mainly physicians) of the double seminal view, who had for many years used similar arguments around shadier similarities, using selected case stories either factually open to doubt or inconclusive in their causal claims. Causal hereditary links were never easy to prove, but they became more so after Maupertuis. In the end, however, Maupertuis was not (and could not have been) interested in postulating a law of heredity or developing a theory of it. Neither, for that matter, were Buffon, Bonnet, or Haller. For them the hereditary was in a sense the same as it had been for Aristotle: a marginal set of facts. Up to and until the end of the eighteenth century the first formation of a living being was the real question, the source of awe and the target of explanatory speculation. As Jacques Roger wrote regarding the theoretical tasks of eighteenth-century French naturalists:

The science of the age was not really concerned with questions of heredity and hybridization . . . The great problem in its eyes was the formation of the living being, considered as an isolated individual, without reference to the individuals of the same species which had preceded and engendered it.²⁸

Heredity, it must be stressed, was not a possible question. Even to start to pose the problem of heredity as a target for autonomous theorizing, an independent or at least partially isolated field of regularities has to be recognized. To be conceivable, the idea of a law or a force of heredity requires the stabilization of a domain, the structuring of a differentiated set of facts and

²⁷Maupertuis took the idea from Réamur, who had argued that observations on the hereditary transmission of some anomalous characters could help tip the balance in favour of one or another of the preformationist positions. See his *L'Art de faire éclore les poulets* (Paris, 1751), vol. 2, pp. 335–336. Réamur himself later did very similar research on transmission of polydactyly within a family.

²⁸Roger, *op. cit.*, note 14, p. 388.

the presumption of an exclusive causal connection between them. The hereditary until the very last years of the eighteenth century was not such a domain. It preserved much of its basic analogical (non-explanatory) origin, and — notwithstanding Maupertuis's or Buffon's clarifications — did not suggest to most writers the necessity of postulating an autonomous set of laws or forces for it. The exception, again, was to be found amongst medical men. It was in their ranks that the major distinctions were made that began to give shape and structure to the hereditary, and to push it towards forming an area of independent scientific enquiry.

What Makes it Hereditary? Causation and Disease

The medical world, I have suggested, provided the setting for a transformation that turned the hereditary into the concept we now recognize as biological heredity.

The story of this reification of biological heredity can be followed closely by tracking the history of the terms 'hereditary' and 'heredity', in their biological sense, in European medical *and* general dictionaries and encyclopedias. By following both the sequence of their appearances, and the way in which their definition was successively gaining in importance and complexity, we can have a very reliable and clear overview of the structuring of the hereditary into an explanatory resource. In its first appearance in a French medical dictionary, early in the nineteenth century, the noun *hérédité* was already carrying a heavy luggage of definitions and re-definitions. This we shall try to show now.

The reification process took place mainly in the restricted context of human hereditary transmission of very striking constitutional (or bodily) qualities: family resemblance, particular malformations, marks, etc. But it was the tendency to inherit certain diseases that first took the adjective 'hereditary' to the dictionaries. The pathological sense was the first to acquire a technical status in the phrase 'hereditary disease', and the pathological connotations, we shall see, were always central to human heredity.

The revival of interest in hereditary disease at the beginning of the seventeenth century produced several treatises in which the Latin formula *haereditarii morbi*, or a similar variant, was employed in the title.²⁹ The medical dictionaries of the period reflected what seems to be a slow increase in the use of the phrase by the medical profession a few decades later. In Britain, Stephen Blancard's *Physical Dictionary* only incorporated an entry under *Haereditarii*

²⁹Ludovico Mercatus (1594); Dermutius de Meara (1619); de Bourges (1621); Cörnerus (1627); Janus (1627); Crüger (1636); Lyonnet (1643). For complete bibliography on the subject see App 1, note 11.

Morbi in its fifth edition in 1708,³⁰ where they were defined simply as those 'which the parents had, and have already seiz'd the children, as the Gout, Consumption, and Stone'.³¹ This definition is basically descriptive, giving only the familial pattern as criterion for the hereditary, and fails to use any of the distinctions, causal or other, that several seventeenth-century authors had developed (especially the Irish physician De Meara). The examples are the only substantial part of such definitions, as they emphasize the constitutional, chronic character of the hereditary diseases.

A slightly more detailed definition is to be found in John Quincy's (1736) *New Medicinal Dictionary*: 'Hereditary Disease is such as' is transmitted from the Parents in the first Rudiments of the Foetus, which is the origin of many Chronik cases'.³² Two years later, in 1738, a British general dictionary followed suit. In Chambers's celebrated *Cyclopaedia*, after the definition of 'hereditary' in its first, legal, non-metaphorical sense,³³ there is added the following:

hereditary is also applied figuratively to good or evil qualities, habitudes, etc., capable of being transmitted, by blood, from father to son. The gout, king's-evil, madness, etc., are *hereditary* diseases, i.e. are transmitted from the parents in the stamen or first rudiments of the foetus. And such, probably is the origin of numerous other chronic diseases.³⁴

As can be seen, some important restrictions are displayed both by Quincy and Chambers to the sense of 'hereditary disease'. Their definition, in emphasizing that it must be a constitutional disease whose causal element is already present in the very first formation (stamen, rudiments) of the embryo, eliminate from the set many diseases that, adopting a familial pattern, were sometimes called hereditary, but which were known to be contracted from the parents after conception, either in the womb or through the maternal milk. This approach to classifying disease was further extended by Chambers when, in another article of his dictionary, he writes that according to their cause (constitutional, chronic) diseases can be divided into 'hereditary, connate or acquired'.³⁵ The first class refers to pathological influence carried in the male or female semen

³⁰The 1st edition being from 1684. Stephen Blancard, *A Physical Dictionary, in which All the Terms Relating to either Anatomy, Chirurgery, Pharmacy, or Chymistry are Very Accurately Explain'd* (London, printed by J. D.).

³¹These three diseases were typical of the sort more commonly believed to be hereditary. These were diseases that depended on flaws in the temperament or constitution of the individual, that is on some kind of fundamental defect (or 'taint') in the organization of the body.

³²John Quincy, *Lexicon Physico-Medicum* (London, 1736).

³³something appropriated to a family, or belonging thereto by right of succession, from heir to heir'.

³⁴Chambers' *Cyclopaedia, or Universal Dictionary of Arts and Sciences*, 2nd edn (1738), vol. 1. Chronic and constitutional diseases were seen as being basically the same. As products of organizational (temperamental) imbalances or defects, they are more difficult to eradicate, though less dramatic, than acute or acquired (invasive) diseases, which are sudden and relatively superficial.

³⁵A classification which coincides with De Meara's (1619), who I believe could have been the source for Chambers' articles on the subject. See Chambers' 1738 entry under 'Disease', *ibid.*, vol. 1.

(or seed) which exists at a time previous or simultaneous to conception and is incorporated into the child's constitution. The second one to prenatal constitutional alterations due to morbid elements (humours) transmitted via the mother's blood through the placenta and which affects the still not 'solidified' structures of the embryo. The last one refers to any *post-partum* influence that could exert dramatic constitutional alterations.³⁶

This emphasis on differentiating the (causal) routes of transmission in such a clear-cut manner, based on mainly 'external' evidence, such as timing of outbreak, kind of affection and patterns of re-occurrence, did not however convince many medical men. The physiological theories in place (with their humoral-solid bases), did not help restrict the possible causal routes, and the big, crucial problem of determining how and when 'the first rudiments or stamen' of the embryo was actually formed (the prestigious and overwhelming problem of generation). This gave ample room for discussion and dissent between different positions.

Perhaps the constitutional disease that received most attention for its hereditary pattern was scrofula.³⁷ Some medical dictionaries reserved their discussions on the hereditary to the entry for this illness. This is the case in R. James's *A Medicinal Dictionary* (1743-45),³⁸ from which I will quote at length in order to show the intricacies of the issue of hereditary transmission under the early eighteenth-century medical viewpoint. James's dictionary begins by posting 'Scrofula' as a candidate for being an authentic hereditary disease, as it exhibits the characteristic familial pattern, and as it always manifests itself at roughly the same time:

so this disease seems owing to a hot, sharp Humor propagated *a Semine* from the Parent, in the first formation, discovering itself at an age, when Glands are fitted for its reception, and disappearing when the digestive powers have arrived to their greatest strength.

³⁶The communication of disease through the milk of the mother, or of a nurse, was called hereditary by many authors. Although this usage was criticised at least since Lyonnet's piece (1643), it remained a much debated theme until the nineteenth century (see E. Lomax, 'Hereditary or Acquired Disease? Early Nineteenth century Debates on the Causes of Infantile Scrofula or Tuberculosis', *Journal for the History of Medicine and Allied Sciences* 32 (1977), 356-374; and 'Infantile Syphilis as an example of Nineteenth Century Belief in the Inheritance of Acquired Characteristics', *Journal for the History of Medicine and Allied Sciences* 34 (1979), 23-39). Some authors considered this route to be akin to the connate influences. Some others put them on the same level as the acquired influences, just like any other nutritional action. Among the acquired influences, climatic ones were often highlighted, and even in some works competed with the hereditary, as the explanation of familial pattern.

³⁷This disease, popularly known as *the king's evil*, was shown to be a tubercular infection of the lymphatic system only in the 1860s. It was a mythical disease at least since the middle ages, when it was thought the touch of the hand of some kings could cure it.

³⁸R. James, *A Medicinal Dictionary*, 3 vols (London: T. Osborne, 1743-1745). This work was a very thorough compilation of many previous foreign and British medical dictionaries. The translation of this dictionary into French provided Diderot with a very ample medical knowledge, and it is considered one of the chief influences on his *Encyclopedie*. 'Scrophula' is in volume 3.

The author is aware of the scepticism that this kind of assertion can generate, so he sets himself to acknowledge the difficulty of the hereditary claim, and tries to justify it for the case of scrofula:

That such a Humor can be derived from the Parent, is granted perhaps in more instances than where it is really so, and is likely to be yielded by many more on the score of a vulgar opinion, than for any true Notions of the manner how such a thing is possible: It may be therefore necessary to form some rational Conceptions hereof in order to judge what Disorders spring from such an origin, and which not; because *without some rules to determine by, Cases may be confounded and mistaken from some Resemblance in their appearance, which flow from very different causes* [emphasis added].

After this, the author proceeds to give a detailed physiological description of how certain constitutional diseases, like scrofula, might be transmitted from parents to offspring, and come to become part of the fabric (or constitution) of the body and manifest its evil effects at a certain point in the development of the organism. He writes also about how sometimes, when internal physiological conditions change, the hereditary cause can later reduce its malignity.

In the iatrochemical manner of the time, James (or his contributor) supposes that hereditary morbid causes could be salts that can both flow diluted in the humours (in blood for instance) or crystallize or incorporate into the solid parts of the body in some way. A revealing aspect of James's discussion of the hereditary is that he starts this part of his analysis by denying that recent microscopic observations, and their concomitant speculations on generation, have relevance to his argument:

To this purpose then I cannot see what we have to do with the Philosophy of the Microscope, so far as it asserts the Semen to be animated before Generation, because it seems not in any manner to affect the Matter under Inquiry,³⁹ but so far as we got any knowledge of the sensible and manifest properties of the small Portion of Matter from whence we boast the Production of the finest Machines in the Creation, it appears to consist of a very subtle, active salt, floating in a soft, balsamic Vehicle, whereas, therefore, we conceive what consequences to the Oeconomy already formed, may flow from an Excess or Defect in the more active Principle of such Composition; so may we by Parity of Reason, conjecture, what must the result of every Deviation from the natural Standard in the same Principle before its Animation in the Matrix. When the Principle abounds . . . in the masculine Semen⁴⁰ it will . . . carry with it the same Qualities into the impregnated ovum; and without some uncommon Interruption, or Cotemperature from opposite qualities, will increase in the growing foetus, Proportion to its enlargement, and make a part of that Constitution to which it gave

³⁹This statement shows very clearly the independence and the limitation of the humoral-solid physiology. It would partially separate its speculation from discussions on generation, but at the same time any accuracy it could obtain in its classification of diseases according to causal routes lost materiality under the excessive reliance on many unobservable physiological occurrences.

⁴⁰Most post-Renaissance physicians still saw the male contribution to the offspring's constitution as the strongest and more important influence; they did not however deny the female contribution, attached as they were to Hippocrates' and Galen's dual seminal approach.

being, with the same Affections and Properties as it stood possessed of in the generating Semen.

As with some family resemblances, the hereditary (seminal) hypothesis of disease transmission has to account for the phenomenon of latency, that is the existence in a body of a given causal factor without its concomitant effect (the resemblance, the disease). James's humoral-solid account tackled the issue:

. . . it will be no difficult thing to imagine what a condition the Offspring of such a Parent must be in, and how sooner or later, in one or another part,⁴¹ this primitive matter may shew itself in a very troublesome if not a very mischievous manner, as the circumstances of life and strength of the Constitution encourage or obstruct its Exertion, and the peculiar Configuration of the Glands favour or resist its accumulation and lodgement.⁴²

The particular case of Scrofula (which manifests itself, according to James, very soon after birth and lasts until after adolescence, when the 'state of manhood' is reached), is explained by him in saying that before birth, and for the few following weeks, the morbid cause

is not in quantity enough to be discernible or [is] hindered from Exertion by the laxity of the parts and viscosity of humors, which is always more or less the case of very young children; but when the parts have got some degree of firmness, and have digested away the tough humors, this hot, sharp matter becomes sensible to the fine strainers and membranes as it passes in course of circulation, and at last fixes upon them so as to occasion pain, inflammation, swelling and running sores.

The aggressive salts then stay in place, swelling the glands and debilitating the constitution, until the latter 'takes another turn and arrives at its utmost vigour' when the 'digestive powers' manage to soften and detach the evil salts from the solids of the body and send them in solution through the circulatory system to the adequate excretory channels, among them — unfortunately — the seminal one completing the 'cycle' of transmission when its own semen carries it to the following generation at conception.

James's description of the hereditary transmission of scrofula concludes by pointing out that this 'mechanism' is 'not only out of question from common Experience,⁴³ but the general manner of it may in some measure be conceived from Hints and the nature of the generation matter'. The above description of

⁴¹It was thought by some that the same taint (causal influence), if situated in different parts of the body, can give rise to different diseases. When this opinion is taken to the extreme, all hereditary diseases are said to be the consequence of only one taint that manifests itself with different symptoms in the different organs.

⁴²This could be taken as a relatively early statement that what is really inherited is not the disease itself but a predisposition to it. Additional, triggering (efficient) causes would be necessary, under the later more elaborated view, for the disease to be developed.

⁴³He is alluding here to the growing accumulation, in the medical literature, of cases that give testimony of hereditary transmission of certain constitutional diseases, and to the everyday experience of seeing them coming down in families.

the causal route of hereditary scrofula, James adds, can also help in the visualizing

in what circumstances a Person may fall into this Distemper without having it to charge upon Parents, or the Milk of a tainted Nurse, which also may possibly happen tho' it is believed very rarely.⁴⁴

Contagion, it is implied, can be produced by the tainted humours, excreted from the ill and recovering person, finding a route into a healthy and immature person's circulation. This person would thus 'acquire' the disease and could itself transmit it to its offspring.⁴⁵ The moment and fashion of such acquisition, as we saw, determine the strength of hold that the morbid cause would have, and the curability of the disease. A hereditary contagion would be stronger from a connate one, and this one stronger than an acquired (post-natal) one. Some authors held that the longer a taint had been within a family (the more generations it had plagued) the stronger hold it would have. Some others held that there was a natural weakening of the morbidity from generation to generation until the effect became negligible. Other authors held an intermediate view, using the analogy of a life cycle. They held that a disease in a family would first grow from generation to generation, mature and eventually begin to decline, until it died away. I mention this now as an example of the kind of speculative distinctions medical men preoccupied with transmission of diseases within families were trying to make, using the evidence available and shaping it up in different fashions to try to back their points. The categories of disease some physicians saw as reflecting the true causal workings of hereditary transmission and the physiological and genealogical evidence they drew upon for support were not, however, persuasive enough to convince the sceptics. With generation theories muddled up in the deep confusion of arguments between the dual seminal position of successionist (anti-preformationist) mechanicians, like Buffon or Maupertuis, and the reformed ovists like Haller and Bonnet, it is not surprising that not many people outside the realm of the physicians appreciated their apparently backward-looking discussions on the hereditary.

Both James's *Medicinal Dictionary* and Chambers's *Dictionary* have been recognised as important influences on Diderot's conception of the *Encyclopédie*.⁴⁶ Due to Diderot's own personal interest, the *Encyclopédie* exhibited a very profound and overarching interest in all matters medical. The topic of hereditary diseases was one of them. Given that France had been only a few

⁴⁴'Scrofula', James's *Dictionary*, *op. cit.*, note 38.

⁴⁵This view, of course, presupposes the 'inheritance of acquired characters', but is basically uninteresting since all eighteenth century views of the hereditary presuppose it. Which is what makes so misguided any interest in finding 'pioneers' of what we now call Lamarckism.

⁴⁶See for this J. Mayer's 'Introduction', *op. cit.*, note 21, and F. A. Kafker (ed.), *Notable Encyclopedias of the Seventeenth and Eighteenth Centuries: Nine Predecessors of the Encyclopédie*, Studies on Voltaire and the Eighteenth Century (Oxford: The Voltaire Foundation, 1981).

years before the scene of what was perhaps the most important sceptical attack on the very idea of a hereditary disease, and adding to this that the author of the piece was the famous surgeon Antoine Louis,⁴⁷ a man who became a constant and important collaborator of the *Encyclopédie*, it is somewhat surprising that the entry for the subject (in Volume VII, 1760?) came out strongly in favour of the hereditary. Almost certainly penned by Diderot himself,⁴⁸ it drew its material and arguments from previous dictionaries and, more interestingly, from the rather obscure, pro-hereditarian and acute analyses of the subject published by Stahl, Zeller and, especially, De Meara.⁴⁹

The adjective 'héréditaire' was given only its medical definition in the *Encyclopédie*. The first thing that the encyclopedist points out is the contingent character of the ascription, given that it depends more upon the *route* of contagion and not upon an essential quality of the causal influence. According to him, a disease is hereditary if its cause (vice) is contracted due to the quality of the seminal liquid and of maternal humours that are joined to form the embryo and to give it the principle of life.⁵⁰

This contingency, however, is qualified by the analogy chosen by the Encyclopedist to illustrate the kind of causal pattern he has in mind, making it seem quite important. He chooses the physiological and anatomical (constitutional) changes that adolescence sparks in the male and female body as an adequate simile.

All male humans have acquired in the body of their mother the disposition for their beard to grow at the age of puberty, and females the disposition to become subject to menstrual flow; this disposition may therefore be regarded as *hereditary*, inasmuch as it is transmitted from father and mother to children; it is the same with respect to certain diseases: it is observed that the individual members of certain families all experience that they became subject to them at a certain age; such are, for example, epilepsy or gout.

By choosing this simile Diderot is asserting the belief in the transmissibility of *latent* constitutional causal influences of some kind: that is, of material elements that can transform the bodily organization at a given period of the life span of an individual. The mystery and the solution to both the dramatic changes at puberty and the appearance of the same disease at the same time in parent and offspring are, in his mind, strongly bound together. Furthermore, he writes, the feasibility of destroying the disposition to develop a disease that has

⁴⁷A. Louis, *Dissertation sur la question ... Comment se fait la transmission des maladies héréditaires?* (Paris: Delaguet, 1749).

⁴⁸For a discussion on Diderot's medical knowledge, see Mayer, *op. cit.*, note 21. For the medical contributors to the *Encyclopédie*, see F. A. Kafker and S. L. Kafker, *The Encyclopedists as Individuals*, Studies on Voltaire and the Eighteenth Century (Oxford: The Voltaire Foundation, 1988); and H. Zeller, *Les Collaborateurs Médicaux de L'Encyclopédie* (Paris: L. Roda, 1934).

⁴⁹See bibliographical details in App1.

⁵⁰See 'Héréditaire' in Diderot and D'Alambert's *Encyclopédie, Dictionnaire Raisonné des Sciences, des Arts, et des Métiers*, vol. 7, p. 156.

already been inherited is as meagre as that of destroying the disposition 'which makes the beard of a young man who is in good health grow'.

The strong hold that hereditary elements have on an individual's constitution derives from the fact that they are there since the first instant of formation of the new being (the stamen, or rudiments), and the contingency of the seminal route for a morbid element does not diminish such strength. The Encyclopedist thus highlights the importance of making a distinction between the disposition to disease acquired at conception (truly hereditary) and that acquired after it.

One must distinguish *hereditary* diseases from those which the Pathologists recognise as *morbi conatti*, that is to say which the foetus has contracted accidentally in the womb of the mother, which one gets at birth, consequently without them being the effect of a fault in the health of the parents, before conception, transmitted to the children, as in the case of *hereditary* diseases.⁵¹

After the *Encyclopédie*, the adjective 'héréditaire' in its technical sense became a recurrent entry in French general and medical dictionaries. Simultaneously, in many of the discussions around generation theories, the awareness of the challenge posed by the mixed hereditary influence made sure that the hereditary phenomena (resemblance, hybridization and hereditary disease) were thoroughly discussed. As R. Rey has recently pointed out, in most dictionaries of the eighteenth century, it was under the entry of 'generation' that the facts of normal hereditary transmission were mentioned.⁵² But generation theorists (Haller, Bonnet, Needham, Buffon) were not interested in the details of the communication of similitudes or emergence of differences through the process of reproduction *per se*. They were after the big question, that is, after an account of how the whole organism came to exist, either produced anew or unfolded from the egg. They tended then to privilege their theoretical schemes and to consider the problem of transmission of characteristics between generations as relatively secondary, helpful or unhelpful for their views, but not determinant.

Physicians on the other hand focused particularly on morbid causes and their possible routes of transmission. The existence, or not, of an exclusively hereditary route was at the centre of their discussion. The fact that they could see analogies between the behaviour of normal, apparently inherited, characters and that of their candidate hereditary diseases reinforced their belief in such a route. Part of their effort was then concentrated on gathering the factual evidence for transmission, and another part on producing adequate causal (physiological) descriptions of it. The latter part of their works was the least

⁵¹*Ibid.*, pp. 156-157.

⁵²'destinées', she writes, 'à confirmer ou à invalider les grandes thèses sur les mécanismes de la reproduction'. R. Rey, 'Génération et hérédité au 18^e siècle', in P. Bénichou (ed.), *L'ordre des caractères* (Paris: Vrin, 1989), p. 16.

convincing. Their humoralist or iatrochemical hypotheses were increasingly in conflict with knowledge and ideas in other fields, mainly chemistry and physiology, besides the questions raised within Generation disputes. That physicians came to need a (clearcut) concept of heredity before other scientists was motivated in some measure by these conflicts.

Meeting Scepticism: French Eighteenth-Century Medics

During the eighteenth century, the issue of hereditary transmission of disease was more alive in France than anywhere else. There were a number of differences amongst French medics concerning the causes of hereditary diseases. For instance, some favoured a distinction between normal and pathological transmission, while others believed in the existence of a unique sort of hereditary transmission that included both kinds.⁵³ Again, some wanted to focus only on solid causes whereas others still held on to old humoralism. As I have showed elsewhere, the main stimulus to thought and discussion on the subject was Antoine Louis's intelligent and highly sceptical small essay published in 1848.⁵⁴ Briefly, what Louis did was to argue that hereditary transmission of disease was a figment of physicians' imagination, and that under a sound physiological (solidist) view no influence of the parents' characters on those of the offspring was conceivable. Such sceptical challenge made the rest of the medical community aware of the weak points of their views on the reality of hereditary influences. Thus arose a quest to gather and organize the evidence, from both available literature and their own practice. No convincing transmission mechanism was described, however. This made the Royal Academy of Medicine, late in the century (1788), call for competition essays amongst physicians on the subject of how hereditary diseases are transmitted.⁵⁵ This competition revitalized the arguments around the subject and was crucial for it 'being in the air' in the heated post-Revolutionary times, when it was taken up by higher order, socio-political forces.

The social and political importance of several constitutional diseases that had for a long time been classified as hereditary (e.g. scrofula, syphilis, madness) seems to have grown with urban concentrations and the industrial revolution. On the other hand, such 'fatalistic' explanation of them has always tended to acquire some importance in non-medical thought. Sempiternal ideological views about the purity of blood, breed, etc., within races, or nations, or within regional or familial groups, were always easily fuelled by any kind of consideration of transmissibility of ills through family lines.

⁵³The dispute between humoralists and solidists had this as its theme. See López-Beltrán, *op. cit.*, note *, chs 2-4.

⁵⁴See 'Les Maladies Héréditaires: 18th Century Disputes in France', Chapter 2 in López-Beltrán, *op. cit.*, note *.

⁵⁵I have had access to most manuscripts of these competitions, and have written an analysis of them in my thesis. A forthcoming paper will be dedicated to the issue.

For much of the eighteenth century, scepticism about hereditary claims, and a strong commitment to climatic and other external forces as a source of differences between humans, maintained the hereditary in the background with regard to explaining human physical and cultural diversity. The situation changed in post-Revolutionary France. Several authors have tried to explain this apparently paradoxical shift.⁵⁶ The case is that the hereditary, as an explanation for a varied number of phenomena, began to receive more attention, especially as a way of accounting for many social ills: madness, syphilis, scrofula, tuberculosis.⁵⁷ The previous efforts of eighteenth-century physicians in clarifying the causal structure of hereditary transmission was put to use by the brash and enterprising early nineteenth-century generation of French physicians.

This phenomenon was also registered in the dictionaries, which are, as I have tried to show here, a most reliable source of traces of conceptual shifts. Post-Revolutionary France saw a flourish of encyclopedist activity. Like other bodies of *savants*, the physicians busied themselves producing compilations of their knowledge, in all of which 'héréditaire' first, and 'hérédité' after 1830, appeared as the heading of an entry. In 1798, as part of Volume VII of the *Dictionnaire de Médecine*, which was itself part of the enormous project of the *Encyclopedie Méthodique*,⁵⁸ 'héréditaire (maladie)' received an unusually long and detailed treatment. Written by Jean-Françoise Pagès, this deep and meticulous essay had been, in a first version, a laurelled final dissertation at Montpellier in 1788.⁵⁹ A revised version of that essay received in 1790 an honorary mention in the second round of the Royal Society of Medicine's competition mentioned above.⁶⁰

Oddly for such a young author, Pagès' essay shows a more profound analysis of the issue than anything that had been published before. Only when it is compared with other essays, published or not, of the same competition, can one see that he was not alone in the 1780s in making the subtle and imaginative

⁵⁶See I. Dowbiggin and D. Pick, *op. cit.*, note 10, and R. Nye, *Crime, Madness and Politics in Modern France: The Medical Concept of National Decline* (Princeton: Princeton University Press, 1984), and C. E. Rosenberg, *No Other Gods: On Science and American Social Thought* (Baltimore: Johns Hopkins University Press, 1976).

⁵⁷See accounts of this by Lomax, *op. cit.*, note 36, and E. H. Ackerknecht, *Medicine at the Paris Hospital 1794-1848* (Baltimore: Johns Hopkins University Press, 1967).

⁵⁸After the *Encyclopédie* this was the most ambitious French compilation of human knowledge. Begun before the Revolution, it was completed over several decades and with very irregular publishing schedules. Its medical part was edited in its first seven volumes (until its first interruption in 1798) by the famous secretary of the Royal Society of Medicine, Vicq D'Azyr.

⁵⁹See Appl, note 11, for details on Pagès and his work on hereditary disease.

⁶⁰The prize was not given in the first round (1788) and only with difficulty in the second round was it awarded to a French expatriate in Bonn, Doctor Joseph-Claude Rougemont. This was in 1790, a few months before the Society was dissolved by the Revolutionary Council. Pagès' and Rougemont's essays are both missing from the archives, now kept in the National Academy of Medicine, Paris. Fortunately, both were published, Pagès' in Vicq D'Azyr's *Dictionnaire* (note 62), and Rougemont's in a German translation (*Abhandlung über die erblichen Krankheiten*) in Frankfurt in 1794. For details see Appl, note 11.

distinctions that are found in his text, the most important of which must be the clearly argued distinction between inheriting the disease itself and inheriting only a disposition (a propensity) to it.⁶¹ Another is the further clarification of what it is to be connate (*maladies connés*) in contradistinction to what hereditary means. A further crucial position that Pagès takes is related to what has been called the transmission problem, in the context of the debate between humoral and solid causes in medicine. Pagès is adamant that hereditary transmission should never refer to humoral causes, but only to solid-related, constitutional ones. Favouring the latter as the only truly hereditary, he reduces *ad absurdum* the former ones by demanding that only those diseases that occur in the very same organs and at the same period of life in parents and offspring are strictly to be considered hereditary. This would require, he argues, the existence of a different humoral vice (or taint) for each individual disease, which would make for an absurd proliferation of 'vices' or humoral causes. These would on the other hand have to be specific for each organ or part of the body, which is implausible. How, he then adds, can a 'virus' be lodged in a body without producing its evil effects? Only the existence in the body since conception of a constitutional (solid) defect, that is later made evident at a certain point in life by the triggering of a new stage, can explain this. In other words, this inherited defect gives only a disposition, not the disease itself.⁶²

The latency of hereditary phenomena in general, and atavism in particular, were also claimed by Pagès as more easily explained by his solid-constitutional view of the hereditary. Given that it is dispositions and not the diseases themselves (or a malefic humoral cause) that are communicated in the constitution, the fact that in a given generation the effect (the disease) is not produced, can be understood as an absence of the triggering 'causes occasionelles'. This however does not preclude the possibility that a healthy person who carries the disposition in his internal organization can in turn transmit it to his descendants, any one of which can develop the disease if the triggering occasional causes concur.

As I said, the clarifications and restrictions that Pagès makes to the concept of a constitutional disease and its possible hereditary character seem, on their own to add up to a surprising individual effort, but in fact they acquire their proper dimensions when set in the context of the many other essays sent to the

⁶¹A distinction which, as I have said, had been obscurely implied by previous authors. In Britain, it appears, it had been made also, at more or less the same time, by John Hunter. But the British surgeon never clarified it in writing and we have to take the word of his disciple John Adams for it. Adams used the idea to develop his views in his well known book on Hereditary Diseases of 1814. I copy from Pagès' essay: 'On appelle maladie héréditaire une maladie qui reconnoit pour cause une disposition particulière du corps à un être attaqué; dispositions que les parens qui ont été sujets à cette maladie, transmettent à leurs enfans par le moyens de la génération.'

⁶²J.-F. Pagès, 'Héréditaires (maladies)', in *Dictionnaire de Médecine, Encyclopedie Méthodique*, Vol. VII (Paris: Agasse, 1798) pp. 162-163.

same competition,⁶³ whose manuscripts are kept in the Library of the National Academy of Medicine. That the advancing of those kind of distinctions was specifically what the setters of the essay question were looking for can be seen in their reports and evaluations of the results, both in manuscripts and in the *Memoires de la Société Royale*.⁶⁴ The other two prize essays made similar attempts, especially that of Alexis Pujol, a physician from Castres, whose very long dissertation, when it was published some years later (1802), became one of the most powerful statements of French medical hereditarianism in the early nineteenth century, although he never gave up humoral causation as an outstanding part of the hereditary influences.⁶⁵

Other French medical dictionaries of the early nineteenth century gave a preponderant position to essays under the adjective 'héréditaire'. Antoine Petit's 40-page *Essai sur les Maladies Héréditaires* (1817) was incorporated with slight changes into the voluminous *Dictionnaire des Sciences Médicales*.⁶⁶ Petit's work followed closely Pagès in the desire to define as clearly as possible the hereditary in terms of the causal transmission route, the moment at which the disposition to disease becomes established in the bodily constitution, and the additional causes needed to trigger it.⁶⁷

In the shorter *Dictionnaire Abrégé des Sciences Médicales* (1823), space was found for five packed pages of analysis of 'hereditary diseases' written by an anonymous author who reacted against the strict solidism of previous dictionary entries.⁶⁸ The increasing dictionary presence of the hereditary was, of course, a symptom of a broader phenomenon that was happening in the French medical community. For instance, a growing number of medical students' theses and similar dissertations, both in Paris and Montpellier, were being focused on the general question of hereditary diseases, or on hereditary explanations of the sources of particular diseases, such as insanity or scrofula. During the 1820s such theses and dissertations would typically refer in their title to 'maladies héréditaires'. But around 1834 they switched to the formula *l'Hérédité dans les maladies*.⁶⁹ It was at this point, I believe, that heredity had

⁶³Only two more of them were published to my knowledge: the other honorary mention by Alexis Pujol, and the prize-winning essay by Rougemont.

⁶⁴*Histoire et Mémoires de la Société Royale de Médecine* (1786, 1787, 1788), vol. 9, p. 17, p. 18; vols 10-11; and 'minutes d'examen de mémoires'. Bibliothèque de L'Académie Nationale de Médecine. Archive de L'ancienne Société Royale de Médecine 181-23-1, 5. Details in Appl, note 11.

⁶⁵*Essai sur les Maladies Héréditaires*, in Alexis Pujol, *Oeuvres de Médecine Pratique*, 2nd edn (Paris: F. G. Boisseau, Baillière & Bechet, 1823), vol. 2. Only Pagès' piece, and of course Antoine Portal's 1808 essay (*Considerations sur la nature et le traitement de quelques Maladies Héréditaires ou de famille*, Paris) seem to have been more influential than Pujol's.

⁶⁶A. Petit, *Essai sur les Maladies Héréditaires* (Paris: Chez Gabon, 1817).

⁶⁷See *Dictionnaire des Sciences Médicales* (Paris, 1817), vol. 19, pp. 58-86. This Dictionary had 52 volumes.

⁶⁸'Héréditaire', in *Dictionnaire Abrégé des Sciences Médicales* (Paris, 1823), vol. 9, pp. 45-49.

⁶⁹The first work that shows this change was the excellent dissertation by a disciple of Fodéré at Strasbourg. D. A. Lereboullet, *De l'Hérédité dans les maladies* (Strasbourg: G. Silbermann, 1834). See also, P.-A. Piorry, *De l'Hérédité dans les maladies* (Paris: Bury, 1840).

completed, within the French medical community, its transition from a metaphor to a thing, from an analogy to an independent and self-sufficient cause. This was also registered by a switch in French dictionary and encyclopedia entries, from the adjective 'héréditaire' to the emphatic, strong sounding noun 'Hérédité'.⁷⁰ A clear evidence of this is found in the French translation of J. Forbes's *Cyclopaedia of Practical Medicine* (1833). The entry which this influential dictionary dedicated to the theme was written by Joseph Brown, who followed closely the lead that in Britain had been given by the writings of Joseph Adams and J. C. Prichard. Significantly, the cumbersome entry heading 'Hereditary Transmission of Disease' was straightforwardly delivered by the French translator as 'Hérédité'.⁷¹ *Hérédité*, as used by medics (that is, synonymous with 'hereditary transmission of disease'), began to overflow the limits of their speciality. Its pathological connotations became increasingly common in wider sectors of society, and began to 'interact' with the worries and ambitions of social thinkers and reformers.

At the same time, physicians began to recognize the unavoidable relevance of knowledge and observation of hereditary transmission among animals of both normal and pathological characters for the validity of their claims for pathological heredity in humans. By the 1840s it became obvious that what needed to be done was to unify the physiological and pathological knowledge into a joint account of 'positive', i.e. normal, transmission of characters. The privileged status that medics were giving to *hérédité* as an explanatory tool, they realized, had to be backed by a fairly well organized collection of 'normal' physiological, zoological and botanical, and embryological facts, and better theories than were available. The unification of pathological and normal hereditary transmission under a single scheme had been by then already advanced considerably by J. C. Prichard, in Britain.⁷²

On the other hand, a question raised by the Montpellier physician Lordat, in a 1842 essay 'The Laws of Physiological Heredity: Are They the Same in Animals and in Man?',⁷³ was a question in many of his colleagues' minds, and that had begun to permeate the work of scientists and social reformers.

At that stage, the perception of the existence of such a thing as the Laws of Heredity was not one shared outside France, with the exception of a few British authors. In quotations and translations of books and articles the French *Hérédité* was transformed into English adjectival forms, like 'Hereditary

⁷⁰For French physicians of the first post-revolutionary generation, such as Lereboullet or Piorry, the reality of hereditary transmission was not even an issue, it was a given. Among alienists of Esquirol's school it was also common. Naturalists and physiologists also joined in the usage of *hérédité*. The work of Girou de Buzareingues and the translation of Burdach's physiological works into French also gave hereditary explanations a boost. See López-Beltrán (*op. cit.*, note *), ch. 5.

⁷¹'Hérédité', in *Encyclopédie Médicale Anglaise* (Paris, 1836).

⁷²See López-Beltrán, *op. cit.*, note *, ch. 3.

⁷³*Les Lois d'hérédité physiologique, sont elles les memes chez les bêtes et chez l'homme?* (Montpellier, 1842).

Disposition' or 'Hereditary Transmission'.⁷⁴ At this time, for instance, in Todd's *Encyclopedia of Anatomy and Physiology* (1839), a satisfactory rendering of recent French, German and British work on the subject by Dr Allen Thomson was hidden, in the eighteenth-century fashion, in an article on 'generation' and under the heading 'Influence exerted by parents on the qualities of their offspring in generations', and referred to in the general index as 'hereditary qualities; mental and physical phenomena of [their] transmission from parents to offspring'.⁷⁵ The measure in which early nineteenth-century 'hereditarianism' was overwhelmingly a French physician's 'craze' can be seen in the imbalance revealed by bibliographical research.⁷⁶

Before 1870 very few medical or other British treatises had 'heredity' in their titles. There was no equivalent proliferation of medical theses focused on the hereditary transmission of disease (or any other physical or mental character), in British medical institutions. After the 'pioneering' work of Joseph Adams and J. C. Prichard and William Lawrence on the matter, only a few medics followed, and those mainly interested in the already sidelined phrenological studies. What was more relevant in those years in Britain was a small but significant current of scepticism around hereditary explanations of constitutional diseases, stemming basically from the ideas of the eighteenth-century physician William Cadogan, and represented by authors like Henning and Phillips. A German immigrant Julius Henry Steinau published in 1843 one of the few known treatises in Britain on hereditary transmission of disease — a work that had originally been written and published in Germany and which seems to have had no local repercussions.⁷⁷ Sir Henry Holland was, to my knowledge, about the only physician of prestige to have given attention to the subject and in so doing directed Darwin's attention to it.⁷⁸

It was not until Spencer, Lewes, Darwin and Galton emphasized the centrality of the hereditary, in the second half of the century, that hereditarianism finally made the leap to Britain. It was not pathological hereditarianism which took hold here, but a more general, theoretical approach. But it nevertheless had its structural origin in the efforts of categorization and analysis that French physicians had made concerning the problem of hereditary transmission.

⁷⁴J. Esquirol's proposed *cause for Manie, Hérédité*, was translated into English as 'Hereditary Disposition', somehow diminishing the strength of the French author's statement. See his *Mental Maladies: A Treatise on Insanity* (Philadelphia: Lee & Blanchard, 1845).

⁷⁵'Generation', in R. B. Todd, *Cyclopedia of Anatomy and Physiology*, 5 vols (London, 1836–1859), vol. 2, pp. 470–480.

⁷⁶The evidence for this can be seen in App1.

⁷⁷Julius Henry Steinau, *Pathological and Physiological Essay on Hereditary Diseases* (London: Marshall & Co. 1843).

⁷⁸Sir James Paget was an exception, and wrote a piece on hereditary cancer (in the *Medical Times*, 22 August 1857). Darwin owned two editions (1839 and 1855) of Holland's *Medical Notes and Reflections*, and in both it is only the chapters 'On Hereditary Diseases' which are annotated. He seems to have been particularly interested in evidence for homochrony and atavism.

All the general phenomena associated with the hereditary that physicians had recognized and tried to account for in their treatments of the pathological — the irregular behaviour of character transmission (similarity vs. dissimilarity), the latency of causes, atavistic regression, homochrony, etc. — were later seen as also important for an understanding of the normal. The first structure of our modern concept of biological heredity was, I want to claim, provided by these medical distinctions. In other words, physicians provided a scheme into which other naturalists could later incorporate their questions and evidence concerning hereditary matters. Hybridization studies by botanists and breeders; the advancing edges of embryology, cytology, physiology, etc.; and the appearance of the Darwinian argument; all made French physicians' causal views of heredity very soon seem outmoded and untenable, but it seems undeniable to me that the very idea of the existence of such a thing as heredity and its general laws we owe to them.

Acknowledgements — I am grateful for the many useful comments and criticism made by M. J. S. Hodge, R. Olby, J. Durant, S. Martínez and two anonymous referees.