VICTORIAN HEREDITARY GENIUS

A Life of Sir Francis Galton

Nicholas Wright Gillham
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Reviewed by Gavan Tredoux

This is only the third full-length biography of the eminent Victorian scientist and polymath Sir Francis Galton (1822-1911). Remarkably, it is the first in a quarter of a century; the previous two include D. W. Forrest's biography in 1974, and the major three-volume biography by the pioneering statistician Karl Pearson.

Galton was the product of a distinguished lineage, with men of marked ability in every one of ten preceding generations. He first made a name as an African explorer and meteorologist, active in the affairs of the Royal Geographical Society. Late in life, inspired by his half-cousin Charles Darwin, he went on to found the scientific study of heritability as the intellectual architect of contemporary behavior genetics, which soon encompassed differential psychology, anthropology, genetics, criminology, statistical methods, and eugenics.

Starting almost from scratch in all the subjects he investigated, Galton invented rigorous intelligence testing, founded experimental psychology in Britain, established the scientific basis for fingerprint identification, formulated the statistical concepts of regression and correlation, pioneered early investigations of genetics, and founded the biometrical school. Financially secured by a legacy from his moderately wealthy father, he might have followed so many of his contemporaries into comfortable idleness. Instead he chose the career of "gentleman scientist," and would on his death bequest his well-managed legacy to University College, London, for further research in eugenics and other related areas of scientific interest.

Galton receives little notice today, so any new biography must be welcomed for the renewed attention it may bring to his life, his achievements, and his contemporary significance. Nicholas Gillham is a geneticist whose interest in Galton was stimulated by recent developments in the human genome project,

the advent of genetic engineering, and cloning, all of which contain distinct echoes of the eugenics movement Galton founded. Gillham plays here to his own strengths and interests as a geneticist. Since Galton was not primarily a geneticist, he emerges from Gillham's treatment looking unfairly diminished, somewhat less relevant than he really is to contemporary science and the history of ideas. However, when properly understood Galton occupies a central place in the development of scientific ideas, as the founder of a research program that remains vital today.

Galton's wide-ranging achievements were grounded in his immense practical genius. This was a general ability, not specific to any discipline, which enabled him to make an impression on nearly everything he embarked on. He had no formal training in most of the subjects he covered, starting almost from a clean slate in each. If previous work had been done, he usually ignored it, with good results.

Galton was simply not well suited to the sort of education then offered. While he was remarkably precocious as a child when tutored at home by an elder sister, he performed only moderately well at school. At Cambridge, studying pure mathematics on the advice of Charles Darwin, he suffered a breakdown and left, like Darwin, with only a "pass" degree, and not "honors." Most of his scientific work was conducted when he was well past middle age, and he would not read widely in his fields, such as they existed.

Galton's practical genius helped him to achieve his first notable success as an African explorer, thereby launching his scientific career. After a two-year exploration of South-West Africa (1850-2) during which he accurately surveyed and charted previously unknown territory, all at his own expense, he was awarded a gold medal by the Royal Geographical Society. His entertaining description of the expedition in *Tropical South Africa* (1852) demonstrates an ability to easily overcome the innumerable practical difficulties which an explorer in unknown territory must face with limited resources, and severe consequences for failure. Galton was obviously a good man to go camping with. He would later produce a best-selling compendium of advice for travelers, *The Art of Travel* (1855), distilling his own experience in solving the practical problems of rough travel, and advice gleaned from others. It went through nine editions in his lifetime, and is still in print today. This manual of "shifts and contrivances" reveals a tremendous talent for grappling with everyday difficulties, for devising working contraptions from simple materials, and for applying basic reasoning processes to common problems. Galton would later demonstrate how a simple application of this method to important theoretical questions could convert subjects formerly reserved for metaphysical speculation into science.

The Art of Travel is full of little devices and elementary technology, all produced by Galton's facility for invention, which was a family trait. All through his life he produced a stream of gadgets, which ranged from devices

for measuring temperature changes over time, to a heliograph for sending sun signals, to whistles for producing high-pitched notes (all of which were extensively used in their fields). There were also devices for harnessing the power of waves, a protocol for interstellar communication, an electric telegraph, a bicycle speedometer, glasses for reading underwater, and scores more. Galton would outfit his scientific researches with instruments that were mostly of his own invention, made to his specifications, almost always for the purpose of measuring something. Much of his research would have made little progress without these instruments, and they were extensively used in their fields. Again, these show the practical genius he invariably brought to bear on his problem set, whether he was in Africa placating a braying donkey by tying a stone to its tail, or in London devising an instrument to measure mental reaction times.

Another important aspect of Galton's practical ability was his talent for simple representation. In meteorology this took the form of greatly improved weather maps, with Galton becoming the first newspaper weather columnist. In statistics it took the form of the quincunx, his device for demonstrating regression in normal distributions; his numerical representation of statistical relationship, the correlation coefficient; and the use of statistical percentiles. For navigation he devised wind charts, so that sailing time could be optimized. For personal and racial identification he devised composite portraits and facial indices. Galton was always finding some way to represent facts not otherwise obvious. More generally, Galton continually sought to create numerical representations of facts through *measurement*, an activity he carried to extraordinary lengths.

The "active ingredient" of Galton's science was his use of measurement, especially in his study of human traits. Counting and comparison were second-nature to him, and he would often idle away slack periods by measuring things: counting brush strokes when having his portrait painted, thereby estimating the number of facial characteristics; counting audience fidgets in lectures, to determine their dullness; counting the number of attractive women he passed in the street, to determine the geographical distribution of beauty in Britain; or just counting leaves on trees in the park, to see how many there really were.

Galton studied human abilities and characteristics by measuring them. This was a genuinely revolutionary approach. Usually he had to devise these measures himself, and mechanical instruments for gathering them, as well as the statistical methods for dealing with the results. Where Galton could not obtain direct numerical measurements he was still able to reason numerically by considering variation and distribution. Intelligence testing, anthropometry, and biometry were born as a result. The statistical revolution that Galton introduced in his quest for measurement spread rapidly throughout the social and biological sciences, because the methods used were universal in nature.

Quantitative methods now distinguish most serious research in the social and biological sciences, and disciplines which have spurned them have not fared well (consider mainstream sociology).

One great virtue of Galton's use of measurement was its ability to cut through tangles introduced by metaphysical speculation, and ground discussion in tangible phenomena. His measures would provide their own defense by demonstrating solid relationships with other phenomena, above all by acquiring predictive power. The utility of this approach is seen in the modern intelligence testing movement, which has bypassed endless wrangling over the "meaning" of intelligence by working with measures of mental powers that justify themselves by predicting real-world outcomes.

Galton's enthusiasm for measurement was a component of his empiricist approach to science, which was quite deliberate and self-conscious. Wherever he could Galton formulated predictions, and put them to the test by taking measurements. Pursuing the idea that the blind are especially discriminating by touch, he proceeded to measure this using blind and sighted subjects, and discovered that the blind are, in fact, usually no more sensitive than the rest. Interested in methods for making tea, he armed himself with notebook and thermometer, and set out on a series of experiments with materials, temperatures, and steeping times, all of which he subjected to taste (his own). Finding a method that produced reliably pleasing results, he pronounced the mystery of the tea pot solved, at least for his own taste. He found space to incorporate his findings into *The Art of Travel*.

Galton used his facility for invention, measurement, and representation to found a research program that remains vital today, some 150 years after he initiated it. Galton's cousin Charles Darwin, whose *Origin of the Species* had a profound influence, sparked the initial inspiration. Darwin's evolutionary theory was based on natural selection. Organisms vary, and evolution proceeds through selection of advantageous variation. Galton considered the human case, which Darwin had barely touched on. It was plain to Galton that people, and races of people, vary a great deal for many important traits, and that certain variations confer a selective advantage. The idea had come to him when he considered gregariousness, a trait that had first interested him when observing the behavior of oxen on his African exploration. Some oxen, he observed, were more gregarious than others, and this might be selectively advantageous as it protected those who expressed it from danger. He detected similar variation among races and individuals, based on his observations of the races he encountered in South-West Africa. He turned from this to consider human ability, which evidently varied greatly. Some initial research suggested this ran strongly in families, and doubtless his own unusually talented forebears sprang to mind. Galton's research program was born in this

observation, and would be a concerted attempt to place these initial observations, in themselves not remarkable or consequential, on a sound scientific basis.

He had to start from the beginning. First, human traits which varied, had to be identified. Then these traits had to be measured and their distribution determined to establish if they really did differ enough to be of consequence. Then the heritability of those traits had to be established, since only heritable traits would have evolutionary significance. This required an understanding of the nature of heredity, and its mechanism. In the early 1860s, when Galton embarked on this ambitious investigation, little was known about any of these topics. Today a great deal more is known under the field of research called "behavior genetics," with its special application to human ability "differential psychology." Little that preceded Galton's approach has survived.

In the end Galton studied a great many traits, and was led into several productive diversions in the process. The most important psychological trait he studied was ability, summarizing his results in *Hereditary Genius* (1869), then in *English Men of Science* (1874). In essence, by gathering a large sample of eminent men in various fields, he was able to determine that a far greater than expected proportion had eminent relatives, and so he inferred that ability must run in families. *Hereditary Genius* proved to be a tremendously influential work, anticipating the concepts of general intelligence and the use of adoption studies to distinguish the effects of nature and nurture, and introducing the use of statistical grades, now referred to as percentiles. Galton's other varied and innovative psychological investigations were summarized in his *Inquiries into Human Faculty* (1883), and included gregariousness, power of mental visualization, spontaneous word-to-idea association, the operations of the subconscious mind, memory, phobias, color blindness, tendency to see "visions," mental representation of "number forms," and more. He concluded that all these traits varied significantly and were heritable to some extent.

The essential shortcoming Galton had to face was a lack of representative data for any of the traits he considered. He was eventually able to overcome his shortage of hard data by collecting a large body of measurements from the anthropological laboratories he founded in the 1880s, after devising a wide range of measurements, and instruments to match, and persuading the general public to pay three pence each for the privilege of being measured "scientifically." Some 17,000 individuals were measured for various characteristics: strength, weight, height, length and breadth of the head, arm span and lung capacity, visual and auditory reaction time, and perceptions of length. Ultimately this data collection was so successful that the volume of data surpassed the computational and statistical resources available at the time. It was only as recently as 1985 that the surviving data set, still unique of its kind, was fully analyzed using appropriate techniques. The analysis shows that

most of the measurements used were reliable, and that Galton's tests of ability correlated significantly, though weakly, with occupation (which can be used as a rough proxy for ability) [Johnson et al, 1985].

Among the measurements taken by Galton in the anthropological labs were those of fingerprints, which he later investigated for their use in criminology to identify individuals. Fingerprints had previously been proposed as a means of identification, but Galton had been interested initially in determining their hereditary nature. He was aware that their use in criminology would have to overcome fundamental hurdles: it had to be shown that the fingerprint stayed constant through life, that it could reliably be distinguished from the prints of others, and that a practically workable scheme could be put in place for taking and keeping records of prints, and matching them. By examining his large and representative collection of prints, unique in its time, he was able to satisfy all these criteria, devising a classification scheme that was adopted by police internationally, in a modified form. He also concluded, correctly, that fingerprints are to some extent hereditary, and to some extent differ from race to race.

Galton realized that his research program could not be completed without determining the nature of heredity itself. His research in this area proved more fruitful for its by-products than for its concrete results. By conducting blood transfusion experiments on rabbits, he was able to disprove Darwin's theory of pangenesis, which held that the gemmules within bodily fluids transmitted hereditary traits. Galton then conducted experiments on sweet peas, but as with all his investigations into heredity, he chose to study a continuous, rather than a discrete, characteristic: seed size. He would eventually shift his focus to the study of human height. By contrast, Mendel had studied discrete traits, allowing him to formulate his theory of particulate inheritance and genetic dominance. This greatly complicated matters for Galton since, as we now know, he chose complex traits with multiple genetic components, and though he came close to reproducing Mendel's then unknown results, he was not ultimately able to produce a coherent account of heredity capable of surviving the Mendelian revolution, although his work was influential at the time. Rather, the difficulties his traits placed him in forced him to produce some of the most important statistical innovations on the nineteenth century, first in his discovery of regression to the mean, then in his formulation of the correlation coefficient. The Galtonian statistical study of heredity lived on in the form of the biometrical school of Karl Pearson and W.F.R. Weldon (R.A. Fisher was able to show by 1918 that, theoretically, the effects the biometricians studied were describable in Mendelian terms).

Galton had founded his research program on the proposition that individuals and races vary in their expression of many traits, such as ability, and that this variation is subject to natural selection on Darwinian lines. It was obvious to Galton that this selection could be harnessed to improve humans, by

encouraging selection of advantageous traits. Indeed, it is hard to argue that less ability is better, or that weaker physical constitutions should be preferred to stronger. He coined the word *eugenics* to describe the process of human improvement he had in mind, an improvement which encompassed not just mental ability but also physical traits such as health, strength, height, and what he called "energy."

Eugenics had been one of Galton's concerns from the very beginning, when he published *Hereditary Genius*. It is not commonly recognized now that he faced a hostile audience from the beginning, and had to make his case patiently and doggedly for many years. After all, if mankind was created in the image of God, how could it be improved? Galton was, above all, afraid of scandalizing public opinion through extremism, and disapproved of the immoderate proposals that H.G Wells and G.B. Shaw brought to the movement. Two kinds of eugenics can now be distinguished: positive and negative. The negative variety operates through punishment and compulsion, usually of the legal kind, sometimes involving measures like sterilization of the unfit. The positive variety seeks instead to promote improvement through rewards, by encouraging those with higher abilities to have more children. Tax breaks and other schemes are what Galton himself had in mind, together with the creation of a *moral* atmosphere which encouraged better breeding, as he would have endorsed. Indeed, eugenics came to be Galton's primary concern later in his life, and he directed all his efforts in the decade before his death to its promotion.

Gillham's account of Galton is well written and fair, more so than one might expect in an age in which publishers are largely hostile to his ideas. Though it breaks little new ground biographically, or even in terms of primary bibliographic sources, it does provide a useful context for some of Galton's interests, especially in its account of the subsequent development of human genetics. It brings to attention some previously neglected aspects of Galton's influence on the statistician F.Y. Edgeworth, who appears to have been written out of the picture by a hostile Karl Pearson. Gillham steers safely away from the sort of psychological speculation about Galton's personal development that he might have indulged in. Refreshingly, he seems to have no political agenda of his own, and does not attempt to evaluate Galton by the standards of "political correctness."

This is a scientific biography by a working scientist. It is divorced from the concerns of postmodernism, and makes no mention of "Victorian hegemony" or "patriarchy." Gillham's book attempts to understand Galton's ideas on their own terms, and for this alone it is praiseworthy. That a major academic publisher has published a substantial biography of Galton twenty-three years after the last biography must surely bring his scientific accomplishments to the notice of a wider audience, who at last has a biography back in print; his cousin Charles Darwin gets one every few months or so.

There is nevertheless much that is unsatisfactory about this biography. An overall timid tone pervades it, especially when the author discusses the subject of eugenics. This timid tone does not leave the room, and demands to be noticed. Gillham wastes no time in decrying the application of eugenics by the Nazis. Hopefully this sort of covering fire is not now a pre-requisite for having a book about a figure like Galton published by a major house.

Gillham also places an undue emphasis on the biology of genetics, no doubt due to his own background in this field. Galton is now mostly an historical footnote in that field, interesting as his role may have been at the time. His contributions were rapidly superceded by Mendelian genetics, and working geneticists today do not pay much intellectual homage to Galton. While Gillham's additional material on the history of developments in this field is useful in itself, it dominates rather much of the book, because it is not matched by similar elaboration of the fields that Galton *did* leave a lasting mark on. This leaves Galton looking unjustly reduced in standing, someone who anticipated some ideas, but got most of the details wrong and was soon eclipsed by modern developments. This impression is amplified by Gillham's habitual understatement. For instance, he describes Galton as a "talented scientist," and thinks that his versatility was typically Victorian. A biographer really should be able to distinguish Galton from the masses of merely "talented" scientists—after all, Galton gave us the conceptual apparatus to make distinctions like that. And Galton was certainly not just another versatile Victorian.

The trouble is that Gillham's interest in genetics apparently does not extend to the field of behavior genetics, let alone differential psychology. There is no reference anywhere to a major work in these fields, apart from Herrnstein and Murray's *The Bell Curve* (1994), and that only in passing. Yet Galton is widely acknowledged to be the founder of these disciplines. Behavior genetics pursues essentially the same research program that Galton established. Working scientists in these fields are well aware of their debt to Galton, and frequently acknowledge this in the literature. His influence can be traced directly through the major figures in these fields, from Spearman and Burt to Eysenck and Bouchard.

Where Gillham does touch on topics that behavior genetics has gathered extensive evidence about, he seems to have misunderstood the results. In a brief discussion of twin studies, he asserts that similarities between twins have been exaggerated by selection of anecdotal coincidences! He should give those who work in the field a little more credit. Bouchard (1997) has provided the following summary of IQ studies conducted on identical twins raised apart (the data is simplified for presentation on the next page).

Authors	Sample size	Correlation
Newman et al 1938	19	0.71
Juel-Nielsen 1980	12	0.69
Shields 1962	38	0.75
Bouchard et al 1990	48	0.75
Pedersen, Plomin et al 1992	45	0.78
Weighted Average		**0.75**

At least half the variation in IQ scores in a modern Western population is genetic in origin. However, many studies of IQ heritability include disproportionate numbers of children. Plomin (1997) observes that heritability increases with age, rising to about 0.80 in late adulthood. So Galton's claim that ability is largely inherited is borne out by the modern evidence.

It should be noted that variance in adult ability that is not due to genetic factors is almost entirely due to *non-shared* environment; that is, to factors outside of family experience. This excludes factors which have usually been promoted as environmental influences, such as socioeconomic status, number of books in the home, and so on. It is still unclear exactly what these non-shared influences are, but they must consist of a series of idiosyncratic influences peculiar to each individual, perhaps exposure to minor biological insults and the like, with a cumulative effect. This means that, insofar as the environment has effects, it tends to make people different, and not the same.

With regard to personality there is not as much hard evidence, but Rowe (1994) has provided the following summary of the data available (simplified for presentation here):

Personality Dimension	Heritability
Extraversion	0.49
Agreeableness	0.39
Conscientiousness	0.40
Emotional stability	0.41
Intellectual openness	0.45
Mean	**0.43**

The Minnesota Study of Twins Raised Apart yielded the following data about other variables that would have interested Galton (from Rowe, 1994):

Measure	Correlation
Fingerprint ridge count	0.97
Height	0.86
Weight	0.73
Systolic blood pressure	0.64
Heart rate	0.49

More data could be presented, but it is enough to note for our purposes that all this data tends to confirm Galton's conclusions to a remarkable degree.

That Gillham is only slightly familiar with differential psychology is shown in his description of Galton's tests of reaction time. As he notes, these tests fell into disfavor when they proved to correlate weakly with themselves and with other tests of ability and achievement. He doesn't seem to be aware that reaction time has now become an important research topic. To make it useful, it must be tested using a series of observations to aggregate the results, thereby eliminating random variation, and overcoming the low item reliability. When Galton's tests were evaluated, a sample of university students was used, greatly restricting the range of variation, and further obscuring the results.

Unfortunately Gillham has missed the opportunity to provide a detailed assessment of Galton's contemporary influence on fields like behavior genetics and differential psychology, and to bring his subject right up to date by presenting the current state of knowledge about the topics that were most important to him. This detracts from the value of what is otherwise a fine biography.

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