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MEASURE FOR MEASURE

The strange science of Francis Galton.

By Jim Holt

In the eighteen-eighties, residents of cities across Britain might have noticed an aged, bald, bewhiskered gentleman sedulously eying every girl he passed on the street while manipulating something in his pocket. What they were seeing was not lechery in action but science. Concealed in the man's pocket was a device he called a "pricker," which consisted of a needle mounted on a thimble and a cross-shaped piece of paper. By pricking holes in different parts of the paper, he could surreptitiously record his rating of a female passerby's appearance, on a scale ranging from attractive to repellent. After many months of wielding his pricker and tallying the results, he drew a "beauty map" of the British Isles. London proved the epicenter of beauty, Aberdeen of its opposite.

Such research was entirely congenial to Francis Galton, a man who took as his motto "Whenever you can, count." Galton was one of the great Victorian innovators. He explored unknown regions of Africa. He pioneered the fields of weather forecasting and fingerprinting. He discovered statistical rules that revolutionized the methodology of science. Yet today he is most often remembered for an achievement that puts him in a decidedly sinister light: he was the father of eugenics, the science, or pseudoscience, of "improving" the human race by selective breeding.

A new biography, "Extreme Measures: The Dark Visions and Bright Ideas of Francis Galton" (Bloomsbury; $24.95), casts the man's sinister aspect right in the title. The author, Martin Brookes, is a former evolutionary biologist who worked at University College London's Galton Laboratory (which, before a sanitizing name change in 1965, was the Galton Laboratory of National Eugenics). Brookes is clearly impressed by the exuberance of Galton's curiosity and the range of his achievement. Still, he cannot help finding Galton a little dotty, a man gripped by an obsession with counting and measuring that made him "one of the Victorian era's chief exponents of the scientific folly." If Brookes is right, Galton was led astray not merely by Victorian prejudice but by a failure to understand the very statistical ideas that he had conceived.

Born in 1822 into a wealthy and distinguished Quaker family—his maternal grandfather was Erasmus Darwin, a revered physician and botanist who wrote poetry about the sex lives of plants—Galton enjoyed a pampered upbringing. As a child, he revelled in his own precocity: "I am four years old and can read any English book. I can say all the Latin Substantives and Adjectives and active verbs besides 52 lines of Latin poetry. I can cast up any sum in addition and multiply by 2, 3, 4, 5, 6, 7, 8, 10. I can also say the pence table. I read French a little and I know the Clock." When Galton was sixteen, his father decided that he should pursue a medical career, as his grandfather had. He was sent to train in a hospital, but was put off by the screams of unanesthetized patients on the operating table. Seeking guidance from his cousin Charles Darwin, who had just returned from his voyage on the H.M.S. Beagle, Galton was advised to "read Mathematics like a house on fire." So he enrolled at Cambridge, where, despite his invention of a "gumption-reviver machine" that dripped water on his head, he promptly suffered a breakdown from overwork.

This pattern of frantic intellectual activity followed by nervous collapse continued throughout Galton's life. His need to earn a living, though, ended when he was twenty-two, with the death of his father. Now in possession of a handsome inheritance, he took up a life of sporting hedonism. In 1845, he went on a hippo-shooting expedition down the Nile, then trekked by camel across the Nubian Desert. He taught himself Arabic and apparently caught a venereal disease from a prostitute—which, his biographer speculates, may account for a noticeable cooling in the young man's ardor for women.

The world still contained vast uncharted areas, and exploring them seemed an apt vocation to this rich Victorian bachelor. In 1850, Galton sailed to southern Africa and ventured into parts of the interior never before seen by a white man. Before setting out, he purchased a theatrical crown in Drury Lane which he planned to place "on the head of the greatest or most distant potentate I should meet with." The story of his thousand-mile journey through the bush is grippingly told in this biography. Improvising survival tactics as he went along, he contended with searing heat, scarce water, tribal warfare, marauding lions, shattered axles, dodgy guides, and native helpers whose conflicting dietary superstitions made it impossible to settle on a commonly agreeable meal from the caravan's mobile larder of sheep and oxen. He became adept in the use of the sextant, at one point using it to measure from afar the curves of an especially buxom native woman—"Venus among Hottentots." The climax of the journey was his encounter with King Nangoro, a tribal ruler locally reputed to be "the fattest man in the world." Nangoro was fascinated by the Englishman's white skin and straight hair, and moderately pleased when the tacky stage crown was placed on his head. But when the King dispatched his niece, smeared in butter and red ochre, to his guest's tent to serve as a wife for the night, Galton, wearing his one clean suit of white linen, found the naked princess "as capable of leaving a mark on anything she touched as a well-inked printer's roller . . . so I had her ejected with scant ceremony."

Galton's feats made him famous: on his return to England, the thirty-year-old explorer was celebrated in the newspapers and awarded a gold medal by the Royal Geographical Society. After writing a best-selling book on how to survive in the African bush, he decided that he had had enough of the adventurer's life. He married a rather plain woman from an intellectually illustrious family, with whom he never succeeded in having children, and settled down in South Kensington to a life of scientific dilettantism. His true métier, he had always felt, was measurement. In pursuit of it, he conducted elaborate experiments in the science of tea-making, deriving equations for brewing the perfect cup. Eventually, his interest hit on something that was actually important: the weather. Meteorology could barely be called a science in those days; the forecasting efforts of the British government's first chief weatherman met with such ridicule that he ended up slitting his throat. Taking the initiative, Galton solicited reports of conditions all over Europe and then created the prototype of the modern weather map. He also discovered a weather pattern that he called the "anti-cyclone"—better known today as the high-pressure system.

Galton might have puttered along for the rest of his life as a minor gentleman scientist had it not been for a dramatic event: the publication of Darwin's "On the Origin of

Species," in 1859. Reading his cousin's book, Galton was filled with a sense of clarity and purpose. One thing in it struck him with special force: to illustrate how natural selection shaped species, Darwin cited the breeding of domesticated plants and animals by farmers to produce better strains. Perhaps, Galton concluded, human evolution could be guided in the same way. But where Darwin had thought mainly about the evolution of physical features, like wings and eyes, Galton applied the same hereditary logic to mental attributes, like talent and virtue. "If a twentieth part of the cost and pains were spent in measures for the improvement of the human race that is spent on the improvements of the breed of horses and cattle, what a galaxy of genius might we not create!" he wrote in an 1864 magazine article, his opening eugenics salvo. It was two decades later that he coined the word "eugenics," from the Greek for "wellborn."

Galton also originated the phrase "nature versus nurture," which still reverberates in debates today. (It was probably suggested by Shakespeare's "The Tempest," in which Prospero laments that his slave Caliban is "A devil, a born devil, on whose nature / Nurture can never stick.") At Cambridge, Galton had noticed that the top students had relatives who had also excelled there; surely, he reasoned, such family success was not a matter of chance. His hunch was strengthened during his travels, which gave him a vivid sense of what he called "the mental peculiarities of different races." Galton made an honest effort to justify his belief in nature over nurture with hard evidence. In his 1869 book "Hereditary Genius," he assembled long lists of "eminent" men—judges, poets, scientists, even oarsmen and wrestlers—to show that excellence ran in families. To counter the objection that social advantages rather than biology might be behind this, he used the adopted sons of Popes as a kind of control group. His case elicited skeptical reviews, but it impressed Darwin. "You have made a convert of an opponent in one sense," he wrote to Galton, "for I have always maintained that, excepting fools, men did not differ much in intellect, only in zeal and hard work." Yet Galton's labors had hardly begun. If his eugenic utopia was to be a practical possibility, he needed to know more about how heredity worked. His belief in eugenics thus led him to try to discover the laws of inheritance. And that, in turn, led him to statistics.

Statistics at that time was a dreary welter of population numbers, trade figures, and the like. It was devoid of mathematical interest, save for a single concept: the bell curve. The bell curve was first observed when eighteenth-century astronomers noticed that the errors in their measurements of the positions of planets and other heavenly bodies tended to cluster symmetrically around the true value. A graph of the errors had the shape of a bell. In the early nineteenth century, a Belgian astronomer named Adolph Quetelet observed that this "law of error" also applied to many human phenomena. Gathering information on the chest sizes of more than five thousand Scottish soldiers, for example, Quetelet found that the data traced a bell-shaped curve centered on the average chest size, about forty inches.

As a matter of mathematics, the bell curve is guaranteed to arise whenever some variable (like human height) is determined by lots of little causes (like genes, health, and diet) operating more or less independently. For Quetelet, the bell curve represented accidental deviations from an ideal he called *l'homme moyen*—the average man. When Galton stumbled upon Quetelet's work, however, he exultantly saw the bell curve in a new light: what it described was not accidents to be overlooked but differences that revealed the variability on which evolution depended. His quest for the laws that governed how these differences were transmitted from one generation to the next led to what Brookes justly calls "two of Galton's greatest gifts to science": regression and correlation.

Although Galton was more interested in the inheritance of mental abilities, he knew that they would be hard to measure. So he focussed on physical traits, like height. The only rule of heredity known at the time was the vague "Like begets like." Tall parents tend to have tall children, while short parents tend to have short children. But individual cases were unpredictable. Hoping to find some larger pattern, in 1884 Galton set up an "anthropometric laboratory" in London. Drawn by his fame, thousands of people streamed in and submitted to measurement of their height, weight, reaction time, pulling strength, color perception, and so on. Among the visitors was William Gladstone, the Prime Minister. "Mr. Gladstone was amusingly insistent about the size of his head . . . but after all it was not so very large in circumference," noted Galton, who took pride in his own massive bald dome.

After obtaining height data from two hundred and five pairs of parents and nine hundred and twenty-eight of their adult children, Galton plotted the points on a graph, with the parents' heights represented on one axis and the children's on the other. He then pencilled a straight line though the cloud of points to capture the trend it represented. The slope of this line turned out to be two-thirds. What this meant was that exceptionally tall (or short) parents had children who, on average, were only two-thirds as exceptional as they were. In other words, when it came to height children tended to be less exceptional than their parents. The same, he had noticed years earlier, seemed to be true in the case of "eminence": the children of J. S. Bach, for example, may have been more musically distinguished than average, but they were less distinguished than their father. Galton called this phenomenon "regression toward mediocrity." Regression analysis furnished a way of predicting one thing (a child's height) from another (its parents') when the two things were fuzzily related. Galton went on to develop a measure of the *strength* of such fuzzy relationships, one that could be applied even when the things related were different in kind—like rainfall and crop yield. He called this more general technique "correlation."

The result was a major conceptual breakthrough. Until then, science had pretty much been limited to deterministic laws of cause and effect—which are hard to find in the biological world, where multiple causes often blend together in a messy way. Thanks to Galton, statistical laws gained respectability in science. His discovery of regression toward mediocrity—or regression to the mean, as it is now called—has resonated even more widely. Yet, as straightforward as it seems, the idea has been a snare even for the sophisticated. The common misconception is that it implies convergence over time. If very tall parents tend to have somewhat shorter children, and very short parents tend to have somewhat taller children, doesn't that mean that eventually everyone should be the same height? No, because regression works backward as well as forward in time: very tall children tend to have somewhat shorter parents, and very short children tend to have somewhat taller parents. The key to understanding this seeming paradox is that regression to the mean arises when enduring factors (which might be called "skill") mix causally with transient factors (which might be called "luck"). Take the case of sports, where regression to the mean is often mistaken for choking or slumping. Major-league baseball players who managed to bat better than .300 last season did so through a combination of skill and luck. Some of them are truly great players who had a so-so year, but the majority are merely good players who had a lucky year. There is no reason that the latter group should be equally lucky this year; that is why around eighty per cent of them will see their batting average decline.

To mistake regression for a real force that causes talent or quality to dissipate over time, as so many have, is to commit what has been called "Galton's fallacy." In 1933, a Northwestern University professor named Horace Secrist produced a book-length example of the fallacy in "The Triumph of Mediocrity in Business," in which he argued that, since highly profitable firms tend to become less profitable, and highly unprofitable ones tend to become less unprofitable, all firms will soon be mediocre. A few decades ago, the Israeli Air Force came to the conclusion that blame must be more effective than praise in motivating pilots, since poorly performing pilots who were criticized subsequently made better landings, whereas high performers who were praised made worse ones. (It is a sobering thought that we might generally tend to overrate censure and underrate praise because of the regression fallacy.) More recently, an editorialist for the *Times* erroneously argued that the regression effect alone would insure that racial differences in I.Q. would disappear over time.

Did Galton himself commit Galton's fallacy? Brookes insists that he did. "Galton completely misread his results on regression," he argues, and wrongly believed that human heights tended "to become more average with each generation." Even worse, Brookes claims, Galton's muddleheadedness about regression led him to reject the Darwinian view of evolution, and to adopt a more extreme and unsavory version of eugenics. Suppose regression really did act as a sort of gravity, always pulling individuals back toward the average. Then it would seem to follow that evolution could not take place through a gradual series of small changes, as Darwin envisaged. It would require large, discontinuous changes that are somehow immune from regression to the mean. Such leaps, Galton thought, would result in the appearance of strikingly novel organisms, or "sports of nature," that would shift the entire bell curve of ability. And if eugenics was to have any chance of success, it would have to work the same way as evolution. In other words, these sports of nature would have to be enlisted to create a new breed. Only then could regression be overcome and progress be made.

In telling this story, Brookes makes his subject out to be more confused than he actually was. It took Galton nearly two decades to work out the subtleties of regression, an achievement that, according to Stephen M. Stigler, a statistician at the University of Chicago, "should rank with the greatest individual events in the history of science—at a level with William Harvey's discovery of the circulation of blood and with Isaac

Newton's of the separation of light." By 1889, when Galton published his most influential book, "Natural Inheritance," his grasp of it was nearly complete. He knew that regression had nothing special to do with life or heredity. He knew that it was independent of the passage of time. Regression to the mean held even between brothers, he observed; exceptionally tall men tend to have brothers who are somewhat less tall. In fact, as Galton was able to show by a neat geometric argument, regression is a matter of pure mathematics, not an empirical force. Lest there be any doubt, he disguised the case of hereditary height as a problem in mechanics and sent it to a mathematician at Cambridge, who, to Galton's delight, confirmed his finding.

Even as he laid the foundations for the statistical study of human heredity, Galton continued to pursue many other intellectual interests, some important, some merely eccentric. He invented a pair of submarine spectacles that permitted him to read while submerged in his bath, and stirred up controversy by using statistics to investigate the efficacy of prayer. (Petitions to God, he concluded, were powerless to protect people from sickness.) Prompted by a near-approach of the planet Mars to Earth, he devised a celestial signalling system to permit communication with Martians. More usefully, he put the nascent practice of fingerprinting on a rigorous basis by classifying patterns and proving that no two fingerprints were exactly the same—a great step forward for Victorian police work.

Galton remained restlessly active through the turn of the century. In 1900, eugenics received a big boost in prestige when Gregor Mendel's work on heredity in peas came to light. Suddenly, hereditary determinism was the scientific fashion. Although Galton was now plagued by deafness and asthma (which he treated by smoking hashish), he gave a major address on eugenics in 1904. "What nature does blindly, slowly, and ruthlessly, man may do providently, quickly, and kindly," he declared. An international eugenics movement was springing up, and Galton was hailed as its hero. In 1909, he was honored with a knighthood. Two years later, at the age of eighty-eight, he died.

In his long career, Galton didn't come close to proving the central axiom of eugenics: that, when it comes to talent and virtue, nature dominates nurture. Yet he never doubted its truth, and many scientists came to share his conviction. Darwin himself, in "The Descent of Man," wrote, "We now know, through the admirable labours of Mr.

Galton, that genius . . . tends to be inherited." Given this axiom, there are two ways of putting eugenics into practice: "positive" eugenics, which means getting superior people to breed more; and "negative" eugenics, which means getting inferior ones to breed less. For the most part, Galton was a positive eugenicist. He stressed the importance of early marriage and high fertility among the genetic élite, fantasizing about lavish state-funded weddings in Westminster Abbey with the Queen giving away the bride as an incentive. Always hostile to religion, he railed against the Catholic Church for imposing celibacy on some of its most gifted representatives over the centuries. He hoped that spreading the insights of eugenics would make the gifted aware of their responsibility to procreate for the good of the human race. But Galton did not believe that eugenics could be entirely an affair of moral suasion. Worried by evidence that the poor in industrial Britain were breeding disproportionately, he urged that charity be redirected from them and toward the "desirables." To prevent "the free propagation of the stock of those who are seriously afflicted by lunacy, feeble-mindedness, habitual criminality, and pauperism," he urged "stern compulsion," which might take the form of marriage restrictions or even sterilization.

Galton's proposals were benign compared with those of famous contemporaries who rallied to his cause. H. G. Wells, for instance, declared, "It is in the sterilisation of failures, and not in the selection of successes for breeding, that the possibility of an improvement of the human stock lies." Although Galton was a conservative, his creed caught on with progressive figures like Harold Laski, John Maynard Keynes, George Bernard Shaw, and Sidney and Beatrice Webb. In the United States, New York disciples founded the Galton Society, which met regularly at the American Museum of Natural History, and popularizers helped the rest of the country become eugenics-minded. "How long are we Americans to be so careful for the pedigree of our pigs and chickens and cattle—and then leave the *ancestry of our children* to chance or to 'blind' sentiment?" asked a placard at an exposition in Philadelphia. Four years before Galton's death, the Indiana legislature passed the first state sterilization law, "to prevent the procreation of confirmed criminals, idiots, imbeciles, and rapists." Most of the other states soon followed. In all, there were some sixty thousand court-ordered sterilizations of Americans who were judged to be eugenically unfit.

It was in Germany that eugenics took its most horrific form. Galton's creed had aimed at the uplift of humanity as a whole; although he shared the prejudices that were common in the Victorian era, the concept of race did not play much of a role in his theorizing. German eugenics, by contrast, quickly morphed into *Rassenhygiene*—race hygiene. Under Hitler, nearly four hundred thousand people with putatively hereditary conditions like feeblemindedness, alcoholism, and schizophrenia were forcibly sterilized. In time, many were simply murdered.

The Nazi experiment provoked a revulsion against eugenics that effectively ended the movement. Geneticists dismissed eugenics as a pseudoscience, both for its exaggeration of the extent to which intelligence and personality were fixed by heredity and for its naïveté about the complex and mysterious ways in which many genes could interact to determine human traits. In 1966, the British geneticist Lionel Penrose observed that "our knowledge of human genes and their action is still so slight that it is presumptuous and foolish to lay down positive principles for human breeding."

Since then, science has learned much more about the human genome, and advances in biotechnology have granted us a say in the genetic makeup of our offspring. Prenatal testing, for example, can warn parents that their unborn child has a genetic condition like Down syndrome or Tay-Sachs disease, presenting them with the agonizing option of aborting it. The technique of "embryo selection" affords still greater control. Several embryos are created in vitro from the sperm and the eggs of the parents; these embryos are genetically tested, and the one with the best characteristics is implanted in the mother's womb. Both of these techniques can be subsumed under "negative" eugenics, since the genes screened against are those associated with diseases or, potentially, with other conditions that the parents might regard as undesirable, such as low I.Q., obesity, same-sex preference, or baldness.

There is a more radical eugenic possibility on the horizon, one beyond anything Galton envisaged. It would involve shaping the heredity of our descendants by tinkering directly with the genetic material in the cells from which they germinate. This technique, called "germline therapy," has already been used with several species of mammals, and its proponents argue that it is only a matter of time before human beings can avail themselves of it. The usual justification for germline therapy is its potential for eliminating genetic disorders and diseases. Yet it also has the potential to be used for "enhancement." If, for example, researchers identified genes linked with intelligence or athletic ability, germline therapy could give parents the option of souping up their children in these respects.

Galtonian eugenics was wrong because it was based on faulty science and carried out by coercion. But Galton's goal, to breed the barbarism out of humanity, was not immoral. The new eugenics, by contrast, is based on a relatively sound (if still largely incomplete) science, and is not coercive; decisions about the genetic endowment of children would be left up to their parents. It is the goal of the new eugenics that is morally cloudy. If its technologies are used to shape the genetic endowment of children according to the desires—and financial means—of their parents, the outcome could be a "GenRich" class of people who are smarter, healthier, and handsomer than the underclass of "Naturals." The ideal of individual enhancement, rather than species uplift, is in stark contrast to the Galtonian vision.

"The improvement of our stock seems to me one of the highest objects that we can reasonably attempt," Galton declared in his 1904 address on the aims of eugenics. "We are ignorant of the ultimate destinies of humanity, but feel perfectly sure that it is as noble a work to raise its level . . . as it would be disgraceful to abase it." Martin Brookes may be right to dismiss this as a "blathering sermon," but it possesses a certain rectitude when set beside the new eugenicists' talk of a "posthuman" future of designer babies. Galton, at least, had the excuse of historical innocence. ♦

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