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Chapter 3
Homo sapiens: Francis Galton's fairground attraction

About 100,000 years ago, a casual observer would probably not have found the early members of *Homo sapiens* particularly remarkable. Like our ancestors, we were essentially apes with bad hair and bad posture. For some reason – much debated, yet still unclear – we'd abandoned the sensible arboreal habits of our cousins and moved out on to the African savannahs to stand more or less upright. Somewhere along the way we lost most of our attractive fur. Perhaps leaving the forests and the cover they provided prompted our ancestors to stand up, so they could spot approaching predators. Leaving the trees may also have had something to do with the hair-loss, but there is no consensus about what the connection might have been, nor is there any convincing evidence.

There was not much to suggest that these unappealing ape-like creatures would eventually colonize most of the planet, but of course we did. About 12,000 years ago we began to create permanent settlements, based on the discovery that we could grow our food instead of pursuing it. Over the next few thousand years farming became more widespread and sophisticated, allowing ever larger groups of people to live closer and closer together. A few thousand years later, *Homo sapiens* made one of its biggest discoveries: living in cities. Once urbanized, our species went on to spread across almost all the earth's continents, building larger and larger cities as it went.

Cities allowed more people to live in less space, which created two major problems. The first was getting enough for everyone to eat, and the other was disposing of the waste after everyone had eaten. On Thursday 8 May 1884, after roughly 6,000 years of coping with these closely related inconveniences, the most advanced solutions to them went on display at an International Health Exhibition in what was then the world's largest city, London. Over the following few months, over 4 million curious *Homo sapiens* came to look at displays that focused on the great problems of city life: eating and excreting.

Ingestion took up much of the available space. In the middle of the exhibition was a working dairy, where city dwellers could watch cows being milked and butter being churned – sights that were beginning to become a little unfamiliar. Around it 'are also illustrated methods of cold storage and transport of fresh meat, ice-making, the preservation of food, making bread, biscuits, &c., the manufacture of confectionary, of condiments, of cocoa and chocolate, and the production and bottling of aerated waters'.[1]

The *Illustrated London News* sent George Augustus Sala to describe the exhibition for its readers. Sala had made a name for himself writing in Charles Dickens's popular weekly, *Household Words*. He observed that if anyone could summon up the 'moral and physical courage to "do" the whole of the contents of the Health Exhibition in the course of a single day', they would at least not go hungry, since 'it is a colossal Café and Restaurant'. Visitors could if they liked 'obtain a sixpenny dinner in the restaurant of the Vegetarian Society . . . ', which planned to spend the profits from its restaurant on 'feeding the poor of London and the provinces – on strict vegetarian principles, of course – during the winter of 1884–5'. One wonders how London's poor responded to this meat-free charity, but Sala at least was impressed; 'I have partaken of the sixpenny vegetarian dinner,' he recorded, 'and found it very nice.'[2]

Those who were not bold enough to attempt the vegetarian dinner could try a '*dîner à la Duval*', in a restaurant based on 'the system so largely made use of in Paris at Duval's Restaurants'.

Great efforts were made to ensure that everyone knew what they were paying and were not over-charged, but the most striking feature of the restaurant was that 'the far end of this dining saloon is closed by plate glass windows, behind which the cooks may be seen at work preparing the various dishes'.[3]

Watching the cooks at work reassured the diners that their food was being prepared in hygienic conditions. Britain still lacked health inspectors and the purity of food was a major concern for many Londoners; the first Food Adulteration Act had been passed in 1860, but no means of enforcing it existed until the first inspectors were appointed in 1872. And it was only in 1885, after the Exhibition, that the Sale of Goods Act made sellers responsible for the goods they sold for the first time.[4] Just a few generations earlier, most people in Britain had still seen their food grown, milled, baked and sold in their own villages, but by the 1880s these were distant memories for the millions crowded into London's narrow, smoky streets. As we saw in the last chapter, London's billowing smoke made it difficult to grow fruit and vegetables close to the people who would eat them. Food now came from shops, whose weighing scales were notoriously inaccurate and whose proprietors were fond of watering the milk and bulking up the flour with alum or even more sinister compounds. The campaigning journalist James Greenwood accused dishonest shopkeepers of being thieves, adding that compared with robbers, the shopkeeper's 'is a much safer system of robbery. You simply palm off on the unwary customer burnt beans instead of coffee, and ground rice instead of arrowroot, and a mixture of lard and turmeric instead of butter. You poison the poor man's bread.'[5] The Health Exhibition's working dairy and glass-walled kitchen were responses to these anxieties, as were the displays of ingenious devices for keeping foods fresh and uncontaminated during their long journeys to the capital.

However, while the restaurants might be seen as vital to the exhibition's ostensible subject, health, there were other displays that seemed less easy to justify. The *Illustrated London News* was sure that 'the international collection of dresses and of English costumes' displayed on waxworks would be 'attractive to the fair sex', while 'persons of antiquarian tastes will be able to inspect an elaborate model of part of the City of London in the olden time'.[6] Others were less convinced; the life-size historic street was a popular attraction, as were the waxworks, illuminated fountains, tiles, pottery, iron-work, tapestries and similar decorative products, but the *Saturday Review* commented that 'those of us who have lived a few years in London will remember more than one "International" show which, opened under Royal patronage, ended up becoming a mere bazaar. There is a good deal of puffing carried on by means of them, and the more satisfactory they are to advertisers, the less they really do for the advancement of science or art.'[7] Even the more enthusiastic journalists had to confess that they could not do justice to the range of 'bronze statues and electroliers, bibles, cabbages, and parasitic pests, vile vegetable dinners [and] dairies'.[8]

The health exhibition was merely the most recent in what had become annual shows of various kinds, shows whose miscellaneous contents had been satirized in *Punch* a few years earlier. The magazine's brief guide to forthcoming 'International Exhibitions' had forecast that the 1880 show would contain 'apparatus for preventing and consuming smoke, observatories, orangeries, artificial flowers, acts of parliament, carriages-and-four, balloons, flying machines, fireworks and anything that may have been omitted in previous years'. *Punch* concluded by observing that 'fine dresses, flirtations, refreshments, season tickets, turnstiles, catalogues, military bands, crowds of people, and grumblers' would be on display every year.[9]

Many of the journalists who reported on the exhibition were content to treat it as entertainment, but the weekly magazine *Knowledge*, which prided itself on being 'an illustrated magazine of science, plainly-worded – exactly-described', was concerned to demonstrate that the show had a more serious purpose. Its publisher and editor, Richard Proctor, a well-regarded astronomer, sent one of his writers, John Ernest Ady, to cover the Health Exhibition. Ady defended its educational claims by arguing that

the 'true sanitary exhibits' had been carefully mixed with 'more entertaining objects', to ensure that the casual visitor did not get bored. Meanwhile:

> The sanitary student . . . who comes intent on study is pleasurably surprised, and imperceptibly led to find how much easier his task becomes under the soothing influences of a *dîner à la Duval*, with music thereafter, and when his eye is delighted by exquisite dress, Doulton's potter's art, beautiful furniture, or quaint houses; and then to see the living cows and goats milked! Why, after that, he can go on his sanitary tour with redoubled vigour.[10]

The refreshed 'sanitary student' could then concentrate on the less salubrious aspects of the show, those that addressed the business of excreting.

By the middle of the nineteenth century, Britain was the most urbanized country the world had ever seen; the 1851 census revealed that, for the first time in the history of any country, more than half its people lived in towns. The decline of rural employment and the growth of factories forced people into cities, where life expectancy was typically half that of the countryside. Among the tightly packed city dwellers epidemic diseases spread rapidly; polluted water supplies spread cholera and typhoid, typhus was spread by lice, and warmer weather brought regular outbreaks of 'summer diarrhoea' as millions of flies feasted on the horse manure and human waste that lay in the streets, before transferring their attentions to human food. Every British city was the same; in Manchester, 'everywhere heaps of débris, refuse and offal; standing pools for gutters, and a stench which alone would make it impossible for a human being in any degree civilized to live in such a district'.[11]

London's untreated sewage flowed straight into the Thames; as a result the city stank. The need for better sanitation, especially for sewers and water treatment plants, preoccupied the Victorians, especially in the hot summer of 1858, when the Thames almost stopped flowing under its burden of refuse and the 'Great Stink' of London began. The river's stench was so overpowering that large parts of the House of Commons became uninhabitable, thus effectively focusing the MPs' minds on the urgency of sanitary reform. In less than three weeks, a bill was rushed through Parliament and money was made available to build miles of new sewers and to construct an embankment to improve the river's flow.

By the time the Health Exhibition opened, London was a little less noisome than it had been, but the problems of sanitation were still very much on Londoners' minds. The engineer and sanitary reformer Sir Douglas Strutt Galton wrote a long article about the exhibition in the *Art Journal*, condemning the terrible conditions of the poor, which resulted from ignorance of basic sanitary measures. He argued that these were everyone's concern, since 'a badly housed population is a discontented population, and legitimately so'.[12] According to the *Pall Mall Gazette*, when His Grace the Duke of Buckingham opened the exhibition he was greeted with cheers as he claimed that the opening would 'mark an era in the records of the social and domestic condition of the nation'.[13]

As if in response to the Duke's challenge, the Doulton & Company pottery (now famous as Royal Doulton) took a whole pavilion at the exhibition, where they exhibited the sewer pipes, toilet bowls and industrial ceramics upon which the company's fortunes were founded. John Ady devoted three full articles in *Knowledge* to describing the wonderful improvements in the art of waste disposal that Doulton were making.[14] Another reporter commended as 'one of the most interesting features in the Exhibition' an ingenious display that attempted to resolve the problems of eating and excreting simultaneously. Britain's fields were increasingly fertilized with guano – dried bird-droppings. Britain's guano was imported but large-scale mining in South America and the southern Pacific had already begun to deplete natural deposits, which seabirds had been diligently building for centuries; as a result, guano was becoming expensive. Britain's

Native Guano Company used the Health Exhibition to exhibit its process 'for purifying sewage, waste waters, &c., before they are allowed to fall into the rivers'. Not only did it remove 'the offensive matters dissolved in the water', but the reporter was convinced 'that vegetables grown with the manure produced by the Native Guano Company's process' were in every way superior to 'vegetables grown on sewage irrigation farms'. The Native Guano Company was awarded a Gold Medal by the organizers, but – perhaps not entirely surprisingly – their process was not to be widely adopted.[15]

Once visitors had inspected the potential improvements to their drains, the fertilizing possibilities of their own 'guano' and registered the hazards of wallpapers whose dyes contained arsenic, they could shock themselves by looking at examples of 'dress injurious to health', which included 'models, in plaster, of the liver of a healthy woman and of the same organ in a wasp-waisted votary of fashion', whose corset was laced so tightly as to displace her internal organs.[16] Also on display was a solution to this predicament, in the form of Madame Eugénie Genty's 'newly patented Health Busk, which enables the ladies, when indisposed, to unclasp their corsets instantaneously'.[17] Those with no interest in busks could turn to bees: 'the visitor who is interested in Bee Culture, will find . . . the collection of frame and straw hives' extractors, comb foundations and other appliances used in bee keeping, together with specimens of pure and adulterated honey, and of the articles used as adulterants'.[18]

At this point an exhausted visitor, well fed and slightly inebriated, dizzied by unlaced corsets and improved cisterns, could have been forgiven for giving up and going home. Which would have been a shame, because in the same corridor as the bee-keeping equipment and a collection of meteorological instruments, sandwiched between the dining-rooms and the bakeries, was a corridor 6 feet wide and 36 feet long in which one curious *Homo sapiens* had devised an experiment intended to improve his own species.

Measuring man

As the official guide to the Exhibition explained, 'Adjoining the meteorological instruments is the so-called Anthropometrical Laboratory, arranged by Mr. Francis Galton, in which visitors can have their principle physical dimensions taken, their hearing power and accuracy of eyesight ascertained, and their strength tested.'[19] Here visitors could pay 3d. to have measured everything from their 'Keenness of Sight and of Hearing' to their colour sense and 'Judgment of Eye'. Physical strength was measured too, using machines that resembled those found in Victorian fairgrounds, which estimated 'Strength of Pull and of Squeeze' and 'Force of Blow'. The laboratory's organizer, Francis Galton (no relation to Sir Douglas, the engineer), wrote that 'the ease of working the instruments that were used was so great that an applicant could be measured in all these respects, a card containing the results furnished him, and a duplicate made and kept for statistical purposes', all for the cost of the threepenny admission fee, which 'just defrayed the working expenses'.[20]

During the six months that the Health Exhibition was open, seventeen different measurements were made of over 9,000 visitors. A sergeant was on duty to superintend the crowds and a Mr Gammage, a scientific instrument maker, came in every evening 'to assist and supervise, and who maintained the instruments in efficiency'. There was also 'a doorkeeper provided by the executive', who let people in, collected their threepences, handed out and collected forms, ensured the latter were correctly filled in, and 'made himself useful in many other details'.[21] Galton was so delighted with the results that after the Health Exhibition closed, 'it seemed a pity that the Laboratory should also come to an end, so I asked for and was given a room in the Science Galleries of the South Kensington Museum. I maintained a Laboratory there for about six years.'[22] This new lab continued the earlier one's work, gathering data on nearly 4,000 people in its first three years.

To understand how all these measurements were supposed to reshape humanity, we need to know a little more about the man

who made them. Even by the standards of Victorian eccentricity, Francis Galton was an extraordinary figure. His mother was a daughter of Erasmus Darwin – Charles Darwin's grandfather. Despite being a child prodigy – he was discussing Homer's *Iliad* at the age of six – he did not do well at school, and found it difficult to stick to his medical studies. In 1840, at the age of eighteen, he dropped medicine and went to Trinity College, Cambridge to read mathematics. He lived the typical life of an undergraduate: after three years of drinking, dancing, hiking and doing no work at all, he had a nervous breakdown while preparing for his finals, and left with an ordinary degree.

When Galton was twenty-two his father died, leaving him a substantial fortune. He gave up study and began to travel, in the Middle East, then Scotland, then in South-West Africa. Back in London he published his first book, *Narrative of an Explorer in Tropical South Africa* (1853). The common thread that was to link all of Galton's varied enthusiasms was already apparent in this book: measurement. During his South African travels, he wanted to determine the precise dimensions of a Hottentot woman's buttocks; since he did not speak her language he resorted to surveying her from a distance, using a theodolite (normally used to survey land); 'this being done', he recorded, 'I boldly pulled out my measuring-tape, and measured the distance from where I was to the place where she stood, and having thus obtained both base and angles, I worked out the results by trigonometry and logarithms.'[23]

Back in London, Galton turned his mathematical mind to more conventional subjects, map-making, geographical instruments and weather forecasting. He coined the term anti-cyclone and also published the first newspaper weather map (in *The Times* of 1 April 1875). Galton was elected a fellow of the Royal Society soon after his return to Britain, and some sense of the diversity of his scientific interests can be gained from the range of societies he was involved with: he was on the managing board of the Kew Observatory in 1858; he joined the Royal Statistical Society in 1860 and had also become a leading member of the Ethnological Society by that time.

In 1859, his cousin Charles Darwin published *On the Origin of Species*. Not surprisingly, given his voracious appetite for scientific novelties, Galton read it immediately and wrote to congratulate Darwin on 'your wonderful volume', which he had finished with 'a feeling that one rarely experiences after boyish days, of having been initiated into an entirely new province of knowledge'.[24] Many years later, in his autobiography, Galton recorded that he had 'devoured its contents and assimilated them as fast as they were devoured, a fact which perhaps may be ascribed to an hereditary bent of mind that both its illustrious author and myself have inherited from our common grandfather, Dr. Erasmus Darwin'. This rapid ingestion of Darwin's 'new views' encouraged Galton 'to pursue many inquiries which had long interested me, and which clustered round the central topics of Heredity and the possible improvement of the Human Race'.[25]

This was a surprising conclusion to draw from Darwin's book, which as we have seen made almost no mention of the evolution of humans, much less of their 'improvement'. However, Galton may perhaps have been inspired by the *Origin*'s famous closing passage, where Darwin wrote that:

> Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved.[26]

Darwin believed he had found a natural law, akin to Newton's 'fixed law of gravity', that governed all living things, including ourselves. Some of the *Origin*'s readers were repelled by the idea that it was not God but natural selection, powered by 'famine and death', which had created them. But others – including Galton – felt liberated from the strain of believing in a religious world-view they found increasingly implausible. He told Darwin that 'your book drove away the constraint of my old superstition as if it had been a nightmare and was the first to give me freedom of thought'.[27] To Galton and many of his contemporaries, Darwin seemed to be saying that progress was one of nature's laws, that every living thing was under the sway of the Victorian creed of self-improvement. The book's final sentence, 'endless forms most beautiful and most wonderful have been, *and are being*, evolved', could be interpreted to mean that evolution was not over. Humanity might still be improving and some future race of people would stand as distant from us as a Victorian gentleman stood from his stooped, hairy African ancestor.

Galton was also inspired by Darwin's analogy between human efforts to improve domesticated plants and animals and the way nature worked to create new species. Darwin used the familiar processes of plant- and animal-breeding, which he called artificial selection, to give his readers some sense of the changes that were possible. Humans had taken the common domestic rock pigeon, *Columba livia*, and by selective breeding over a few hundred years had produced the extraordinary array of ornamental pigeons that fascinated Victorian pigeon fanciers: the English carrier, the short-faced tumbler, the runt, the barb, the pouter and the fantail. If these bizarre birds, with their extravagant tail feathers and extraordinary shapes, were shown to an ornithologist who did not realize they were domesticated, they would, Darwin felt sure, 'be ranked by him as well-defined species', perhaps even as members of different genera. Given that artificial selection could do so much in so short a time, just imagine, Darwin suggested, what natural selection can achieve as it works away over 'the long lapse of ages'.[28]

This sense that living creatures offered almost infinite scope for improvement caught Galton's imagination. A few years after reading the *Origin*, he wrote two articles on 'Hereditary Talent and Character'. He began by noting that the 'power of man over animal life, in producing whatever varieties of form he pleases, is enormously great. It would seem as though the physical structure of future generations was almost as plastic as clay, and under the control of the breeder's will. It is my desire to show . . . that mental qualities are equally under control.' The idea that an animal's mental characteristics could be improved by breeding seemed entirely plausible; one only had to consider a gentleman's best friend and companion, his hunting dog, whose instincts to point and retrieve had been sharpened by generations of careful, artificial selection. But Galton had a rather more controversial target in mind; the mental qualities of his fellow humans. Contrary to common prejudice, Galton wrote, 'I find that talent is transmitted by inheritance in a very remarkable degree.'[29]

Galton's evidence for this claim was to examine the biographies of eminent men (women seldom attracted his consideration) to see if talent ran in families. He was convinced that it did. He and his famous cousin, two eminent scientific men who shared a grandfather, were just one of hundreds of examples that showed famous men were more likely to be related to each other than to crop up randomly among families of nonentities. Just as prize-wining horses were more likely to sire future Derby winners, so the leading judges, authors, essayists, musicians, divines, artists and scientific men were most likely to father equally successful sons. Wherever we look, Galton argued, 'the enormous power of hereditary influence is forced on our attention'. The implication, he felt, was clear: the talent that made men eminent in their fields was inherited, so if eminent men could be persuaded to breed with women 'who possessed the finest, and most suitable natures, mental, moral, and physical', they would produce outstanding offspring. And if the children of these select marriages were to be equally choosy about their own spouses, it might be possible to accelerate Darwin's process dramatically. As Galton put it:

> 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 improvement of the breed of horses and cattle, what a galaxy of genius might we not create! We might introduce prophets and high priests of civilization into the world, as surely as we can propagate idiots by mating crétins. Men and Women of the present day are, to those we might hope to bring into existence, what the pariah dogs of the streets of an eastern town are to our own highly-bred varieties.[30]

Whatever the practicality, much less the morality, of such a scheme, it was a somewhat perverse reading of Darwin, who had looked to *natural* selection to make whatever improvements species might in future undergo. At the very least, the *Origin* seems superfluous to Galton's view, since he was simply promoting an extension of the well-known, longstanding practices of artificial selection to humans; no one needed to read Darwin to know that humans had been effectively breeding dogs for hundreds of years. Yet Galton felt the *Origin* was vital, because it had helped him discard his religious views.[31] Darwin had persuaded him that humans were animals like any other, subject to the same laws of inheritance and competition; if a breeder could reshape a dog's mind so that it retrieved more effectively, why could not a human mind be bred to improve its ability to paint, compose or theorize? If people could be persuaded to put aside their superstitious belief in their divinely created uniqueness, they would see themselves as capable of potentially infinite improvement.

Galton was thrilled by his own idea. He cast around for a succinct and memorable name for his theory, and initially called it viriculture, but eventually settled on the term eugenics.[32] He promoted it in magazines and eventually wrote a book, *Hereditary Genius* (1869), which was essentially a much-expanded version of his original article, bolstered with many more accounts of eminent men. Since he had no way of directly measuring a person's intelligence or other mental qualities, Galton had to use posthumous reputation as a guide, bolstered by his – largely unsubstantiated – conviction that whatever 'eminence' men attained must be predominantly a product of their innate gifts, not of their being well-connected members of privileged families.

Yet, despite the weight of his evidence, Galton's idea did not catch on. The reviews of *Hereditary Genius* were almost all hostile. The Manchester *Guardian*'s reviewer focused on what remains one of the central objections to eugenics: 'Who is to decide whether a man's issue is not likely to be well fitted "to play their part as citizens?" '[33] Even more annoyingly, many reviewers were simply amused by Galton's idea; one wryly commented that if Galton's 'happy and philosophic system' were to be adopted, 'we shall no more hear of a lady "throwing herself away" upon an unworthy object'.[34]

One of the largest obstacles in Galton's path was that he had no real evidence for his controversial claim that mental qualities were inherited. Most of his contemporaries believed that humans had unique, divinely created mental qualities that set them apart from other animals. And even the less religious believed that such factors as parents' health and habits shaped their children. Alcoholism, for example, was considered a degenerative disease, whose effects were inherited; drunken parents weakened their minds and bodies by drinking, and then passed these weaknesses on to their children. By the same logic, it was assumed that if fathers and mothers were healthy they would tend to produce healthy children, regardless of their bloodline, and that improvements in their mental ability were most likely to arise from better education. Such arguments drastically curtailed the appeal of Galton's views, since they suggested that – even if the ill-effects of alcohol were inherited – people were primarily shaped by their environments; temperance campaigns and improved sewers rather than selective breeding were the most urgent task for those who wanted to improve humanity. The 1860s was a fairly prosperous decade in Britain: the country maintained its industrial lead over its competitors; it gained new colonies, and with them both cheap raw materials and new markets; and the economy continued to grow. The nation seemed to be getting steadily richer and many influential people felt they could afford to pull down some slums and build a few schools and drains.

There was nothing new about debates over the roles of inherited and environmental factors in shaping human nature;

they had been going on since at least the late eighteenth century, pitting 'hereditarians' against 'perfectibilists'. In very simplified terms, the latter argued that if the progress of civilization improved the conditions of human life, humans themselves would be improved. The hereditarians rejected this approach, insisting that good breeding was the key to improvement. Galton liked to think of himself as having reinvigorated the hereditarian argument and he brought the term 'heredity' into English (from the French *hérédité*) to symbolize his supposedly new approach. But in fact it was widely accepted that clever parents tended to have clever children, mainly because they often shared an advantageous environment but to some lesser degree because intelligence was inherited; the issue for Galton was to overturn the received view, by establishing that breeding played the dominant role in forming someone's intelligence.[35]

For most of his life Galton seems to have simply assumed the hereditary factors were dominant, and in 1874 he adopted a memorable verbal contrast to summarize his view:

> The phrase 'nature and nurture' is a convenient jingle of words, for it separates under two distinct heads the innumerable elements of which personality is composed. Nature is all that a man brings with himself into the world; nurture is every influence from without that affects him after his birth.[36]

He borrowed the phrase from Shakespeare's *Tempest*, in which Prospero describes the monstrous Caliban as 'A devil, a born Devil, on whose nature nurture can never stick'. Convinced that nature dominated nurture, Galton was sure that reformers were deluding themselves and would waste the money contributed by wealthy taxpayers like himself on their schemes for environmental and educational improvements. 'I have no patience,' he snarled, 'with the hypothesis occasionally expressed, and often implied . . . that babies are born pretty much alike, and that the sole agencies in creating differences between boy and boy, and man and man, are steady application and moral effort.' In case anyone had missed the point, he added, 'It is in the most unqualified manner that I object to pretensions of natural equality.'[37] Despite his Darwinism and contempt for traditional religion, Galton was a deeply conservative man and felt a contempt, tinged with fear, for his social inferiors. He had no patience with the filthy, immoral Calibans who swarmed through London's slums, demanding reforms they expected eminent men to pay for.

The return of Lord Morton's mare

The problem Galton faced was that he, like his contemporaries, had no idea how biological inheritance worked. Even for simple physical attributes, the patterns of inheritance were complex, but they were even more so for mental ones which were so hard to measure. As the *Guardian*'s hostile review of *Hereditary Genius* had put it: 'Do not weak men have strong children, stupid ones wise, wicked good? – while on the other hand, do we not find the weak emanating from the strong, and bad from good?'[38] Neither the reviewer, nor Galton, nor any of their contemporaries had any idea of what was actually passed from generation to generation, nor of how it was passed. As Galton later noted, at this time scientific opinions about heredity were 'vague and contradictory'; however, 'most authors agreed that all bodily and some mental qualities were inherited by brutes, but they refused to believe the same of man'.[39] Galton needed to understand how inheritance worked before he could seriously attempt to prove that it, not education and environment, determined human mental qualities.

Shortly after *Hereditary Genius* appeared, Galton received a letter from Darwin, who exclaimed enthusiastically that 'I do not think I ever in all my life read anything more interesting and original. And how well and clearly you put every point!'[40] Darwin was also contemplating the question of heredity. His lack of a theory of inheritance had been seized on by some critics of the *Origin* as the weakest link in his argument. In 1867 a Scottish engineer, Fleeming Jenkin, published a critical review of the *Origin* that Darwin himself had to acknowledge 'seems to me one of the most telling Reviews of the hostile kind, & shews much ability'.[41] Jenkin

had three objections to Darwin's theory, of which the most serious focused on inheritance. Jenkin – like Galton, Darwin and most of their contemporaries – assumed that when two organisms mated, their offspring displayed a mixture of the parents' characteristics. This seemed a reasonable theory (after all, we still talk about a baby having its father's nose, but its mother's eyes) and was known as 'blending inheritance'. Jenkin thought blending was fatal to Darwin's ideas: he asked his readers to imagine what would happen if a white man were shipwrecked on an island inhabited by black people. Assume, proposed Jenkin, that he possessed 'the physical strength, energy, and ability of a dominant white race'. This superior white man is then in a position analogous to that of a new type of plant or animal, which has been thrown up by the chance variations that were crucial to Darwin's theory. Jenkin suggests that we imagine this Robinson Crusoe to have 'every advantage which we can conceive a white to possess over the native':

> Our shipwrecked hero would probably become king; he would kill a great many blacks in the struggle for existence; he would have a great many wives and children . . . Our white's qualities would certainly tend very much to preserve him to good old age, and yet he would not suffice in any number of generations to turn his subjects' descendants white.[42]

Jenkin's argument was a simple one, and his racist assumptions should not blind us to its logic. No matter how many wives our hero acquired, they would all be black and so, no matter how many children he had, they would tend to be darker-skinned than their father, and – given that there would be no white spouses available for his children to choose, the white king's offspring would also have black wives and so their grandchildren would be darker still. In a few generations, the old king would be dead and his descendants would be as black as ever.

Jenkin admitted that white skin might not, in itself, convey any advantage, but he assumed that whatever superior qualities the white races possessed – strength, vigour or courage – were traits that were inherited in exactly the same way as skin colour and so would undergo the same dilution over successive generations. The same would be true for all traits in all organisms: one fast antelope could not make its species faster any more than one freakishly tall flower could make its descendants taller.

Darwin was worried by Jenkin's argument and he made some changes to the following edition of the *Origin* (the fifth, of 1869) that he hoped would address it. He acknowledged that if a new form arose as an isolated freak of nature, or 'sport', it would not be able to alter the nature of the species, but he did not believe natural selection was invalidated by blending inheritance; instead, he simply focused his argument on the normal level of variability in a population, instead of on the sports. Suppose, he argued, that a species of bird has beaks that normally vary from being completely straight to being very curved. Imagine what would happen if a change in the birds' environment gave curved beaks an advantage: perhaps a drought made the insects that the birds normally ate scarce, so they have to dig into cracks in rock to retrieve seeds instead. If a curved beak worked better for this kind of feeding, the straight-beaked birds would do less well in the competition for food and so have fewer offspring. Meanwhile the curved beaks would be doing well and – being more numerous and better fed – breeding more successfully. Their offspring would face the same competition in the next generation and those with the most curved beaks would do best. Over many generations, beaks would become more and more curved. Such small, gradual variations (which were, in any case, much more common than sports), allowed natural selection to work just as Darwin had foreseen.

However, while Darwin felt he had seen off Jenkin, he was acutely aware that the lack of an explicit mechanism of inheritance was still a major weakness in his argument. He had been puzzling over the problem ever since his days at Edinburgh University; and had given it a great deal of thought while he worked on what he called his 'big species book'. This had

absorbed him for nearly twenty years, but in 1858 he had been stunned by a letter from another naturalist, Alfred Russel Wallace, who had hit on the idea of natural selection entirely independently. Terrified that Wallace would get credit for the idea, Darwin rushed *The Origin of Species* into print, describing it as an 'abstract' of the larger book he still hoped to write.

Once the *Origin* was out, and Darwin's intellectual priority was established, he returned to the unfinished manuscript of his 'big book', eventually turning sections of it into *The Variation of Animals and Plants under Domestication* (1868), in which he focused on a collection of puzzles relating to heredity – in the hope that solving them would help him understand how inheritance worked.

To modern readers, the *Origin* can seem long-winded at times, but any reader who finds it heavy going should try reading *Variation*; had it not been for Wallace's accidental intervention, Darwin's theory (if it had ever appeared at all) would have been buried under such a mass of detailed information that it is possible no one would ever have understood its significance. *Variation* piles on example after example of breeding, from dogs and cats through to gooseberries, from pigeons to peaches, canaries to cherries, from asses to apricots. Only a very patient reader would have perceived the significance of the various phenomena that interested Darwin. Among these were 'reversion': why is it that babies sometimes have their grandmother's or great-grandmother's nose, rather than their mother's? Regeneration: why is it that if you cut the tails of some lizards, they are able to grow new ones? And Darwin was also interested in the curious case of Lord Morton's mare.

Being a country boy at heart, Darwin drew many of his examples of reversion from the farmyard, asking why breeds of sheep that for generations had been bred without horns should suddenly throw up a lamb with horns. In part, he hoped that understanding reversion might solve the problem of blending inheritance: whatever caused such characters to appear had obviously not been swamped, so perhaps this unknown cause could explain how improved variations might survive, spread and develop into species. After pondering the question, Darwin argued that whatever it was that caused horns to appear in hornless breeds, it must persist, like words 'written on paper with invisible ink', which were always present but could not be seen until some unknown factor caused them to reappear.[43]

Darwin was also fascinated by the way creatures such as salamanders could grow new limbs. This ability suggested to him that whatever the mysterious 'invisible' characters were, they need not be restricted to a creature's reproductive organs, but appeared to be diffused through its body. Finally, there was Lord Morton's mysterious mare. As we have seen, the mare had been mated with a male quagga and had produced stripy, quagga-like foals. But the pure-bred mare had also produced striped foals when she was subsequently mated with another horse. This suggested to Darwin that there was a 'direct action of the male element on the female form'; some essence of the quagga had been left in the mare.[44]

Darwin's challenge was to find a connection between his hereditary puzzles (he cited plenty of others). *Variation*'s 800 pages of detailed cases finally concluded with his answer, the 'Provisional Hypothesis of Pangenesis'. He suggested that every part of an organism must 'throw off minute granules which are dispersed throughout the whole system; that these . . . multiply by self-division, and are ultimately developed into units like those from which they were originally derived'. He christened these granules 'gemmules', and argued that 'they are collected from all parts of the system to constitute the sexual elements'.[45]

Looked at from the perspective of modern genetics, Darwin's theory looks quaint, but it is important neither to dismiss it, nor – even less appropriately – to interpret gemmules as ancestors of modern genes. Darwin's idea grew out of a long tradition of thinking about 'generation', which linked together all sorts of things – such as inheritance, development and healing – that we now see as separate. To understand why he thought pangenesis was plausible, we need to understand how it seemed to solve his various problems. In the case of reversion, for example, he argued

that the ancestral gemmules for horns lie dormant even in hornless sheep, waiting to reappear. And because gemmules were supposedly dispersed throughout the organism, they explained the regeneration of missing limbs; the necessary 'leg gemmules' were circulating elsewhere in the salamander's body.

Darwin thought of his gemmules almost as tiny creatures; they multiplied within an organism and then combined to produce the offspring's characters. He argued that if 'unmodified and undeteriorated gemmules' were present in two parents, they 'would be especially apt to combine'.[46] This suggests some kind of competition among the gemmules; the 'pure' un-hybridized gemmules are described as 'undeteriorated', and so they predominate in the offspring. Darwin presumed that in such a competition, the male elements would be stronger, which explained how the quagga's gemmules had made their impact on Lord Morton's mare. But the idea of competition also seemed to explain how new, improved characteristics could survive and spread.

Gemmules had a final trick up their sleeve. Darwin – like most of his contemporaries – thought that there was good evidence that characteristics which an organism acquired during its lifetime could be inherited – and that they often were. He was particularly interested in the idea that the way an organism used – or neglected – one of its features might be passed on. This idea was an ancient one, but in Darwin's day was mainly associated with the French naturalist Jean-Baptiste Lamarck, the man who coined the word 'biology'. Lamarck, who was an evolutionist long before Darwin, argued that organisms that ran became faster because they exercised and strengthened their running muscles; he also believed that evolution, which he called transmutation, occurred because creatures could pass these advantages on to their offspring, so that gradually the whole species got faster. Although few people in Britain had ever heard of Lamarck, much less read him, the widespread belief that you could 'catch' something like alcoholism and pass it on to your children was a comparable idea. Darwin certainly believed that some acquired characteristics were inherited, but he wondered 'how can the use or disuse of a particular limb or the brain affect a small aggregate of reproductive cells, seated in a distant part of the body . . . ?' In other words, precisely what did all that running do to your eggs and sperm that allowed you to pass on your acquired talent? Pangenesis was intended to explain this too: since gemmules were produced throughout an organism's life, an altered organ would produce altered gemmules; faster legs produced 'faster' gemmules.[47]

Darwin tried to explain all these issues – from reversion to the case of Lord Morton's mare – using a persuasive analogy similar to those he had used so successfully in the *Origin*:

> Each animal and plant may be compared with a bed of soil full of seeds, some of which will soon germinate, some lie dormant for a period, whilst others perish. When we hear it said that a man carries in his constitution the seeds of an inherited disease, there is much truth in the expression. No other attempt, as far as I am aware, has been made, imperfect as this confessedly is, to connect under one point of view these several grand classes of facts. An organic being is a microcosm – a little universe, formed of a host of self-propagating organisms, inconceivably minute and numerous as the stars in heaven.[48]

Galton read *Variation* as he was putting the finishing touches to his own *Hereditary Genius*, and he added an extra chapter endorsing pangenesis. He was particularly excited by the thought that gemmules were discrete entities – thus ensuring that traits were passed on intact without blending. He even argued that with characteristics such as human skin colour, where blending seems indisputable, the intermediate colours were in fact a very fine mosaic of the two distinct parental colours. Galton also commented that because gemmules were discrete entities, 'the doctrine of Pangenesis gives excellent materials for mathematical formulae'.[49] But although pangenesis sounded exciting in theory, Galton – like many of *Variation*'s readers – remained worried by

the lack of evidence for it. Neither Darwin nor anyone else had ever observed a gemmule, so Galton decided to prove that they existed.

In the blood

Darwin had referred to gemmules being 'dispersed throughout the whole system' before collecting in the sex organs, so Galton expected to find them circulating in the blood. Blood was proverbially synonymous with breeding: after all, what made a horse or an aristocrat superior? – Its bloodline. Galton decided to test his cousin's idea by seeing whether this time-honoured conceit was literally true: could blood transfusions be used to pass on hereditary characteristics? He started experimenting with rabbits, transfusing blood from black and white ones into pure-breeding silver-greys, in the hope that they would then produce some piebald offspring. He chose rabbits because they take only a few months to reach sexual maturity, so any results would show up fairly quickly. Galton consulted Darwin about which breeds to use and kept him updated on the progress, or – as it turned out – the lack of progress. All Galton could report was 'No good news', despite Darwin's 'valuable advice & so much encouragement'.[50] Galton tried various techniques and different amounts of blood, but among 124 offspring from twenty-one litters, not one 'mongrel' appeared.

Disappointed, Galton concluded that pangenesis must be wrong. He published his results in the *Proceedings of the Royal Society*, bluntly concluding that 'the doctrine of Pangenesis, pure and simple, as I have interpreted it, is incorrect'.[51] Darwin was uncharacteristically angry and claimed Galton had misinterpreted his theory. He pointed out that he had 'not said one word about the blood', adding that it should be 'obvious that the presence of gemmules in the blood can form no necessary part of my hypothesis', since he had clearly claimed that pangenesis operated in organisms like plants, which do not have blood. Galton's conclusion must therefore be considered 'a little hasty'.[52]

Galton himself might well have felt annoyed, given that Darwin had never raised this objection in all the months they had been corresponding. But if he was, he kept his irritation to himself, telling Darwin he was 'grieved beyond measure, to learn that I have misrepresented your doctrine'.[53] The two collaborated on further unsuccessful rabbit experiments for another eighteen months, but by the end of 1872 they were still getting nowhere; Galton wrote to Darwin that 'the experiments have, I quite agree, been carried on long enough'.[54]

Despite this setback, Galton retained considerable faith in pangenesis and published his own, modified version of the theory. He extended Darwin's approach to explaining the phenomenon of reversion by assuming that there were two kinds of gemmules: those that lay dormant, which Galton christened 'latent' and those that were expressed in the individual, which he called 'patent'. Each organism contained a mixture of latent and patent gemmules, derived from different generations of their ancestors. He compared this mixture to a parliament, consisting of 'representatives from various constituencies', while acknowledging that his analogy 'does not tell us how many candidates there are usually for each seat, nor whether the same person is eligible for, or may represent at the same time, more than one place'. Galton hoped that his readers would find 'no difficulty' in seeing that the particular set of characters found in any organism were 'the result of election'.[55] Yet Darwin, like most of Galton's other readers, found this analogy entirely incomprehensible.

Galton's logic becomes a little clearer once we understand his goal 'of applying these considerations to the intellectual and moral gifts of the human race'. He was not especially concerned with exactly where his parliament of gemmules was situated nor how they were transferred from generation to generation. He was more worried by the argument that children were sometimes much more (or less) intelligent than either of their parents, a fact that his critics offered as 'proof that intellectual and moral gifts are not strictly transmitted by inheritance'. If there was no correlation between parental intelligence and that of their offspring, it was a fact that killed eugenics stone dead, so Galton's analogy was

intended to show that in species and varieties that had been heavily interbred, like most domesticated animals, each individual was a random selection of ancestral gemmules. He asked his readers to imagine 'an urn containing a great number of balls, marked in various ways'; these represented the traits, latent and patent, that made up an individual. When two animals mated, the result was like a handful of these balls being 'drawn out . . . at random as a sample'. He wanted people to think of children not so much as a mixture of their parents' characteristics, but as a mixture of the characteristics of their parents, grandparents and even more distant ancestors. Your own parents might not be geniuses, but if – like Galton – your grandfather had been, then the latter's characteristics could resurface, which explained your exceptional talents. Given that, as Galton put it, the human species 'is more mongrelised than that of any other domesticated animal', an adequate study of the relationships between children and their forebears would eventually 'prove that intellectual and moral gifts are as strictly matters of inheritance as any purely physical qualities'.[56]

Unlike Darwin, Galton imagined the mixtures of gemmules that made up an animal, plant or person as resulting from chance. As he had written when he first read *Variation*, pangenesis 'gives excellent materials for mathematical formulae': he was thinking in particular of the then novel mathematics of statistics and probability, in which he was an expert. Darwin, by contrast, was a mathematical lightweight, unable to make sense of even the simplest equations. The other distinction between Darwin's theory and Galton's was that Darwin hoped to explain how the acquired effect of, for example, exercising a muscle could be passed on. Galton, however, was adamant that the 'effects of the use and disuse of limbs, and those of habit, are transmitted to posterity in only a very slight degree'.[57] Again, this was essential to his eugenic argument – if improved bodies could be inherited, why not improved minds? If Lamarck and Darwin were right, better schools – and gymnasia – might do more to improve humanity than Galton's breeding schemes could.

Galton's conviction that acquired characteristics could not be inherited led him to anticipate what would become one of the central dogmas of later biological theory: in 1883, the German biologist August Weismann announced that although eggs and sperm contained the material that built an animal, the hereditary influence of the sex cells could only flow one way, into the body cells: any subsequent changes to the animal's body – whether they were brought about by injury or exercise – were not incorporated into its sperm or ova and therefore could not be transmitted to the next generation. As we will see in later chapters, this doctrine, which became known as the 'continuity of the germ-plasm' (that being Weismann's term for the heritable material) was to become vital to the way genetics developed in the twentieth century. Weismann did not know of Galton's papers when he first formulated this idea, but later acknowledged his English predecessor. It is noticeable, however, that Galton had no theory of biological inheritance – his theory rested on nothing more solid than his political conviction that nature must always dominate nurture; that in itself does not of course mean he was wrong.

Despite the bafflement that greeted Galton's announcement of his modified theory of inheritance, he remained convinced that it must be largely right. But he still faced the problem of gathering sufficient data to prove it. A few years after giving up his rabbit experiments, he tried again, this time with sweet peas (Lathyrus). These were common flowers that rarely cross-fertilized (which made it easier to keep different strains apart), and they were hardy and prolific. Nonetheless, Galton's first experimental crop failed, so he sent packets of seeds to friends and relations all over the country, including to Darwin, with elaborate instructions on exactly how to plant and harvest them. The mature plants were to be returned to Galton, who counted and weighed their seeds to demonstrate that seed weight was almost entirely a matter of heredity – the heaviest seeds produced plants with the heaviest seeds. However, these results were not as clear-cut as they first appeared, not least because Galton had sorted the seeds he had initially planted by size, not by lineage, and so had intermingled

seeds from many varieties. It was therefore possible that the eventual differences in seed sizes were simply a product of the different environments in which the plants had been grown. However, none of this really bothered Galton; as he himself observed, 'It was anthropological evidence that I desired, caring only for the seeds as a means of throwing light on heredity in man.'[58]

Sweet peas seem to have proven as frustrating as rabbits as a research tool, and in any case it was never going to be easy to prove that either sweet peas or rabbits possessed 'intellectual and moral gifts', much less that these were inherited like physical characteristics. If Galton were to prove this central conviction, upon which his entire eugenic philosophy rested, he needed evidence from humans. In 1874, he successfully proposed to the Council of the Anthropological Institute that they collect height and weight data from students at a cross-section of English schools. These kinds of measurements might seem irrelevant to the issue of mental and moral faculties, but Galton was a firm believer in the adage *mens sana in corpore sano* ('a healthy mind in a healthy body'), and assumed the two were invariably linked – and linked by heredity, not by a shared healthy environment. This was a widely held view (more than one observer commented that it could well have served as the Health Exhibition's motto). Physical and mental vigour were always linked in Galton's mind; as he noted: 'A collection of living magnates in various branches of intellectual achievement is always a feast to my eyes; being, as they are, such massive, vigorous, capable-looking animals.'[59]

Unfortunately measuring schoolboys did not allow comparisons between generations, so could shed little light on heredity. So in March 1882, Galton began to call for the foundation of national human-measuring, or 'anthropometric', laboratories, 'where a man may from time to time get himself and his children weighed, measured, and rightly photographed, and have each of their bodily faculties tested, by the best methods known to modern science'. These would not only assess physical qualities, but test mental abilities such as memory and hand-eye coordination. The measurements would be recorded alongside full medical histories and photographs, and information on the 'birthplace and residence, whether in town or country, both of the person and his parents'. Galton recognized that people would need to be motivated to have themselves measured, so he proposed that the labs function as a sort of careers advice centre. Since his work had proved that nature trumps nurture: 'It follows . . . that it is highly desirable to give more attention than has been customary hitherto to investigate and define the capacities of each individual.' Such investigations would allow us 'to forecast what the man is really fit for, and what he may undertake with the least risk of disappointment'. He also argued that the labs should be welcomed by doctors who, instead of keeping anthropometric equipment in their own consulting rooms, 'could send their patients to be examined in any way they wished, whenever they thought it desirable to do so'. Galton added that 'the laboratories would be of the same convenience to them that the Kew Observatory is to physicists, who can send their delicate instruments there to have their errors ascertained'.[60] This is a revealing analogy, since it made human patients equivalent to the 'delicate instruments' used by physicists: it suggests that, for Galton, his volunteers were merely a means to an end.

Evolving the average man

Despite Galton's enthusiasm, no one seemed interested in founding the labs he was proposing, so he decided to do it himself, convinced that – whatever rabbits and sweet peas did or did not prove – it was only direct evidence from humans that would make his case. However, Galton soon found that his earlier difficulties were nothing compared with those posed by humans. 'The stupidity and wrong-headedness of many men and women' was, he decided, 'so great as to be scarcely credible'. For example, his lab included an instrument for measuring strength, which he intended to be as simple as possible: it was a tough wooden rod in a spring-loaded tube – all the subject had to do was punch it and see how far into the tube the rod went. Galton 'found no difficulty

whatever in testing myself with it', but within a few weeks of opening of the Health Exhibition, 'a man had punched it so much on one side' that he broke the rod. Galton replaced it with a stronger, oak rod, 'but this too was broken, and some wrists sprained'.[61] He commented that 'Notwithstanding the simplicity of the test, a large proportion of persons bungled absurdly over it . . . and often broke the rod or hurt their knuckles.'[62]

However, broken equipment and bruised fists were only the beginning of Galton's troubles. As the crowds flowed through the lab's doors, he found it was essential 'to keep parents and their children apart', because 'the old did not like to be outdone by the young and insisted on repeated trials', which wasted his precious time. His rabbits may have not have given him the results he wanted, but at least he did not have to stop them showing off. Nor did rabbits need to have the experiment explained to them, whereas human subjects needed time-consuming explanations and demonstrations; Galton bemoaned the 'waste of the attendant's time in idly watching examinees puzzling over tests'. A partial solution was to take people through the lab in pairs, so 'that one explanation and illustration might suffice for both'. This had the added benefit that 'the promptest minded man of the two was usually the one who presented himself first, [so] the less prompt man had the advantage of seeing his companion perform the test before he was called upon to do so himself'.[63] Even so, it all took time and the lab was only able to measure around 90 people a day.

When George Sala, who had a reputation for being fond of the occasional drink, had described the Health Exhibition, he was delighted to report that alcohol was widely available, in every form from mint juleps and arrack punch to the fermented mare's milk known as *kumiss*, produced on the premises by horses and attendants from the steppes of Russia. Sala congratulated the organizers for treating the public like adults, allowing them to 'eat and drink what they like. In the gardens they make smoke. They are not turned out of the building at an unduly early hour. They may stay there, if they will, until ten o'clock at night.'[64] This liberty may have pleased Sala, but it caused Galton some annoyance, since 'on some few occasions rough persons entered the laboratory who were apparently not altogether sober'.[65]

Despite the occasional inebriate and all the other difficulties, Galton got enough results to publish several papers. In the course of analysing his measurements, he developed or improved basic statistical tools that are still in use today, including percentiles (a method of estimating the proportion of the data that should fall above and below a particular value) and correlation coefficients (a measure of the degree to which two variables are related). However, it was not how he measured but what he measured that caught the public's imagination. In the course of comparing the strength of the male and female visitors to the lab, Galton observed that 'very powerful women exist', who could squeeze with a force of 86lb – equal to that of many men. But, he added, 'happily perhaps for the repose of the other sex, such gifted women are rare', so rare that 'the population of England hardly contains enough material to form even a few regiments of efficient Amazons'.[66] These throwaway remarks caught the sharp eye of the satirical weekly *Punch*, which published a poem observing that a 'Maiden of the mighty muscles / Famous in all manly tussles', would be able to keep her husband on the straight and narrow:

> That if in the dim hereafter
> Any husband should play tricks
> You would with derisive laughter,
> Give a 'Squeeze of 86'.[67]

Ignoring such jocularity, Galton ploughed on both with the analysis of his results and with promoting the benefits and usefulness of laboratories such as his. While he recognized that the results lacked some precision, he argued that they were 'of considerable importance' because he had recorded both whether his subjects had been born in the hazardous city or the healthy country, and where they now lived, and so, he thought, afforded

'materials for testing the relations between various bodily faculties and the influences of occupation and birthplace'.[68]

However, perhaps the most obvious problem with Galton's measurements was that he had no way of assessing the very thing that interested him most, the mental qualities of his visitors. While planning the lab, he had sought advice from various experts about what kind of equipment might be used for this purpose, but no one had any useful suggestions. One option might have been to measure people's heads, as a possible indicator of the power of their brains, but as Galton explained, 'it would be troublesome to perform on most women on account of their bonnets, and the bulk of their hair, and would lead to objections and difficulties'.[69]

As with the earlier schoolboy measurements, the physical tests Galton administered were intended to measure overall health while others, such as those for sight, hearing and ability to distinguish between similar colours, were intended to provide some measure of intelligence, but not in the way one might expect. It was widely believed that animals had sharper vision and more acute hearing than people – good scores in these tests were thus a measure of how close to the animal state, how primitive or savage, the visitor was. Those possessed of the supposedly uniquely human virtue of intelligence should score badly in such trials. Yet even if these measurements did indeed shed light on intelligence, they shed little on the question of if, much less *how*, it was inherited. Galton had collected brief pedigrees of visitors to the lab, so that he could analyse the relationship between the heights of parents and children, but while the data was interesting, it provided no conclusive evidence of the inheritance of mental qualities.

Galton tried again. He attempted to persuade doctors to gather data on hereditary diseases that ran in families, even offering a £500 prize for the best analysis, but got no takers. In 1884 he made two attempts at gathering the same data directly from the public. He offered another £500 prize to whoever did the best job of completing a fifty-page questionnaire, *The Record of Family Faculties*, on their own family's heredity and health, but he only got

150 replies, for which he gave out a few small prizes. He also devised, edited and arranged to publish the *Life-History Album*, a prototype of something he hoped would eventually be presented to all new parents, so that they could keep a record of their children's development. The children themselves could then take over and complete it for their children, and so on. But even if the albums had met with a more enthusiastic response, it would have taken several generations to accumulate sufficient data for analysis.

The insoluble difficulty Galton confronted was not so much that mental abilities were so hard to measure, tough though that proved, it was that *Homo sapiens* breeds so slowly. Even a long-lived specimen like Galton – who was almost ninety when he died – could not hope to trace the breeding patterns of his own species for long enough to get reliable data. And, if that was not bad enough, humans make such recalcitrant laboratory animals; those very mental qualities he was so interested in allowed his specimens to make their own decisions: simply persuading them into the lab to be measured in the first place was hard work.

In 1890, Galton published his latest attempt at persuasion, a little pamphlet extolling the benefits of anthropometrics, which was sold for just 3d. in his second lab, at the Science Museum. The first chapter asked, 'Why do we measure humans?' and Galton offered various answers, similar to the ones he had given in his earlier article; the identification of aptitudes and talents, and perhaps spotting potential health issues that could be corrected. And, of course, he stressed the benefits to pure science. Yet anyone who bought the pamphlet, perhaps inspired by the thought that they were contributing to such noble goals, might well have been put off by its latter sections, in which Galton turned his attention to the issue of human variety. He admitted that he was really only interested in exceptional individuals, commenting that 'an average man is morally and intellectually an uninteresting being' and therefore 'of no direct help towards evolution, which appears to our dim vision to be the goal of all living existence'.[70] Galton's interest was in assisting exceptionally

fine specimens of humanity, while aiming to eliminate the exceptionally poor ones. The average person played no part in this scheme, other than to be a 'sensitive instrument', the benchmark that defined who was exceptional. Small wonder that few of his contemporaries were excited by the prospect of having themselves measured.

Galton's contempt for the 'average man' may well have grown out of his frustration with the 'stupidity and wrong-headedness' of the crowds that had visited his lab, who wandered in drunk, wasted his time puzzling over simple tests or were incapable of completing them without breaking his equipment. How were these urban Calibans ever to be transformed into the 'prophets and high priests of civilization' or made over into 'massive, vigorous, capable-looking animals'? The answer, clearly, was that they were not: theirs were natures upon which nurture would never stick, so his priority was to help rid the population of such worthless specimens. More than a decade before the Anthropometric Laboratory opened, Galton wrote that he looked forward to the day when 'the non-gifted would begin to decay out of the land' just as 'inferior races always disappear before superior ones'. This shift would, he assumed, be 'effected with little severity', since the 'gifted class' would treat their inferiors 'with all kindness'. But only, he added menacingly, 'so long as they maintained celibacy. But if these continued to procreate children, inferior in moral, intellectual and physical qualities, it is easy to believe the time may come when such persons would be considered as enemies to the State, and to have forfeited all claims to kindness.'[71] This appalling prophecy was one of the few Galton made that came true: as we shall see in later chapters, the early twentieth century witnessed a revival of interest in his ideas. In countries as different as Sweden and the USA, tens of thousands of people were compulsorily sterilized 'in the name of eugenics', but the worst horror came in Nazi Germany, where Galton's ideas inspired the policy of sterilizing, and eventually of exterminating, the unfit and those from 'inferior races'.

Galton died in 1911, too early to observe the horrors his theory would inspire, so we will never know how he would have responded to them. What is certain is that his faith in his ideas remained undiminished at his death: he left £45,000 (the equivalent of over £3 million today) to found a national eugenics laboratory and endow a professorship of eugenics. He could afford to leave such a large sum because, ironically given his lifelong preoccupation with inheritance, Francis Galton died childless. His ideas were to be his only children.

45. C. Darwin to J. Scott, [19 November 1862]: *The Correspondence of Charles Darwin (Volume 10: 1862)*: 538.
46. J. Scott to C. Darwin, [20 November–2 December 1862]: *The Correspondence of Charles Darwin (Volume 10: 1862)*: 542.
47. Darwin, *On the Origin of Species by Means of Natural Selection: or the preservation of favoured races in the struggle for life* (1859: Penguin Books, 1964): 250–51.
48. J. Scott to C. Darwin, [3 March 1863]: *The Correspondence of Charles Darwin (Volume 11: 1863)*: 189. Darwin had mentioned *Passiflora* in passing in the *Origin of Species*: 250–1.
49. C. Darwin to J. Scott, [6 March 1863]: *The Correspondence of Charles Darwin (Volume 11: 1863)*: 213–14; J. Scott to C. Darwin, [21 March 1863]: *The Correspondence of Charles Darwin (Volume 11: 1863)*: 251–2; C. Darwin to J. Scott, [24 March 1863]: *The Correspondence of Charles Darwin (Volume 11: 1863)*: 262–3.
50. C. Darwin to J. Scott, [3 December 1862]: *The Correspondence of Charles Darwin (Volume 10: 1862)*: 582.
51. C. Darwin to J. Scott, [11 December 1862]: *The Correspondence of Charles Darwin (Volume 10: 1862)*: 594.
52. J. Scott to C. Darwin, [17 December 1862]: *The Correspondence of Charles Darwin (Volume 10: 1862)*: 607–8. Darwin later helped Scott emigrate to India and recruited Hooker's support to get Scott the curatorship of the Royal Botanic Garden, Calcutta.
53. Darwin, *The Effects of Cross-and Self-Fertilisation in the Vegetable Kingdom* (1878; New York University Press, 1989): 384.
54. Darwin, *On the various contrivances by which British and foreign orchids are fertilised by insects, and on the good effects of intercrossing* (John Murray, 1862): 286.
55. Darwin, *The Descent of Man, and Selection in Relation to Sex* (1871; Princeton University Press, 1981): II, 403.
56. Jonathan Smith has noted ('*Une Fleur du Mal?* Swinburne's "The Sundew" and Darwin's Insectivorous Plants') that Darwin's *Orchids* was reviewed with works on 'consanguineous' marriage as early as 1863 in [G.W. Child], 'Marriages of Consanguinity,' *Westminster Review,* 1863, 24 n.s. 88–109. Darwin's son, George, took up the questions extensively in 'On Beneficial Restrictions to Liberty of Marriage,' *Contemporary Review,* 1873, 22, 412–26, and 'Marriages Between First Cousins in England and Their Effects,' *Fortnightly Review* 18 n.s. (1875), 22–41. A.H. Huth, who incorporated the Darwins' work in his *Marriage of Near Kin* (1875; 2nd edition 1887), reviewed father and son together in 'Cross-Fertilisation of Plants, and Consanguineous Marriage,' *Westminster Review,* 1877, 52 n.s. 466–85.
57. Darwin, *The Descent of Man, and Selection in Relation to Sex*: II, 402–3.

Chapter 3: *Homo sapiens*: Francis Galton's fairground attraction

I have used **Galton's own publications** as a major source, most of which are available online at www.galton.org – an invaluable site. For the anthropometric laboratory, see in particular: 'The Anthropometric Laboratory', *Fortnightly Review,* 1882: 332–8; 'Blood-Relationship', *Proceedings of the Royal Society,* 1872: 394–402; *English Men of Science: Their Nature and Nurture* (Macmillan, 1874); 'Experiments in pangenesis, by breeding from rabbits of a pure variety, into whose circulation blood taken from other varieties had previously been largely transfused', *Proceedings of the Royal Society,* 1871: 393–410; *Hereditary Genius* (1869; Macmillan, 1892); 'Hereditary Improvement', *Fraser's Magazine,* 1873: 116–30; 'Hereditary talent and character', *Macmillan's Magazine,* 1865: 157–66, 318–27; *Memories of My Life* (Methuen, 1908); *The narrative of an explorer in tropical South Africa* (John Murray, 1853); 'On the Anthropometric Laboratory at the Late International Health Exhibition', *Journal of the Anthropological Institute,* 1884: 205–18; and 'Some Results of the Anthropometric Laboratory', *Journal of the Anthropological Institute,* 1884: 275–87.

For **Francis Galton's life**, see: D.W. Forrest, *Francis Galton: The Life and Work of a Victorian Genius* (Paul Elek, 1974); K. Pearson, *The life, letters and labours of Francis Galton* (Cambridge University Press, 1914–30); and, most useful of all, N.W. Gillham, *A Life of Sir Francis Galton: From African Exploration to the Birth of Eugenics* (Oxford University Press, 2001).

For **Darwin's theory of inheritance**, see the sources cited in Chapter 2, plus: G.L. Geison, 'Darwin and Heredity: the Evolution of His Hypothesis of Pangenesis', *Journal of the History of Medicine and Allied Sciences*, 1969: 375–411; D.L. Hull, *Darwin and his Critics: the Reception of Darwin's Theory of Evolution by the Scientific Community* (Harvard University Press, 1973); R.W. Burkhardt, 'Closing the Door on Lord Morton's Mare: The Rise and Fall of Telegony', *Studies in the History of Biology*, 1979: 1–21; P.H. Barrett, *The Collected Papers of Charles Darwin* (University of Chicago Press, 1980); L.J. Jordanova, *Lamarck* (Oxford University Press, 1984); M. Bulmer, 'Did Jenkin's swamping argument invalidate Darwin's theory of natural selection?', *British Journal for the History of Science*, 2004: 281–97.

Studies of **Galton's scientific work**, methods and its background include: C. Zirkle, 'The Early History of the Idea of the Inheritance of Acquired Characteristics and of Pangenesis', *Transactions of the American Philosophical Society*, 1946: 91–150; R.S. Cowan, 'Nature and Nurture: The Interplay of Biology and Politics in the Work of Francis Galton', *Studies in the History of Biology*, 1977: 133–208; J.A. Secord, 'Nature's Fancy: Charles Darwin and the Breeding of Pigeons', *Isis*, 1981: 163–86; R. Olby, *Origins of Mendelism* (University of Chicago Press, 1985); R.S. Cowan, *Sir Francis Galton and the study of heredity in the 19th century* (Garland, 1985); M. Hodge, 'Darwin as a lifelong generation theorist', in *The Darwinian Heritage*, (Princeton University Press, 1985); D.J. Kevles, *In the Name of Eugenics: Genetics and the uses of Human Heredity* (Penguin Books, 1986); E.A. Gökyigit, 'The reception of Francis Galton's *Hereditary Genius* in the Victorian periodical press', *Journal of the history of biology*, 1994: 215–40; R. Olby, 'The Emergence of Genetics', in *Companion to the History of Modern Science* (Routledge, 1996).

For **London in Galton's day**, see: F. Engels, 'The Condition of the Working Class in England', in *Literature and Science in the Nineteenth Century: An Anthology*, (Oxford University Press, 2002); J. Greenwood, *The Seven Curses of London* (1869; Blackwell 1981); S. Halliday, *The Great Stink of London: Sir Joseph Bazalgette and the Cleansing of the Victorian Metropolis* (Sutton Publishing, 2001); M. Daunton, 'London's 'Great Stink': The Sour Smell of Success' (British Broadcasting Corporation, n.d., www.bbc.co.uk/history/lj/victorian_britainlj/smell_of_success_1.shtml).

Notes

1. D. Galton, 'The International Health Exhibition', *The Art Journal*, 1884: 156
2. [G.A. Sala], 'The Health Exhibition: a look around', *Illustrated London News*, 1884: 94. Emphasis in original.
3. Anon., *Miscellaneous (Including: Return of Number of Visitors and Statistical Tables & Official Guide)* (Executive Council of the International Health Exhibition and the Council of the Society of Arts, 1884): 12–13.
4. My thanks to Judith Flanders for this information.
5. J. Greenwood, Ch. IX, 'The Thief Non-professional'. *The Seven Curses of London* (1869; Blackwell Publishers, 1981).
6. [G.A. Sala], 'Echoes of the Week [International Health Exhibition]', *Illustrated London News*, 1884: 439, 438.
7. Anon., 'International Health Exhibition', *Saturday Review: of Politics, Literature, Science and Art*, 1884: 634–5.
8. J.E. Ady, 'The International Health Exhibition', *Knowledge*, 1884: 387–8, 415–18, 434–5, 454–5, 476–7.
9. 'International Exhibitions', *Punch*, June 8, Vol. LXII, 1872: 240.
10. J.E. Ady, 'The International Health Exhibition': 388.
11. F. Engels, 'The Condition of the Working Class in England', in *Literature and Science in the Nineteenth Century: An Anthology* (Oxford University Press): 492.
12. D. Galton, 'The International Health Exhibition', *The Art*

Journal, 1884: 153–6, 161–4, 293–6: R. H. Vetch, 'Galton, Sir Douglas Strutt (1822–1899)', rev. David F. Channell, *Oxford Dictionary of National Biography*, Oxford University Press, 2004

13. Anon., *Miscellaneous (Including: Return of Number of Visitors and Statistical Tables & Official Guide)*: 8.
14. J.E. Ady, 'The International Health Exhibition': 434–5, 454–5, 476–7.
15. [J. Manley], 'The International Health Exhibition', *Journal of Science and Annals of Astronomy, Biology, Geology, Industrial Arts, Manufactures, and Technology*, 1884: 350–54, 412–16, 579–85: 583; Anon., *Miscellaneous (including Jury Awards and Official Catalogue)*: 59.
16. D. Galton, 'The International Health Exhibition': 155–6; [J. Manley], 'The International Health Exhibition': 413.
17. [G.A. Sala], 'The Health Exhibition: a look around': 94.
18. Anon., *Miscellaneous (Including: Return of Number of Visitors and Statistical Tables & Official Guide)*: 14.
19. ibid.
20. F. Galton, *Memories of My Life* (Methuen, 1908), 245–6.
21. F. Galton, 'On the Anthropometric Laboratory at the Late International Health Exhibition', *Journal of the Anthropological Institute*, 1884: 205–18: 206–7.
22. F. Galton, *Memories of My Life*, 249.
23. R.S. Cowan, *Sir Francis Galton and the study of heredity in the 19th century* (Garland, 1985): viii–ix; F. Galton, *The narrative of an explorer in tropical South Africa* (John Murray, 1853), 54; N.W. Gillham, *A Life of Sir Francis Galton: From African Exploration to the Birth of Eugenics* (Oxford University Press, 2001), 76. The nineteenth-century term Hottentot is now considered offensive and the indigenous people of Namibia are now usually known as the Khoikhoi.
24. F. Galton to C. Darwin, [9 December 1859]: F. Burkhardt and S. Smith (eds.), *The Correspondence of Charles Darwin (Volume 7: 1858–1859)* (Cambridge University Press, 1991): 417.

25. F. Galton, *Memories of My Life*, 288.
26. C. Darwin, *On the Origin of Species by Means of Natural Selection: or the preservation of favoured races in the struggle for life* (1859; Penguin Books, 1964), 490.
27. F. Galton to C. Darwin, [24 December 1869]: K. Pearson, *The life, letters and labours of Francis Galton: I. Birth 1822 to marriage 1853* (Cambridge University Press, 1914–30), 6–7.
28. C. Darwin, *On the Origin of Species*, 22–3, 84; J.A. Secord, 'Nature's Fancy: Charles Darwin and the Breeding of Pigeons', *Isis*, 1981, 163–86.
29. F. Galton, F, 'Hereditary talent and character', *Macmillan's Magazine*, 1865: 157–66, 318–27: 157.
30. ibid., 165–6.
31. R.S. Cowan, 'Nature and Nurture: The Interplay of Biology and Politics in the Work of Francis Galton', *Studies in the History of Biology*, 1977: 133–208: 163–4.
32. Viriculture first appeared in 'Hereditary Improvement', *Fraser's Magazine*, 1873, 7: 116–30; eugenics was coined in *Inquiries into Human Faculty and Its Development* (1883).
33. *Guardian*, 4 April 1883: 1001. Quoted in N.W. Gillham, *A Life of Sir Francis Galton: From African Exploration to the Birth of Eugenics* (Oxford University Press, 2001): 207–8.
34. Quoted in E.A. Gökyigit, 'The reception of Francis Galton's *Hereditary Genius* in the Victorian periodical press', *Journal of the history of biology*, 1994: 215–40: 234; N.W. Gillham, *A Life of Sir Francis Galton*: 171.
35. My thanks to John Waller for clarifying this point for me.
36. F. Galton, *English Men of Science: Their Nature and Nurture* (Macmillan, 1874): 12. He had also used the nature/nurture pairing in the title of an address to the Royal Institution earlier that year: N.W. Gillham, *A Life of Sir Francis Galton*: 191–2.
37. F. Galton, *Hereditary Genius* (1892; Macmillan, 1869): 14.
38. *Guardian*, 4 April 1883: 1001. Quoted in N.W. Gillham, *A Life of Sir Francis Galton*: 207–8.
39. F. Galton, *Memories of My Life*: 288.

40. C. Darwin to Francis Galton, [23 December 1869]: F. Darwin and A.C. Seward. *More Letters of Charles Darwin*, Vol II (London: John Murray, 1903): 41.
41. C. Darwin to C. Kingsley, [10 June 1867]: in F.E. Kingsley (ed.), *Charles Kingsley: his letters and memories of his life* (1878, 2 vols. London), 2: 242.
42. D.L. Hull, *Darwin and his Critics: the Reception of Darwin's Theory of Evolution by the Scientific Community* (Harvard University Press, 1973): 315–6.
43. C. Darwin, *The Variation of Animals and Plants under Domestication, volume 2* (1875; Johns Hopkins University Press, 1998): 35–6.
44. R.W. Burkhardt, 'Closing the Door on Lord Morton's Mare: The Rise and Fall of Telegony', *Studies in the History of Biology*, 1979: 1–21: 3; M. Hodge, 'Darwin as a lifelong generation theorist', in *The Darwinian Heritage*, Princeton University Press: 224; C. Darwin, *The Variation of Animals and Plants under Domestication, volume 1* (1875; Johns Hopkins University Press, 1998): 435.
45. C. Darwin, *The Variation of Animals and Plants under Domestication, volume 2*: 370.
46. ibid.: 394–5.
47. ibid.: 346–7.
48. ibid.: 398–7.
49. F. Galton, *Hereditary Genius*: 370; N.W. Gillham, *A Life of Sir Francis Galton*: 174–5.
50. F. Galton to C. Darwin, [17 December 1870]; and [8 April 1870]: K. Pearson, *The life, letters and labours of Francis Galton: II. Researches of middle life* (Cambridge University Press, 1914–30): 158–9.
51. F. Galton, 'Experiments in pangenesis, by breeding from rabbits of a pure variety, into whose circulation blood taken from other varieties had previously been largely transfused', *Proceedings of the Royal Society*, 1871: 393–410: 404.
52. C. Darwin, *Nature*, 27 April 1871, in: P.H. Barrett, *The Collected Papers of Charles Darwin* (University of Chicago Press, 1980): 165–6.
53. F. Galton to C. Darwin, [25 April 1871]: K. Pearson, *The life, letters and labours of Francis Galton: II. Researches of middle life*: 162.
54. N.W. Gillham, *A Life of Sir Francis Galton*: 176–9; F. Galton to C. Darwin, [15 November 1872]: K. Pearson, *The life, letters and labours of Francis Galton: II. Researches of middle life*: 175.
55. F. Galton, 'Blood-Relationship', *Proceedings of the Royal Society*, 1872: 394–402: 173–4.
56. ibid.: 175–6; R. Olby, *Origins of Mendelism* (University of Chicago Press, 1985): 55–63.
57. F. Galton, 'Blood-Relationship': 175.
58. Quoted in D.W. Forrest, *Francis Galton: The Life and Work of a Victorian Genius* (Paul Elek, 1974): 188; N.W. Gillham, *A Life of Sir Francis Galton*: 205.
59. F. Galton, *Hereditary Genius*: 332.
60. F. Galton, 'The Anthropometric Laboratory', *Fortnightly Review*, 1882: 332–8: 332–4, 37–8.
61. F. Galton, *Memories of My Life*: 246.
62. F. Galton, 'On the Anthropometric Laboratory at the Late International Health Exhibition': 211.
63. ibid.: 208, 209–10.
64. G.A. Sala, 'The Health Exhibition: a look around': 91.
65. F. Galton, 'On the Anthropometric Laboratory at the Late International Health Exhibition': 206–7.
66. F. Galton, 'Some Results of the Anthropometric Laboratory', *Journal of the Anthropological Institute*, 1884: 275–87: 278.
67. *Punch*, 15 April 1884, quoted in K. Pearson, *The life, letters and labours of Francis Galton: II. Researches of middle life*: 375.
68. F. Galton, 'Some Results of the Anthropometric Laboratory': 275.
69. F. Galton, 'On the Anthropometric Laboratory at the Late International Health Exhibition': 210.
70. Quoted in K. Pearson, *The life, letters and labours of Francis Galton: II. Researches of middle life*: 381–5.
71. F. Galton, 'Hereditary Improvement': 129.