FRANCIS GALTON AND THE SKIN

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INTRODUCTION

Few have earned the title of 'polymath' more completely than Francis Galton, who stirred up every science of his day. Yet, despite this, Galton has had a mixed press over the years. Some have portrayed him as an eccentric who liked nothing better than inventing impractical devices (like his self-ventilating top hat with a hinged lid that could be raised by squeezing a rubber bulb). Others have seen him as an arrogant elitist who created and disseminated the doctrine of eugenics.

Both of these views contain a grain of truth, but Galton was also, without doubt, one of the founding fathers of several important branches of science such as meteorology, anthropology, genetics, statistics and psychology. An interest in the skin as an organ was part of Galton's mosaic of sciences, featuring in several of his main themes, and he used his uniquely quantitative approach on a wide range of dermatological subjects. This paper is an attempt to present his ideas on the skin against the background of his other activities.

GALTON'S BACKGROUND

Galton was fond of the phrase 'nature and nurture' and tried to disentangle the two in his pioneering studies of twins.[1] The influence of both can be seen clearly in his own life.

Nature

In his book *Hereditary genius*, Galton showed that talent could be inherited. This view was 'almost inescapable for a man with his predecessors'[2] coming from such a 'lettered and intellectual race',[3] littered as it was with Fellows of the Royal Society. Charles Darwin was a half cousin through a shared and famous maternal grandfather, the philosopher–physician Erasmus Darwin, and the strongest hereditary strand in Galton's character was the scientific trait of the Darwins.

Nurture

Galton trained both in medicine and mathematics. On leaving school he became an 'indoor pupil' at Birmingham General Hospital and later went to King's College and St George's Hospital in London. His medical studies helped him in his later work, but he was happy to give them up, without qualifying, when his father died. His inheritance meant he became rich enough to devote his life to travel and scientific leisure.

He was clearly a medical student with unusual ideas. At the age of 16, for instance, he used blood to shave the heads of those injured in brawls as he found it gave a better lather than soap. Given the run of the dispensary, he ate the seeds of the poppy capsules kept there before their use as an ingredient in various lotions.[4] Later he wanted first-hand experience of every commonly used medicinal substance and, methodical as ever, took them in alphabetical order. He got no further than C when a violent reaction to croton oil ended his project. Some of his other medical ideas have a curiously modern flavour. He designed one of the first statistically controlled treatment trials[5] and suggested that an 'index of curative skill' should be awarded to doctors based on their clinical success.

Galton also studied mathematics at Cambridge, but could not cope with the examinations. In his third year he suffered from 'brain symptoms of an alarming kind' after working 'too irregularly and in too many directions'.[6] He could not 'banish obsessing ideas' and his mother advised him to give up all 'headwork' for a year. Despite his great mathematical talent he gained only a pass degree.

GALTON'S QUALITIES

Galton was intelligent and totally obsessional. After he died, a psychologist estimated that his IQ had been 200, basing this on his grasp of Latin and mathematics as a four-year-old child.[7] His thinking differed from that of his half cousin Charles Darwin, who collected facts on a grand scale and then searched for a unifying law. Galton found his problem first, then narrowed it down to a small issue, and tested this by experiment or observation. He 'verified his hypotheses by the statistical handling of masses of data whether collected by himself or supplied by others'.[8]

Galton 'pictured life statistically'.[9] 'Whenever you can, count' was his golden rule. With counting went measuring, often with ingenious gadgets of his own creation. These included a series of devices known as registrators, with which he could record the characteristics of crowds without being seen; 'if it was not yawns or fidgets it was colour of hair, of eyes, or of skin'.[10] He counted everything from the girls he passed in the streets to the brush strokes used by artists painting his portrait.[11, 12] Sometimes his activities seem slightly ludicrous, as when he measured the buttocks of a Hottentot princess from a distance using a sextant,[13] but his passion for measuring everything – from boredom to sweet peas – led him to the concept of correlation.

His contributions to statistics include the idea of 'regression to the mean' – derived from his studies of the inheritance of height in humans, and of size in sweet pea seeds; and the 'correlation coefficient' – after a look at the Bertillon anthropometric system used to identify criminals in France. This system offended him by treating body measurements as if they were independent variables, though clearly they are not.[14] A tall person, for example, is likely to have long fingers. He was also the first to use the term 'centile'. His biographer and pupil, Karl Pearson, was so 'charmed by the concept and implication of Galton's correlation'[15] that he invented the chi-squared test.

Galton wrote well,[16] but did not feel that this allowed him to pose as a literary critic. However, as he said, 'a man need not be a cobbler to know when his shoe pinches'. He found too many scientific papers hard to understand because of their 'rugged and careless writing' and was conscious of 'a rare relief when one of an opposite quality comes to my hand'. He was keen to 'put a stop to obscurity of expression, to bad grammar, and to faulty logical arrangement'.

GALTON'S INTERESTS

At first sight Galton's publications seem to be a confused jumble of unrelated subjects, in which Hottentot buttocks jostle with anticyclones, high-pitched whistles, blood transfusions, word associations and even the ripples in his bath. In fact, his interests followed a logical sequence, each branch of knowledge that he mastered acting as a stepping stone to a further advance. He was often the first to explore these subjects, and tackled new ones with gusto. Previous work could be looked at later, if at all; general impressions were to be distrusted; and everything had to be counted, measured and tested statistically.

From travel to anthropology

As a young man, Galton went deeply into uncharted south west Africa. His books *Hints for Travellers* and *The Art of Travel* both ran to five editions. His interests soon included techniques of survival (on which he lectured to the army during the Crimean War) and weather forecasting (he was the first to describe the anticyclone, as 'a downrush of air associated with a high barometer and a clear sky, with an outflow having a clockwise twist').[17] Wherever he went, he studied the physical differences between the races he met and in this way 'grew from traveller to geographer, from geographer to ethnologist, from ethnologist to anthropologist'.[18]

His later research had two main themes. One was to show that mental characteristics 'cling to families,'[19] being inherited in the same way as physical traits. The other was that humans should be observed and studied in the same way as animals. He wanted to 'follow them as individuals through life and in families from generation to generation'.[20] At this stage, his interest in the difference between races turned into an interest in the difference between individuals – for example, in their fingerprints.

His progress in these fields was hampered by a lack of information and so he set up an anthropometric laboratory where human qualities, both physical and mental, could be measured. Later he had to create new statistical techniques to handle the huge amount of data which had been collected.

Galton's anthropometric laboratory

At first Galton obtained his data from questionnaires, but he became frustrated by the 'dead weight of inertia' that stopped people filling them in.[21] He then changed his methods and set up an Anthropometric Laboratory at the International Health Exhibition in London in 1884. For three pence, any visitor could have him- or herself tested and measured in 17 different ways. Eye colour was recorded but hair colour was not, because of the widespread use of false hair and dyes.[22] When the Health Exhibition closed he moved the laboratory to the Science Museum where it worked on for another eight years. By 1895 Galton had over 13,000 records, and ruminations over these kept him busy for a further ten years.

SKIN TOPICS OF INTEREST TO GALTON

Pigmentation

Standard colour scales

Galton wanted to record human colouring accurately, and was unhappy that the standard colour scales then in use, devised by Broca, had faded over the years.[23] More permanent standards were needed and so Galton switched to coloured glass eyes and to spun glass fibres for hair colour. Skin colour was more difficult but, in 1869, he saw trays of coloured mosaic tiles in the Vatican. About 500 of these, he thought, would cover the shades of Caucasoid skin, but the price asked by the papal government was too high. He dropped the idea, turning to coloured enamel instead for his skin colour standards.

Human pigmentation

Galton was born in the same year as Mendel, whose work was not widely known until 1900. Long before then, Galton had divided inherited traits into 'those that blend and those that are mutually exclusive'. With hindsight, these would have been polygenic and single gene traits. Skin colour in man, he felt, followed the blending type of inheritance as was shown by the intermediate colour of children of mixed race.[24] Eye colour was more of the mutually exclusive type.

After looking at large numbers of people in his laboratory, and at records of naval personnel, Galton concluded that the English were 'a fair or reddish race'.[25] He also discovered that English men of science preferred to marry spouses with much the same hair colour as themselves, a good example of assertive mating.[26]

He knew that the survival of some animals was partly determined by their colour; and wondered if the same could be true of man[27] after reading a study of more than 300,000 cases of invalidism in the American army during the Civil War. This suggested that light haired soldiers suffered more than dark haired ones from every disease except chronic rheumatism.[28] If natural selection, the pet theory of his cousin Charles Darwin, really existed, then the nation's hair should slowly be getting darker, but Galton could find no evidence of such a change over four generations in England.

Later he hired Professor Sorby to analyse the pigments in human hair. Two were found, one red and one black, presumably phaeo- and eu-melanin. This professor painted pictures of a red and a black tree using these pigments, and for many years these hung in a place of honour in Galton's dressing room.

Pangenesis

Most of Charles Darwin's ideas were right: but his theory of 'pangenesis' was not. Even its originator felt that the theory was 'wildly, abominably speculative'.[29] Darwin had devised it to explain the inheritance of acquired characteristics,[30] believing that the physiques of tradesmen ran in families, for example that blacksmiths' children were born with 'hammering biceps'. Tiny particles (gemmules), he said, were thrown off by each cell in the body and carried hereditary qualities through the blood to the germ cells. Galton's house was overrun with rabbits (88 in 13 litters) while he conducted the experiments that killed this theory. He transfused silver-grey rabbits with the blood of rabbits of a different colour.

According to pangenesis, some of the offspring of the transfused animals should have had the same colour as the blood donor rabbits – but they did not.[31] After a minor spat – in the correspondence columns of *Nature* – had been defused by Galton, the theory of pangenesis was dropped, even by Darwin.

Bay horses and Basset Hounds

Just before Mendel's work became widely known, Galton had looked into the inheritance of colour in horses[32] using data from the Christmas edition of the *Horseman Magazine*. He struggled to make sense of the range of colours of the 3,100 offspring of 46 different bay sires, and showed that the ability of dams to transmit a bay colour was the same as that of sires. He calculated how much redness was passed on by chestnut, brown and black parents.

Galton investigated the inheritance of pigmentation in Basset Hounds in a similar way, using data from the Basset Hound Club studbook. These dogs have only two colour schemes: tricolour (lemon and white with black markings) and not-tricolour (lemon and white only). The findings fitted with his own Law of Ancestral Heredity.[33]

An albino Pekinese

In old age Galton acquired a pet with a strange pedigree. It came from Edward Nettleship, who may have been the first to describe *urticaria pigmentosa*, and who had stumbled into a dispute over the inheritance of albinism between Karl Pearson, Galton's biographer, and William Bateson, who had popularised Mendel's work. In an attempt to clarify the issue, Nettleship bred 18 albino Pekinese dogs, one of which was given to Galton.[34] It had a horrid temper and swore in 'Chinese dog language'; its face reminded Galton of a portrait he once had of Confucius.[35] Galton was also interested in albino hens and in albino orchids which 'rarely if ever produce albino offspring'.[36]

Dermatoglyphics

Legal aspects

To Galton, fingerprints were the 'most beautiful and characteristic of all superficial marks,'[37] and they suited his obsessional talents perfectly. For some years he carried a fingerprinting apparatus in his pocket and became 'somewhat of a trial to his acquaintances' as he collected prints of all types, from farm labourers to apes.[38] By 1884 he had managed to classify them and it was largely through his activities that police forces throughout the world were persuaded to use fingerprints routinely.

He found that the general pattern of fingerprints remains the same throughout life, though its proportions can vary. 'So it is with the pattern on a piece of lace,' he wrote, 'the piece as a whole may be stretched in this way or that, and its outline altogether altered; nevertheless every one of the component threads, and every knot in every thread, can easily be identified in both.'[39] He concluded that fingerprints were 'an incomparably surer criterion of identity than any other bodily feature'.[40] Galton spent a few days in Paris with Bertillon, but thought that the French system of indexing would be greatly improved by including fingerprints. He was also struck by the large number of criminals who were tattooed.[41]

Inevitably Galton brought mathematics to bear on the subject. As he put it: 'Our problem is this: given two fingerprints, which are alike in their minutiae, what is the chance that they were made by different persons?' His answer was one in 64,000 million – a number far larger than there were then people on earth. He then counted the English words that expressed 'different shades of fraud', finding more than 50.[42] Fingerprints would help to prevent some of these, he suggested, if used to identify people before they withdrew money from a bank.

The function of fingerprints

One day Galton was discussing this topic with the philosopher Herbert Spencer, whose 'rare gleams of tenderness amidst a wilderness of abstract thought' appealed to him greatly.[43] Spencer had coined the phrase 'survival of the fittest' but knew nothing about fingerprints; he guessed that the openings of the sweat ducts needed

the protection of the ridges on either side of them. When told that the ducts opened on to the crests of the ridges, he was reminded of T.H. Huxley's crushing remark about 'a beautiful theory, killed by a nasty ugly little fact'.

Galton had ideas of his own about the function of fingerprints. Perhaps raising the duct openings allowed sweat to be eliminated more easily.[44] He also thought that ridges assisted in the identification of surface texture: 'The ridges engage themselves with the roughness of the surface, and greatly help in calling forth the required sensation.'[45]

Skin sensation

During his medical training Galton saw that 'different persons felt pain with different degrees of acuteness'.[46] Much later, he devised instruments to test the delicacy of several different human senses. For touch he used 'wirework' of varying degrees of fineness[47] and was the first to show that blind people are no more sensitive to touch than sighted ones. He also tried to solve the highly complicated question of how several sensory modalities can act together. Complicated devices were designed to separate the sensations of touch and of muscular effort.[48] One was a modified balance. A finger was placed in one pan, and a weight in the other. The pressure of the contact could be varied 'with perfect smoothness' by pressing a plunger which filled a glass cylinder with water. This turned out to be too cumbersome for routine use.[49]

Two-point discrimination

Galton's work on two-point discrimination illustrates his thoroughness. All recordings had to be made by the same observer, Sergeant Randall, the Superintendent of his laboratory, with the same instrument, the two points of a Flowers craniometer. The tests were always performed on the back of the neck, so that the person being tested could not see what was going on. The number of subjects tested was large (932 males and 377 females) so that statistically tested conclusions could be drawn. Two-point discrimination on the back of the neck of the 'median man' was found to be 13·8 mms: that of the 'median woman' was 11·8 mms. The difference between the sexes was significant, and did not correlate with the stature of the person being tested. This seemed to rule out the idea that males and females have the same number of nerve endings, but that those of the larger males are stretched further apart.[50] Recent work confirms that there are significant sensory differences between the sexes, even in animals.[51]

Fingerprints and skin sensation

Galton thought that the presence of fingerprints might concentrate pressure, that would otherwise be spread over the whole surface, onto the ridges, then thought to be especially richly supplied with nerve endings.[52] If so, tactile discrimination should depend on the closeness of the ridges. However, it soon became clear that this had no effect on the delicacy of tactile discrimination. In addition, though their ridge interval is roughly the same, he found that the least distance for two-point discrimination was four times as great on the palms as on the bulbs of the fingers.

Itching and scratching

Galton liked to quantitate human movements, but did not himself measure scratching. He used the fidgeting of an audience as a measure of its boredom – the Royal Geographical Society being a good hunting ground for this.[53] An interested audience sits upright, with its heads equidistant; in a bored audience, bodies sway from side to side and the intervals between faces vary.[54] To follow this up, he put pressure tambours under the legs of his dining room chairs to record the movements of his guests as they interacted. More recently, the modern equivalents of pressure tambours (proximity vibration transducers) have been attached to bed legs and used to record nocturnal scratching.[55]

Galton also thought that itching helped to preserve alertness, pointing out that dogs scratch themselves continually when not occupied with 'food, hunting or love': 'Well washed and combed domestic pets grow dull: they miss the stimulus of fleas.' He extended the argument to humans who also had to be 'goaded into activity by the conditions and struggles of life;'[56] and shared Darwin's interest in the differences between the lice collected from various human races. Those from infested Sandwich Islanders died in a few days if they were transferred to Englishmen. Darwin was not sure if this meant that the various types of man were 'varieties' or 'species'.[57]

The complexion of the upper classes

In 1879 Galton became the only person ever to assess 'the average tint of the complexion of the British upper classes'. His study was a simple one, even though it was published in *Nature*. It took place at the Epsom racetrack. Eccentric as ever, he liked to watch the start of a horse race rather than its finish. One day he looked across at the grandstand and saw 'a broad area of white faces' packed together so that each 'formed a mere point in the general effect'. Then, as the horses thundered past the stands, the distant sheet of faces turned a uniform pink colour, which faded slowly after the race had finished. Clearly phaeomelanin was not involved and he called his paper *The average flush of excitement*.[58]

Nails and a dermatoscope precursor

Galton became interested in nail damage at the age of 84. He drew diagrams of the changes seen after he had pinched one of his own nails, and watched the black areas through an isoscope – a machine of his own invention that foreshadowed the modern dermatoscope. It could 'secure a sharp image for the eye at any distance', from a few inches upwards.[59, 60] Naturally he also measured the rate at which the black areas grew out –

about 2 mms a week. He wanted surgeons to look at healing wounds through isoscopes, and perhaps to record the changes seen by time lapse photography.

Fashions in facial hair

Galton did not agree that social codes are unchangeable. He used the changes seen in male facial hair during his lifetime to illustrate this point. In his youth, he said, having a moustache was 'worse than wicked, it was atrociously bad style'; but, during the Crimean War, the infantry were excused from shaving. On their return to England 'beards spread to the laity, but stopped short of the clergy'. Next a distinguished clergyman successfully 'bearded' his bishop on a critical occasion and 'forthwith hair began to sprout in a thousand pulpits where it had never appeared before in the memory of man'.[61]

Death from smallpox

Galton was always interested in vaccination. As a medical student he wrote to his father: 'You ought to see me vaccinate. I do so like to pitch the lancet into the children's arms.' Many years later he prepared a paper for the Royal Commission on Vaccination on its value in England. He divided the years from 1838–87 into three periods: 1838–53, when vaccination was optional; 1854–71, when vaccination was obligatory but poorly enforced; and from 1872–87, when vaccination was obligatory and efficiently enforced. He was cautious about drawing conclusions from crude death rates, but estimated that mortality from smallpox over the period had decreased by between 500 and 150 per million of the population.[62]

CONCLUSIONS

Galton's main claims to fame are not in the field of dermatology. However, he was one of the founding fathers of many other branches of science including meteorology, anthropology, genetics, statistics and psychology. His papers, with their 'flash of clear words', are still a pleasure to read: but it is easy to see why serious problems have stemmed from them.

Most of his subjects had not been explored before, so that he 'blazed a trail where others have followed with a highway'.[63] Inevitably his work in these new fields was based on an underestimate of their complexity, and 'it seemed no great harm that Galton should assume in theory a simple scale for physical beauty, moral value, or mental ability'.[64] These scales of individual merit led to what Galton thought were straightforward assessments of superiority and inferiority, but his ideas became perverted when they fell into less benign hands. His scales were then used, wrongly, to rank different races. Discrimination and oppression quickly followed. This would have horrified Galton, whose naivety on these matters was genuine, although perhaps tinged with arrogance. He undoubtedly wanted more people to be like himself and his friends, but his main characteristic was an 'all-embracing but apparently impersonal beneficence'.[8]

It is true that 'no serious scientist now has the slightest interest in producing a genetically planned society';[65] but the reputation of much of Galton's work has been damaged by the gross abuses committed in the name of eugenics. His papers on skin subjects are free of this taint and show off 'the fibre and flavour of his mind, with its youth, charm of humour, and its ever-springing originality and acuteness',[66] as well as his wonderfully obsessional nature. They deserve to be more widely known.

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