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FRANCIS GALTON
1822–1922

A CENTENARY APPRECIATION

BY

KARL PEARSON, F.R.S.

WITH FRONTISPIECE DRAWING
OF
FRANCIS GALTON

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SIR FRANCIS GALTON
1910
From a sketch by his niece, Mrs. Ellis

FRANCIS GALTON

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But all these must be splendid Madmen who initiate any great Theory, any great Work, which does not recommend itself to the present Knowledge or Ignorance of Minds which do not see so far as the splendid Madmen of this Age, who will be sensible Men to the next Age, and, perhaps, a little in arrear to the Age after that.

FLORENCE NIGHTINGALE.

FRANCIS GALTON, 1822—1922

THE year which forms the centenary of Francis Galton's birth demands more recognition of the part he has played in the spread of human knowledge and in its application to the future of the human race than appears thus far likely to be forthcoming. If the present paper should contribute even but a small amount to the fuller recognition which one day will be paid to Galton, it will more than have fulfilled its writer's aims. For he realises that the time is hardly suited to impressing on the majority of men a conviction of the futility of most of their aims, of the depths of their ignorance of what makes for progress, and of the unsatisfying nature of their present pleasures. We can scarcely believe that the bicentenary of Galton's birth will find the world so little in the frame of mind to appreciate his work or so little able to judge clearly the efficacy of his proposals for raising the standard of human fitness.

The present generation are apt to speak of the Victorian or 'mid-Victorian' age with contempt. As a matter of fact there has been no such homogeneous period of culture. They speak of it as of an inartistic, self-satisfied and materialistic period. They forget that the Victorians were so little self-satisfied, that they themselves produced the very men who changed the nation's views of art, who set going craftschools, and art-guilds, and only just failed to reform the Royal Academy; they forget all the efforts the Victorians made to induce class to understand class; they overlook the work that period did for the education of the masses, the improvement of factory life, and the emancipation and training of women. They fix their attention on Tennyson's *Idylls*, on a suite of furniture sold in the sixties in Tottenham Court Road, or on a product of the old Art Union and scornfully mutter: Mid-Victorian! Above all they forget the revolution in thought which the scientists of the so-called Victorian era—Darwin, Lyell, Maxwell and Kelvin, to confine our attention solely to British names—brought about. They call the period materialistic, which ended by destroying

conceived of Eugenics before Galton. Well, the imagination of man has always run riot, but to imagine a thing is not meritorious, unless we demonstrate its reasonableness by the laborious process of studying how it fits experience, or make it a real factor of practice. Darwin did bring the ideas of evolution home to science; logarithms did come into general use after the publication of Napier's *Logarithmorum canonis descriptio* (1614); Newton did predict the motion of the moon on the basis of his law of gravitation, and the name and idea of a science of Eugenics have become worldwide only since Galton made his appeal and showed its possibilities.

The little men say that Darwin did not know all about variation, and that they have found out many important facts since his death. Let us admit that the knowledge of variation has increased ten per cent. since Darwin's day, and we have then to add that the ninety per cent. which he did know has been overlooked or purposely disregarded by those who came after him. The little men say that mechanical calculators have replaced Napier's discovery. So they have; but they do not add that when mechanical knowledge is so far advanced that setting a number on to a machine will record its logarithm, then one turn of the handle will replace their forty turns[1]. The little men say that relativity has killed Newtonian mechanics, but they do not add that now and for long years to come satisfactory answers to ninety-nine per cent. of mechanical and physical problems—problems now essential to our daily existence—will be reached by Newtonian approximations. Strange as it may seem to the uninitiated the Great War cost our country fifty per cent. more than was necessary in life and treasure, because the older commanders were ignorant of the Victorian developments of Newtonian mechanics, and the war was finally won, solely because our sluggish executive ultimately realised that these things were the all important factors of modern warfare. It may safely be asserted that relativity contributed nothing to the outfit of any nation during the last European struggle.

Do these statements belittle Einstein? On the contrary the writer believes that while relativity now modifies the treatment of a very small percentage of physical problems, it will in future modify the treatment of more and more.

[1] A glorified slide rule which will read to 8 or 12 figures is the mechanical calculator of the future.

It is a question of the growth in accuracy of our instruments and the developing refinement of our observational powers. The fundamental importance of relativity at the present time is the manner in which it is changing and must change our attitude towards the physical universe. As the post-Darwinians see, so the men who come after Einstein will see natural phenomena in a wholly new and different light; relativity will change men's attitude to the physical universe as Darwinism changed their attitude to organic creation. Relativity has put the last as evolution put the first nails into the coffin of the old tribal beliefs. New phases of philosophy, new phases of religion will grow up to replace the old. But the cultivated mind can never regard life and its environment in the same way as men did before those days of Darwin and before these days of Einstein. The 'value' of words, the 'atmosphere' of our conceptual notions of phenomena, has been for ever changed by the movement which began with Darwin and at present culminates in Einstein.

The historian of science in the future, standing further from the events of today than we can do, will judge not of a group of Victorian scientists, but of a brilliant scientific epoch common to all Europe, as influential on human culture as the Renascence itself, contributing more even to our knowledge of the universe than the stride from Galileo to Laplace. Our English Victorians contributed their full quota to that brilliant epoch; they were not self-satisfied, unimaginative materialists. Their method was essentially Baconian; they accumulated facts and allowed the trained imagination to play upon them. If the matter be investigated it will be found that such was the case not only with Darwin, but with Lyell and Hooker, not only with Faraday, but with Maxwell and Rayleigh, Ramsay and Kelvin. Even when their imaginations played with aethers and vortex rings and later with electrons, they saw them with a wide range of physical facts within their ken. Self-satisfied? Why, they were so dissatisfied, that they started struggling in every direction to raise the veil and push into the light beyond! It was shortness of life, rather than self-satisfaction which left Clifford with his 'wrinkle in space' for matter—a precursor of Einstein but not a claimant for the honour of the discovery of relativity,—precisely as Goethe, Lamarck, and Erasmus Darwin were precursors of Charles Darwin, but

failed to make evolution a dominating factor in science and philosophy. Their imaginations were not trained in the like manner to the coordination of a vast hoard of facts.

The reader may wonder at first what the bearing of this account of Victorian science has upon the centenary of Galton. It has a two-fold bearing. In the first place it is impossible to appreciate Galton unless we bear in mind that he was the product of the Victorian epoch. When he came back from apparently profitless wanderings in the east, when he had carved an Englishman's name on that almost inaccessible rock in Damaraland where it still stands once again in British ownership[1], when he had applied the knowledge thus strenuously gained in field and camp to aid our helpless soldiers in the Crimea, there seemed no fitting task before him, no great future of useful work. And then came the publication of the *Origin of Species*; and the light cast by Charles Darwin on the dark places of man's knowledge freed Galton and showed him what his main work in life must be.

'I always think of you in the same way as converts from barbarism think of the teacher who first relieved them from the intolerable burden of their superstition...consequently the appearance of your *Origin of Species* formed a real crisis in my life; 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.' Galton to Darwin, Dec. 24, 1869.

Strange as it seemed to the biologist of those days: unwelcome as it appears to be to some biologists of today, Galton's wide general training fitted him better for the study of evolution and its bearing on man than if he had received an intensive training in comparative anatomy alone. His grandfathers, Samuel Galton and Erasmus Darwin were both fellows of the Royal Society, and both friends of Priestley, Boulton, Watt and Wedgwood. His father, Tertius Galton, had, as his diaries and papers show, a strong scientific bent and was keen on statistical inquiry. Before

[1] Shortly before he died (1916) Professor H. H. W. Pearson of the South African College, Cape Town, went upon a scientific journey into Damaraland, and sent a letter to England stating that the name of Galton stood as legible as it had done when in 1851 he swam the lake and posted his name on the rock which rises from the water as that of the first European to reach the spot. Will any British Governor of Damaraland have imagination enough to call a town of that colony 'Galton' in memory of the colony's first discoverer and of the little Somersetshire village whence the yeoman side of Galton's ancestry sprang?

Francis Galton went up to Cambridge he had been trained in clinical observation in the wards of the Hospital at Birmingham; in London he pursued studies of a like observational kind, anatomy, botany and the preliminary medical sciences.

Going up to Cambridge he was disillusioned by finding how little the Cambridge of those days cared for the experimental, physical and observational work which he had learnt at home and in London to value[1]. Yet Galton fell to on his mathematical studies, and but for the break-down of his health—a break-down largely due to that greed of youth which would grasp at one and the same time 'the whole wide world of thought to it unknown'—he would certainly have been in the wranglers, probably in the first ten. Thus it came about that Galton had far more mathematics and physics than nine biologists out of ten, and more biology than nineteen mathematicians out of twenty, and more acquaintance with diseases and anomalies than forty-nine out of fifty biologists and mathematicians together. He was well able to hold his own on physical and meteorological committees; and his letters to Stokes and Maxwell show that he knew how to put his physical problems, if he sometimes had to seek others' aid in the solution of them. It was the very width of his knowledge that made him the friend of Huxley, of Spencer, of Spottiswoode and of Hooker; he could speak their language and they understood his. Well, given the man of this broad training, of this widely interested mind—a type far rarer in this day of specialisation, when the embryologist knows nothing of genetics, the geneticist little of palaeontology, the palaeontologist less of morphology, than it was in the much abused mid-Victorian day—given, we say, such a mind, aroused from the torpor of tribal dogmas, and how will it plan its life-work, how will it envisage that novel universe which Darwin and evolution threw open to the youthful pioneers of the sixties[2]?

[1] Sharpey had not yet sent his apostles, Michael Foster to Cambridge, and Burdon-Sanderson to Oxford. At Cambridge there was little biological laboratory work till post-Darwinian days when Michael Foster and Frank Balfour were its pioneers.

[2] Galton's mind was boyish at his majority, youthful in the fifties and still that of a joyful pioneer at his death. He could write a novel in the last year of his life, which his friends feared was the product of senility, although it was really the output of a still unexhausted exuberant youth!

Of two things we may be fully certain: it will seize salient problems for attack and it will attack those problems in its own individual way. The salient problems of evolution are those of Heredity, Environment, Variation and Selection. The methods by which they may be attacked are two-fold: by experiment or observation and by analysis. Galton's training fitted him in an unique degree to develop both methods. He was a pioneer in both methods—witness his work on sweet-peas, moths and man—and combining them he laid the firm foundations of the modern science of statistics. In his notebook on the sweet-pea experiments occur the first correlation table, the first regression curve, and the first numerical measure of the intensity of heredity, i.e. that between mother and daughter plant. Like Kelvin, Galton conceived that if a phenomenon could not be reduced to quantity and number we have but a very confused conception of it; or as Galton himself expressed it still more strongly: 'until the phenomena of any branch of knowledge have been submitted to measurement and number it cannot assume the dignity of a science.'

And from that seed of the sweet-pea sprang the correlational calculus. From the seed of Gregor Mendel's peas arose possibly the major portion of modern genetics. In the pride of that birth one of the leaders of the Mendelian school expressed his pleasure at knowing no mathematics. With singular want of foresight he had not grasped the evolution of all branches of science from the merely descriptive to the measured and quantitative. He had not realised that the correlational calculus becoming dominant in psychology, anthropology and medicine, could not possibly remain recessive even in Mendelian genetics! More intense genetic research was compelled to discard one by one its primary axioms. More and more determinants were demanded for the simplest characters—skin colour in man required at least five[1] even for a scarce adequate description, coat colour in mice asked for ten—and there was nothing to prevent a still further extension of the constants which might be requisite to describe the numerical results of a breeding experiment, except the needful mathematical knowledge,

[1] And by one of those strange freaks of Dame Nature they happen to coincide with the units of reading on the investigator's arbitrary colour top!

and the length of life available to test adequately the further inferences which ought to be drawn from the scheme of determinantal factors fitted to the already observed data. 'Give me enough arbitrary constants and I will describe any past experience,' cries the mathematician. 'Possibly,' replies drily the natural philosopher, 'but will your description not only suffice to predict, will it predict correctly *future* experience?'

Strange as it may seem to the uninitiated the geneticist of the future, whether he follow Galton's analysis of mass-phenomena as the more appropriate to the study of evolution, or Mendel's analysis of the individual matings, will need a mathematical training—a training on the lines which Galton originated when he first approached the problems of Darwinian evolution. Such is the frolicsome reply of that Puck, who controls scientific growth, to those who would oppose the results which have flowed from Mendel's edible pea to the calculus which has sprung from Galton's experiments on the sweet-pea. Whether Mendelian views on heredity be correct or be false, or be partly one and partly the other, we can be certain that the future lies with those geneticists, who are able not only to develop their formulae, but to test the fit of their observations to theory by the statistical methods that arose from Galton's experiments and observations on heredity.

There are those among Galton's Mendelian critics who, clearly without understanding of his work, assert that there are two kinds of variations—fluctuations and mutations; the former are due to chance occurrences and are not hereditary, the latter are the real material for inheritance. Galton they assert dealt with the former and his work was accordingly worthless. The charge is, of course, absurd, because had he dealt with the former he could not have found the somatic character in the parent influencing the somatic character of the offspring. Nor again could the environmental element in the somatic characters dealt with by Galton be a very serious element, for if so, the relationship between parent and offspring would represent a minimum value, whereas it is already in excess of that which seems suggested by Mendelian theory.

The controversy on this point has not been without profit for it has led to the testing of what various authorities term

'pure lines,' and the possibility of selection within the pure line. Most of the evidence provided for the existence of pure lines can be refuted where the authors have published data enough to test their theories, but this is not always the case, and we must wait in patience for more ample experimental data. It appears to the present writer extremely unlikely that the theory of pure lines can under any circumstances have the least bearing on mammals, let alone man. On the contrary it seems extremely probable that there is no absolute identity between the reproductive cells thrown off by the reproductive organs of the same individual, and that both the somatic and the genetic characters of the resulting offspring are correlated to a greater or less degree of intensity with these differences in the reproductive cells. In other words there is diversity in the reproductive cells of the same individual and thus selection within the so-called pure lines will always be possible. It may well be doubted whether the Mendelian theory of the absolute identity of the reproductive cells of the same individual is a wide enough mechanism to cover the observed facts in the case of man. At any rate Galton's method of approaching the subject must stand at present when we study the mass-phenomena of racial evolution.

It was not till 1889, however, many years after the Darwinian impulse, that Galton published his *Natural Inheritance*, and with it the first solid foundation of the correlational calculus. He had first studied the characters that are inherited in man, and he had trained himself in anthropometry, not the measurement of external physical characters only, but of psychological characters also. For heredity in man was Galton's goal from the first and if he had at the outset to think of sweet-peas, it was because data for man were in those days not easy to obtain. Galton was not a teacher in touch with large numbers of men and women; that commonplace of University, College and School today, the Anthropometric Laboratory, had then no existence. Galton evolved the conception and set up the first Anthropometric Laboratory at South Kensington in order to procure material for the purpose of testing the new calculus he was developing. The fifteen folio volumes of measurements and the cabinets with thousands of indexed finger-prints still remain, only in part utilised, a great monument to Galton's

energy, and witnesses to the truth of the statement we have made above, that he collected his material before he proceeded to the mathematical interpretation of it[1]. But in thus indicating how Galton reached his calculus we are anticipating many years of growth in his own development.

Coming straight from Darwin to the problems of evolution Galton not unnaturally started from Darwin's theory of heredity, Pangenesis, and determined to test that. According to Darwin every element of the organism gives forth hereditary particles or 'gemmules' representative of its characters, and these gemmules are not only present in all parts of the body but summed in the constituents of the reproductive cells, from whence they pass on reproduction and control the development of the corresponding parts in the new individual. Pangenesis is one of the few cases in which Darwin going far beyond his observed facts ventured to suggest a mechanical hypothesis to explain them. Darwin's idea was clearly invented to account for regeneration of parts and the propagation of individuals by budding. Galton approaching the problem of pangenesis assumed that if the gemmules existed in all parts of the body they must certainly be found in the blood. Hence he proposed to Darwin himself an experiment to test this. There should be a series of experiments on transfusion of blood, between animals with markedly different characters—he chose rabbits, chiefly silver grey and the common brown—and after transfusion an investigation was made as to whether the characters of the offspring of such rabbits differed in any way from the offspring they had borne before transfusion. The transfusions produced no change whatever in the character of the offspring as it might have been anticipated they would do, if gemmules bearing different characters had been transmitted with the change of blood. Darwin made many suggestions during the course of the experiments,—the rabbits even went to and

[1] A fine illustration of this is the process Galton actually followed in dealing with heredity in parent and child. He obtained measurements of stature in father and son; he tabled the frequency with which each value of the stature in son occurs for a given stature in the father; he constructed the lines of equal frequency by interpolation and found them to be a system of similar and similarly placed concentric ellipses. Then and then only he turned to mathematical analysis and asked what is the law of inheritance which would lead to these elliptic contours, and so developed the theory of normal correlation.

fro between London and Down. His letters seem to suggest that he thought light would be thrown on his theory by an attempt to ascertain whether blood has any important function in the transmission of hereditary characters. Indeed popular language and folk-tradition has always associated 'blood' with the hereditary nature of stock.

Galton's results were published in the *Proceedings of the Royal Society* (March 30, 1871) and as far as the blood is concerned they were definitely opposed to Darwin's doctrine of pangenesis; they still more definitely suggested that blood *per se* is not fundamental in the popular sense in the matter of heredity. Galton's paper was followed by a letter of Darwin's to *Nature*[1], in which he denied that the transfusion experiments necessarily touched his hypothesis. He writes:

'In the chapter on Pangenesis in my "Variation of Animals and Plants under Domestication" I have not said one word about the blood or about any fluid proper to any circulating system. It is indeed obvious that the presence of gemmules in the blood can form no necessary part of my hypothesis, for I refer to the lowest animals such as Protozoa... The fundamental laws of growth, reproduction, inheritance, etc., are so closely similar throughout the whole organic kingdom, that the means by which the gemmules (assuming for the moment their existence) are diffused through the body would probably be the same in all beings; therefore the means can hardly be diffusion through the blood.'

This letter was followed by one from Galton, perhaps the most perfect letter that was ever written by a great disciple about a great master who had really misled him. He makes no direct reference to Darwin's antecedent knowledge of the experiments; he does not criticise as he might well have done the other methods proposed for the transmission of the gemmules: He says simply[2]:

'It appears from Mr Darwin's letter to you in last week's *Nature*, that the views contradicted by my experiments, published in the recent number of the "Proceedings of the Royal Society" differ from those he entertained. Nevertheless, I think they are what his published account of Pangenesis ("Animals, etc. under Domestication," II. 374, 379) are most likely to convey to the mind of a reader....

I do not much complain of having been sent on a false quest by ambiguous language, for I know how conscientious Mr Darwin is in all he writes, how difficult it is to put thoughts into accurate speech, and again how words have conveyed false impressions on the simplest matters from the earliest times. Nay, even in that idyllic scene which Mr Darwin has sketched of the first invention of language awkward blunders must of necessity have often occurred. I refer to the passage in which he supposes some unusually wise, ape-like animal to have

[1] April 27, 1871. [2] May 4, 1871.

first thought of imitating the growl of a beast so as to indicate to his fellow-monkeys the nature of expected danger. For my part, I feel as if I had just been assisting at such a scene. As if having heard my trusted leader utter a cry, not particularly well articulated, but to my ears more like that of a hyena than any other animal, and seen none of my companions stir a step, I had, like a loyal member of the flock, dashed down a path of which I had happily caught sight, into the plain below, followed by the approving nods and kindly grunts of my wise and most-respected chief. And I now feel, after returning from my hard expedition, full of information, that the suspected danger was a mistake, for there was no sign of a hyena anywhere in the neighbourhood, and am given to understand for the first time that my leader's cry had no reference to a hyena down in the plain, but to a leopard somewhere up in the trees; his throat had been a little out of order—that was all. Well, my labour has not been in vain; it is something to have established that there are no hyenas in the plain, and I think I see my way to a good position for a look out for leopards among the branches. In the meanwhile, *Vive* Pangenesis.

Reference is only made to the *published* statements of Darwin, not a word as to the previous correspondence. Galton restrained himself, and out of respect for a great master, indulged merely in an allegory hardly intelligible to anyone but Darwin himself.

But Galton now tacitly discarded pangenesis and sought elsewhere for a solution of the problem of heredity. He thought for himself over the problem and came to the conclusion that the facts fitted better with the concentration of the hereditary elements in the reproductive cells, and that the power of some body or somatic cells to reproduce the individual must lie in the fact that they are also reproductive cells and not purely somatic cells. Proceeding from the idea of the reproductive cells only being the bearers of hereditary characters, Galton evolved the conception that what we now term the germ-plasm of the individual is not peculiar to the individual but to his 'stirp.' Individuals are merely the conduits through which flow the germ-plasm of the stock or stirp to the next generation. The child is not like the parent because it springs from the parent, but because both are to a definite extent representatives of the same stirp, i.e. partial or in the case of parthenogenesis complete products of the same germ-plasm. Galton's idea of the 'stirp,' better known under the name given to it by its later German propounder, the 'continuity of the germ-plasm,' has played a very large part in modern theories of heredity. It involves the fundamental principle that in organisms in which somatic and

reproductive cells are rigidly distinct you cannot hope to modify the somatic characters of the next generation by altering the somatic characters of the parent generation, you can only do so by influencing the reproductive cells. But how to affect the reproductive cells so as to modify a given somatic character in a given way is a problem on which embryology is only just beginning to throw a feeble light. It is obvious that the reproductive cells are much more easily accessible to environmental influences in the very simple than in the highly developed forms of life.

The next stage of Galton's mental growth follows at once. The moment he realised the substantial truth of his theory of the stirp, he had forced upon him two broad principles which really run into each other. In the first place modifications of somatic characters—somewhat loosely but with quite definite meaning termed 'acquired characters'—will not be inherited. There are no 'gemmules' to be integrated in the reproductive cells. In the next place the modification of environment will only influence racial characters in so far as it modifies the germ cells; its action on the somatic cells will have no direct effect on the germ cells. There has been in our opinion a sad waste of paper and of printing energy in recent controversy over heredity and environment, or as Galton preferred to state it, the problem of the relative importance of nature and nurture. To proclaim the platitude that no species can continue to exist without its appropriate environment does not in the least answer the fundamental problem of the relative importance of nature and nurture. The problem which Galton and those who followed him had clearly defined in their minds was this: We find a variety of stirps in the community; these give a definite mean character, and a definite variability about that mean: we find also definite grades of environment subject to which the species can exist. These grades of environment have again their mean character and definite variability. This variability may be due to variation of physical conditions, or in the case of man to political, social and economic conditions. If we give equal divergences from mediocrity measured in their units of variation to the stirp and to the environment, which will produce the greater effect on the somatic characters of the offspring? This problem could be answered and has been answered by Galton's correlational calculus.

The answer in broad lines has been invariably the same, the differences in the characters of the offspring produced by a difference of stirp are immensely more important than those which can be produced by any variations of environment which seem politically or socially feasible. Galton himself sought the solution of the problem, as he always did of any problem, in a unique fashion. He studied twins, the identical twins who are completely alike, and the non-identical twins who are only as much alike as ordinary brothers and sisters. He found that the former, subjected to different environments, grew no less alike, and the latter, subjected to the same environment, grew no more alike. And from this he concluded that nature was indefinitely stronger than nurture. This problem of the relative intensity of nature and nurture was fundamental in Galton's ideas. It was one he turned over and pondered on year by year during the course of a long life, and his views were quite definite upon the subject; it was essentially what ultimately drove him to the eugenetic solution of the national welfare problem[1].

It is here we reach the central factor of Galton's work and career. He had—aroused by Darwin—asked himself what does evolution mean for Man? How can our knowledge of it raise man, man as an individual, and men combined to form a community or nation? He studied first heredity and he demonstrated that not only physical characters, but that psychological characters—mental and moral characters—are hereditary in man. He dealt with these characters in the mass and he rightly did so; for the material for natural selection lies in the somatic characters. Nature when it destines an organism to extermination does so, not by examination of its germ-plasm, but on the ground that its somatic characters, physical and mental, are not adequate to its environment. But if it thus became obvious that heredity could affect a change in man, might it not be

[1] And yet, *mirabile dictu*, there are those who profess to understand and honour Galton's work, who yet do not realise that the landmarks of his development were his discovery that mental and moral characters were inherited to the same extent as the physical, and that nurture played a small part as compared with nature in improving the race. A hard cradle rather than a soft one makes for racial fitness, and Nature has bred successfully only by the stringency of her selection. Take away these features of Galton's work and what is there left to honour him for?

possible that environment could produce a change as great or greater in a far more pleasant manner? Galton's answer was: No! And that answer has been echoed by all those who have studied at first hand the influence of environment on man. Doubts may even arise in the minds of such inquirers whether a hard environment is not an essential for a tough race, a race sturdy in mind and body.

But if Galton be correct in his opinion, have not our social reformers for generations been in the phrase of the late Lord Salisbury 'putting their money on the wrong horse'? After years of legislative improvement of housing, of sanitation, of hours and conditions of labour, of food supply, of medical treatment and of the care of children, can we say that we are physically and mentally a fitter race? We are no doubt a happier race—as far as an Englishman will ever admit that he is happy. We play more, we read more—if it be open to question whether we read more intelligently; we have more variety of food, more variety of sports and pastimes, more change in life, and possibly relatively fewer human wrecks. But what evidence have we that the race is physically stronger, or that its mental characters are more highly developed? The evidence, not very conclusive, because there were no anthropometric laboratories a hundred years ago, is certainly not in favour of an advance in physical and mental characters at all comparable with the advance in environment. Can it be that, perpetually pottering with environmental changes, we have made our race happier, but failed to make it physically fitter and mentally worthier? Must the nation which disregards heredity, and considers solely environment, ultimately degenerate and disappear?

It is true that practically no nation has made heredity consciously a part of its policy in the past, but Dame Nature by the stringency of her environmental conditions, which man had not science, or culture, or wealth enough to modify, thrust the stern discipline of heredity upon the peoples, and the feeble in mind, the weak in body, the inert in action perished, and humanity as a whole went forward. When a nation reached that stage of culture that it could suspend the environmental check on the spread of its feebler members, then that nation and its civilisation reaching their full blossom, withered away and perished. One of the most significant facts in the long history of humanity, now traceable

if often only in the vaguest outline, for several hundred thousand years, is not the continuous growth of all humanity, but the replacement of one race of men and its culture by a second race and its culture. Acheulean culture succeeded Chellean, to be replaced in its turn by Moustierian, then Neanderthal man was swept out of existence by Cromagnon man, and the latter's Aurignacian culture disappeared in turn before Solutrean and Magdalenian types. Again Palaeolithic man in his varied anatomical and mental phases was succeeded by Neolithic man; and empires based on bronze, and iron and steel have followed. And each race and its culture has been replaced by another of whose locality of origin and method of development we have but the vaguest conception. We may hesitatingly allot its cradles to the unknown east, or to the unknown south; but we are certain that the race did not spring from the previously dominant civilisation. Nursed in an unknown cradle, probably in isolation, a hard environment toughened it by selection, gave it in mind or body or both some slight advantages over its precursors; it broke its limits, spread over Europe or Asia, dominated and perished in its turn, or the fragments, perhaps, remain to our own day as a fringe folk of small efficiency on the borders of the habitable world.

The processes of Nature are stupendous but they are not economical in the eyes of man; the powers of the Deity are limited, let man help him, cry our modern god-makers; the laws of evolution are open to our study, let us once understand them, and man can elevate man as he has developed his domestic animals—such was the gospel of Galton. Our race dying, shall not be a mere stepping stone for another race to reach loftier things; study how a race can reach higher mental and bodily efficiency, and this knowledge, which Galton termed the science of national eugenics, will carry your nation forward in the future, as Nature in the past carried humanity forward by a stringent selection of races, and a ruthless destruction of nations and cultures. 'Do this and your nation shall not perish'—was Galton's creed, for to him in the last years of his life Eugenics had grown to be a faith. Eugenics, he said, must become a religious belief.

The little men say: 'Faugh! it means that man is to be bred as a domestic animal.' If this means that matings shall or shall not take place after consideration of the stirps of

the families to be linked, it is undoubtedly the foundation stone of Eugenics. But if it means that the mating of *A* and *B* is to follow at the command of *C* as in the case of domestic animals the sentence stands as a pitiable caricature of Galton's 'Eugenics as a religious belief.' If the physically fitter or the mentally more efficient, or still better those whose stirps unite *both* these desirable characters, were to resolve tomorrow to form consciously a caste apart, to mate only within their own members and leave adequate progeny; if they were to look on marriage out of their caste as a disgrace, then that caste in a generation or two would be the aristocracy of the nation, its ruling caste. It would be individual man selecting himself, breeding himself, if Galton's critics prefer that term, as a domestic animal. With our present knowledge of heredity, with our present measures of bodily fitness and mental proficiency, there is no greater difficulty in roughly classifying mankind into grades of intellectual and physical fitness than was found during the war in passing conscripts into A I to C III classes.

But Galton's critics may add: 'What is the value of creating a "religious" pride of caste in A I, if your C III's unrestrictedly multiply, and will eventually swamp your supermen?' Are the latter like Mr Bernard Shaw's supermen to be endowed with the power of killing at sight, if not by sight? The answer is a simple one, the social, that is the moral feeling of the nation has to be so intensified that C III individuals shall not mate like wild animals regardless of the fitness of possible offspring. Nay, rather let us say like domestic animals uncontrolled by man, for nature does not permit the maimed and stupid among wild animals to rear offspring at all, and the nation which creates an environment that permits such mating will not survive in the struggle of nations.

How are we to bring home to the sound majority of the people the greatness of the burden which that C III minority inflicts upon it! The one blind man with twenty blind descendants; the two deaf-mutes with forty or more additional deaf-mutes proceeding from them, the insane stirp extending its family curse over five generations; the unmarried mentally defective woman whose pedigree shows upwards of a hundred criminals and mental defectives deriving their life from her! Nature is indefinitely more

tender of the future of humanity than humanity itself is! Yet so strangely weird is the history of language that we call it humanity to permit these things! Galton grasped all this as he had grasped the other side of the picture, the stirps which produced great statesmen, those producing great lawyers, those producing great scientists, those producing great leaders of commerce, or great musicians or actors generation by generation. Galton saw these things, and he said make sure the new knowledge, and then teach it in the market-place, proclaim it as a new religion. It was because Galton realised that knowledge was a talent buried in a napkin unless it was applied in the service of man, it was because he saw that modifying environment could not be trusted as it had been by the social reformers of the past to elevate our race, that his name will grow more and more important as generation succeeds generation. Marriages are made in heaven, said the guileless folk of past ages; man is the domestic animal of the angels, said the Alfred Russel Wallace of yesterday, that strange compound of tribal superstition and modern science; man can be the domestic animal of man, if he will but combine scientific knowledge with a faith amounting to religion, said, capping them, Galton the prophet of man's future. Many and strange are the marriage customs, the commands and prohibitions as to mating, often accompanied as sanctions by exile or death, always recognised as part of religious belief, which man has laid upon his tribe or his community in his ignorance. Why should the commands and prohibitions as to mating which he lays upon the community in his knowledge not have equal social and religious weight? If a whole community may be outraged by a man marrying a woman of his own totem, may not a community grow up which holds it an outrage when a man of insane stock marries a woman of a mentally defective stirp? If a whole tribe shall insist that one man and one man only, the husband's brother, shall mate with his widow, shall a tribe not possibly arise which sets a stigma on the mentally endowed who mate outside their caste or provide no descendants for the welfare of the community? Think of the numerous phases of mating or non-mating—polyandry, incest, prostitution, monogamy, asceticism, self-emasculation, etc.—in the days of ignorance they have one and all been associated with religious sanctions.

In the days of our knowledge, and with the authority of that knowledge, is it impossible to believe that a like system of commands and prohibitions held with a conviction amounting to a religion may not again be developed? Galton believed this possible, and the growth of this belief in his mind was the history of his mental development in the last eight years of his life; it was the last product of his evergreen youthful enthusiasm. In 1903 Galton still had the desire to leave his property for the endowment of an institute for experimental breeding in animals. In 1911 Galton died and by his will founded the Laboratory which bears his name, a laboratory for the study of national eugenics, for what makes for better breeding in man. It may not be of serious weight, but at least it indicates the tendency of human social evolution, when it is reported that during the brief life of that laboratory there has been an increasing number of intelligent inquiries either directly or (what is more significant) through their medical men from those about to marry, as to the advisability of their proposed marriages, or from those already married as to the morality of their having or not having children. The older view that marriages are 'made in heaven,' in other words that they are made at hap-hazard—at first sight and as uncontrolled sex impulse dictates—has never really and completely ruled human matings among either uncivilised or civilised communities. There have always existed tribal and religious sanctions with regard to human marriage and what Galton and his eugenetic disciples have taught in their writings is not the abrogation, but the reform and extension of these sanctions in the light of our modern knowledge of heredity and racial progress. Darwin was a great scientist, but he could refrain from applying his doctrine to man's conduct because that was a thorny topic. Francis Galton was a Great scientist, one, perhaps, of wider outlook than his cousin, if far less intensely productive in one specialised field. But he was more than a great scientist, he was a social reformer, not appealing to sentiment but to knowledge for his basis of reform. The future will decide whether he was not also a prophet, if he has failed to be adequately recognised in the country of his birth. From New Zealand to Scandinavia, from Japan to Calcutta, from New York even to Petrograd, the seed he cast has germinated. Here and there in the form of

professorships, or of state endowed or assisted laboratories for the study of Eugenics; elsewhere in the form of propaganda societies, or, on a higher level, societies for the study of agencies under social control which can improve the human race mentally and physically. And yet, Galton was in the first place essentially an Englishman. His wide experience of travel seemed only to have confirmed his love of his own race; he did not speak readily, he did not even read with ease and pleasure foreign languages. He would not allow the word 'national' to be omitted from his definition of Eugenics. It will be for his nation to reckon, perhaps in sadness at the bicentenary of his birth, how much they have contributed to the science he created; how much they have profited by the light he cast, in the first place for their benefit, upon the factors which make for racial fitness.

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