ilated through identity of nurture. However, a somewhat exaggerated estimate of dissimilarity may be due to the tendency of relatives to dwell unconsciously on distinctive peculiarities, and to disregard the far more numerous points of likeness that would first attract the notice of a stranger. Thus in case 11 I find the remark, "Strangers see a strong likeness between them, but none who knows them well can perceive it." Instances are common of slight acquaintances mistaking members, and especially daughters of a family, for one another, between whom intimate friends can barely discover a resemblance. Still, making reasonable allowance for unintentional exaggeration, the impression that all this evidence leaves on the mind is one of some wonder whether nurture can do anything at all, beyond giving instruction and professional training. It emphatically corroborates and goes far beyond the conclusions to which we had already been driven by the cases of similarity. In those, the causes of divergence began to act about the period of adult life, when the characters had become somewhat fixed; but here the causes conducive to assimilation began to act from the earliest moment of the existence of the twins, when the disposition was most pliant, and they were continuous until the period of adult life. There is no escape from the conclusion that nature prevails enormously over nurture when the differences of nurture do not exceed what is commonly to be found among persons of the same rank of society and in the same country. My fear is, that my evidence may seem to prove too much, and be discredited on that account, as it appears contrary to all experience that nurture should go for so little. But experience is often fallacious in ascribing great effects to trifling circumstances. Many a person has amused himself with throwing bits of stick into a tiny brook and watching their progress; how they are arrested, first by one chance obstacle, then by another; and again, how their onward course is facilitated by a combination of circumstances. He might ascribe much importance to each of these events, and think how largely the destiny of the stick had been governed by a series of trifling accidents. Nevertheless all the sticks succeed in passing down the current, and in the long-run, they travel at nearly the same rate. So it is with life, in respect to the several accidents which seem

to have had a great effect upon our careers. The one element, that varies in different individuals, but is constant in each of them, is the natural tendency; it corresponds to the current in the stream, and inevitably asserts itself.

Much stress is laid on the persistence of moral impressions made in childhood, and the conclusion is drawn, that the effects of early teaching must be important in a corresponding degree. I acknowledge the fact, so far as has been explained in the chapter on Early Sentiments, but there is a considerable set-off on the other side. Those teachings that conform to the natural aptitudes of the child leave much more enduring marks than others. Now both the teachings and the natural aptitudes of the child are usually derived from its parents. They are able to understand the ways of one another more intimately than is possible to persons not of the same blood, and the child instinctively assimilates the habits and ways of thought of its parents. Its disposition is "educated" by them, in the true sense of the word; that is to say, it is evoked, not formed by them. On these grounds I ascribe the persistence of many habits that date from early home education, to the peculiarities of the instructors rather than to the period when the instruction was given. The marks left on the memory by the instructions of a foster-mother are soon sponged clean away. Consider the history of the cuckoo, which is reared exclusively by foster-mothers. It is probable that nearly every young cuckoo, during a series of many hundred generations, has been brought up in a family whose language is a chirp and a twitter. But the cuckoo cannot or will not adopt that language, or any other of the habits of its foster-parents. It leaves its birthplace as soon as it is able, and finds out its own kith and kin, and identifies itself henceforth with them. So utterly are its earliest instructions in an alien bird-language neglected, and so completely is its new education successful, that the note of the cuckoo tribe is singularly correct.

Domestication of Animals.[1]

Before leaving the subject of Nature and Nurture, I would direct attention to evidence bearing on the conditions under

[1] This memoir is reprinted from the *Transactions of the Ethnological*

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which animals appear first to have been domesticated. It clearly shows the small power of nurture against adverse natural tendencies.

The few animals that we now possess in a state of domestication were first reclaimed from wildness in prehistoric times. Our remote barbarian ancestors must be credited with having accomplished a very remarkable feat, which no subsequent generation has rivalled. The utmost that we of modern times have succeeded in doing, is to improve the races of those animals that we received from our forefathers in an already domesticated condition.

There are only two reasonable solutions of this exceedingly curious fact. The one is, that men of highly original ideas, like the mythical Prometheus, arose from time to time in the dawn of human progress, and left their respective marks on the world by being the first to subjugate the camel, the llama, the reindeer, the horse, the ox, the sheep, the hog, the dog, or some other animal to the service of man. The other hypothesis is that only a few species of animals are fitted by their nature to become domestic, and that these were discovered long ago through the exercise of no higher intelligence than is to be found among barbarous tribes of the present day. The failure of civilised man to add to the number of domesticated species would on this supposition be due to the fact that all the suitable material whence domestic animals could be derived has been long since worked out.

I submit that the latter hypothesis is the true one for the reasons about to be given; and if so, the finality of the process of domestication must be accepted as one of the most striking instances of the inflexibility of natural disposition, and of the limitations thereby imposed upon the

Society, 1865, with an alteration in the opening and concluding paragraphs, and with a few verbal emendations. If I had discussed the subject now for the first time I should have given extracts from the works of the travellers of the day, but it seemed needless to reopen the inquiry merely to give it a more modern air. I have also preferred to let the chapter stand as it was written, because considerable portions of it have been quoted by various authors (*e.g.* Bagehot, *Economic Studies*, pp. 161 to 166: Longman, 1880), and the original memoir is not easily accessible.

choice of careers for animals, and by analogy for those of men.

My argument will be this:—All savages maintain pet animals, many tribes have sacred ones, and kings of ancient states have imported captive animals on a vast scale, for purposes of show, from neighbouring countries. I infer that every animal, of any pretensions, has been tamed over and over again, and has had numerous opportunities of becoming domesticated. But the cases are rare in which these opportunities have led to any result. No animal is fitted for domestication unless it fulfils certain stringent conditions, which I will endeavour to state and to discuss. My conclusion is, that all domesticable animals of any note have long ago fallen under the yoke of man. In short, that the animal creation has been pretty thoroughly, though half unconsciously, explored, by the every-day habits of rude races and simple civilisations.

It is a fact familiar to all travellers, that savages frequently capture young animals of various kinds, and rear them as favourites; and sell or present them as curiosities. Human nature is generally akin: savages may be brutal, but they are not on that account devoid of our taste for taming and caressing young animals; nay, it is not improbable that some races may possess it in a more marked degree than ourselves, because it is a childish taste with us; and the motives of an adult barbarian are very similar to those of a civilised child.

In proving this assertion, I feel embarrassed with the multiplicity of my facts. I have only space to submit a few typical instances, and must, therefore, beg it will be borne in mind that the following list could be largely reinforced. Yet even if I inserted all I have thus far been able to collect, I believe insufficient justice would be done to the real truth of the case. Captive animals do not commonly fall within the observation of travellers, who mostly confine themselves to their own encampments, and abstain from entering the dirty dwellings of the natives; neither do the majority of travellers think tamed animals worthy of detailed mention. Consequently the anecdotes of their existence are scattered sparingly among a large number of volumes. It is

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when those travellers are questioned who have lived long and intimately with savage tribes that the plenitude of available instances becomes most apparent.

I proceed to give anecdotes of animals being tamed in various parts of the world, at dates when they were severally beyond the reach of civilised influences, and where, therefore, the pleasure taken by the natives in taming them must be ascribed to their unassisted mother-wit. It will be inferred that the same rude races who were observed to be capable of great fondness towards animals in particular instances, would not unfrequently show it in others.

[North America.]—The traveller Hearne, who wrote towards the end of the last century, relates the following story of moose or elks in the more northern parts of North America. He says:—

"I have repeatedly seen moose at Churchill as tame as sheep and even more so. . . . The same Indian that brought them to the Factory had, in the year 1770, two others so tame that when on his passage to Prince of Wales's Fort in a canoe, the moose always followed him along the bank of the river; and at night, or on any other occasion when the Indians landed, the young moose generally came and fondled on them, as the most domestic animal would have done, and never offered to stray from the tents."

Sir John Richardson, in an obliging answer to my inquiries about the Indians of North America, after mentioning the bison calves, wolves, and other animals that they frequently capture and keep, said:—

"It is not unusual, I have heard, for the Indians to bring up young bears, the women giving them milk from their own breasts."

He mentions that he himself purchased a young bear, and adds:—

"The red races are fond of pets and treat them kindly; and in purchasing them there is always the unwillingness of the women and children to overcome, rather than any dispute about price. My young bear used to rob the women of the berries they had gathered, but the loss was borne with good nature."

I will again quote Hearne, who is unsurpassed for his

minute and accurate narratives of social scenes among the Indians and Esquimaux. In speaking of wolves he says:—

"They always burrow underground to bring forth their young, and though it is natural to suppose them very fierce at those times, yet I have frequently seen the Indians go to their dens and take out the young ones and play with them. I never knew a Northern Indian hurt one of them; on the contrary, they always put them carefully into the den again; and I have sometimes seen them paint the faces of the young wolves with vermilion or red ochre."

[South America.]—Ulloa, an ancient traveller, says:—

"Though the Indian women breed fowl and other domestic animals in their cottages, they never eat them: and even conceive such a fondness for them, that they will not sell them, much less kill them with their own hands. So that if a stranger who is obliged to pass the night in one of their cottages, offers ever so much money for a fowl, they refuse to part with it, and he finds himself under the necessity of killing the fowl himself. At this his landlady shrieks, dissolves into tears, and wrings her hands, as if it had been an only son, till seeing the mischief past mending, she wipes her eyes and quietly takes what the traveller offers her."

The care of the South American Indians, as Quiloa truly states, is by no means confined to fowls. Mr. Bates, the distinguished traveller and naturalist of the Amazons, has favoured me with a list of twenty-two species of quadrupeds that he has found tame in the encampments of the tribes of that valley. It includes the tapir, the agouti, the guinea-pig, and the peccari. He has also noted five species of quadrupeds that were in captivity, but not tamed. These include the jaguar, the great ant-eater, and the armadillo. His list of tamed birds is still more extensive.

[North Africa.]—The ancient Egyptians had a positive passion for tamed animals, such as antelopes, monkeys, crocodiles, panthers, and hyenas. Mr. Goodwin, the eminent Egyptologist, informed me that "they anticipated our zoological tastes completely," and that some of the pictures referring to tamed animals are among their very earliest monuments, viz. 2000 or 3000 years B.C. Mr. Mansfield Parkyns, who passed many years in Abyssinia

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and the countries of the Upper Nile, writes me word in answer to my inquiries :—

"I am sure that negroes often capture and keep alive wild animals. I have bought them and received them as presents—wild cats, jackals, panthers, the wild dog, the two best lions now in the Zoological Gardens, monkeys innumerable and of all sorts, and mongoos. I cannot say that I distinctly recollect any pets among the *lowest* orders of men that I met with, such as the Denkas, but I am sure they exist, and in this way. When I was on the White Nile and at Khartoum, very few merchants went up the White Nile ; none had stations. They were little known to the natives ; but none returned without some live animal or bird which they had procured from them. While I was at Khartoum, there came an Italian wild beast showman, after the Wombwell style. He made a tour of the towns up to Doul and Fazogly, Kordofan and the peninsula, and collected a large number of animals. Thus my opinion distinctly is, that negroes do keep wild animals alive. *I am sure of it;* though I can only vaguely recollect them in one or two cases. I remember some chief in Abyssinia who had a pet lion which he used to tease, and I have often seen monkeys about huts."

[Equatorial Africa.]—The most remarkable instance I have met with in modern Africa is the account of a menagerie that existed up to the beginning of the reign of the present king of the Wahumas, on the shores of Lake Nyanza. Suna, the great despot of that country, reigned till 1857. Captains Burton and Speke were in the neighbourhood in the following year, and Captain Burton thus describes (*Journal R. G. Soc.*, xxix. 282) the report he received of Suna's collection :—

"He had a large menagerie of lions, elephants, leopards, and similar beasts of disport ; he also kept for amusement fifteen or sixteen albinos ; and so greedy was he of novelty, that even a cock of peculiar form or colour would have been forwarded by its owner to feed his eyes."

Captain Speke, in his subsequent journey to the Nile, passed many months at Uganda, as the guest of Suna's youthful successor, M'tese. The fame of the old menagerie was fresh when Captain Speke was there. He wrote to me as follows concerning it :—

"I was told Suna kept buffaloes, antelopes, and animals of all colours' (meaning 'sorts'), and in equal quantities. M'tese, his son, no sooner came to the throne, than he indulged in shooting them down before his admiring wives, and now he has only one buffalo and a few parrots left."

In Kouka, near Lake Tchad, antelopes and ostriches are both kept tame, as I was informed by Dr. Barth.

[South Africa.]—The instances are very numerous in South Africa where the Boers and half-castes amuse themselves with rearing zebras, antelopes, and the like; but I have not found many instances among the native races. Those that are best known to us are mostly nomad and in a chronic state of hunger, and therefore disinclined to nurture captured animals as pets; nevertheless, some instances can be adduced. Livingstone alludes to an extreme fondness for small tame singing-birds (pp. 324 and 453). Dr. (now Sir John) Kirk, who accompanied him in later years, mentions guinea-fowl—that do not breed in confinement, and are merely kept as pets—in the Shiré valley, and Mr. Oswell has furnished me with one similar anecdote. I feel, however, satisfied that abundant instances could be found if properly sought for. It was the frequency with which I recollect to have heard of tamed animals when I myself was in South Africa, though I never witnessed any instance, that first suggested to me the arguments of the present paper. Sir John Kirk informs me that :

"As you approach the coast or Portuguese settlements, pets of all kinds become very common ; but then the opportunity of occasionally selling them to advantage may help to increase the number; still, the more settled life has much to do with it."

In confirmation of this view, I will quote an early writer, Pigafetta (*Hakluyt Coll.*, ii. 562), on the South African kingdom of Congo, who found a strange medley of animals in captivity, long before the demands of semi-civilisation had begun to prompt their collection :—

The King of Congo, on being Christianised by the Jesuit missionaries in the sixteenth century, "signified that whoever had any idols should deliver them to the lieutenants of the country. And within less than a month all the idols which they worshipped were brought into court, and certainly the number of these toys was infinite, for every man adored what he liked without any measure or reason at all. Some kept serpents of horrible figures, some worshipped the greatest goats they could

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get, some leopards, and others monstrous creatures. Some held in veneration certain unclean fowls, etc. Neither did they content themselves with worshipping the said creatures when alive, but also adored the very skins of them when they were dead and stuffed with straw."

[Australia.]—Mr. Woodfield records the following touching anecdote in a paper communicated to the Ethnological Society, as occurring in an unsettled part of West Australia, where the natives rank as the lowest race upon the earth:—

"During the summer of 1858-9 the Murchison river was visited by great numbers of kites, the native country of these birds being Shark's Bay. As other birds were scarce, we shot many of these kites, merely for the sake of practice, the natives eagerly devouring them as fast as they were killed. One day a man and woman, natives of Shark's Bay, came to the Murchison, and the woman immediately recognising the birds as coming from her country, assured us that the natives there never kill them, and that they are so tame that they will perch on the shoulders of the women and eat from their hands. On seeing one shot she wept bitterly, and not even the offer of the bird could assuage her grief, for she absolutely refused to eat it. No more kites were shot while she remained among us."

The Australian women habitually feed the puppies they intend to rear from their own breasts, and show an affection to them equal, if not exceeding, that to their own infants. Sir Charles Nicholson informs me that he has known an extraordinary passion for cats to be demonstrated by Australian women at Fort Phillip.

[New Guinea Group.]—Captain Develyn is reported (Bennett, *Naturalist in Australia*, p. 244) to say of the island of New Britain, near Australia, that the natives consider cassowaries "to a certain degree sacred, and rear them as pets. They carry them in their arms, and entertain a great affection for them."

Professor Huxley informs me that he has seen sucking-pigs nursed at the breasts of women, apparently as pets, in islands of the New Guinea Group.

[Polynesia.]—The savage and cannibal Fijians were no exceptions to the general rule, for Dr. Seemann wrote me word that they make pets of the flying fox (bat), the lizard,

and parroquet. Captain Wilkes, in his exploring expedition (ii. 122), says the pigeon in the Samoon islands "is commonly kept as a plaything, and particularly by the chiefs. One of our officers unfortunately on one occasion shot a pigeon, which caused great commotion, for the bird was a king pigeon, and to kill it was thought as great a crime as to take the life of a man."

Mr. Ellis, writing of these islands (*Polynesian Researches*, ii. 285), says:—

"Eels are great favourites, and are tamed and fed till they attain an enormous size. Taoarii had several in different parts of the island. These pets were kept in large holes, two or three feet deep, partially filled with water. I have been several times with the young chief, when he has sat down by the side of the hole, and by giving a shrill sort of whistle, has brought out an enormous eel, which has moved about the surface of the water and eaten with confidence out of his master's hand."

[Syria.]—I will conclude this branch of my argument by quoting the most ancient allusion to a pet that I can discover in writing, though some of the Egyptian pictured representations are considerably older. It is the parable spoken by the Prophet Samuel to King David, that is expressed in the following words:—

"The poor man had nothing save one little ewe lamb, which he had bought and nourished up: and it grew up together with him and with his children; it did eat of his own meat, and drank of his own cup, and lay in his bosom, and was to him as a daughter."

We will now turn to the next stage of our argument. Not only do savages rear animals as pets, but communities maintain them as sacred. The ox of India and the brute gods of Egypt occur to us at once; the same superstition prevails widely. The quotation already given from Pigafetta is in point; the fact is too well known to readers of travel to make it necessary to devote space to its proof. I will therefore simply give a graphic account, written by M. Jules Gérard, of Whydah in West Africa:—

"I visited the Temple of Serpents in this town, where thirty of these monstrous deities were asleep in various attitudes. Each day at sunset, a priest brings them a certain number of

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sheep, goats, fowls, etc., which are slaughtered in the temple and then divided among the 'gods.' Subsequently during the night they (? the priests) spread themselves about the town, entering the houses in various quarters in search of further offerings. It is forbidden under penalty of death to kill, wound, or even strike one of these sacred serpents, or any other of the same species, and only the priests possess the privilege of taking hold of them, for the purpose of reinstating them in the temple should they be found elsewhere."

It would be tedious and unnecessary to adduce more instances of wild animals being nurtured in the encampments of savages, either as pets or as sacred animals. It will be found on inquiry that few travellers have failed altogether to observe them. If we consider the small number of encampments they severally visited in their line of march, compared with the vast number that are spread over the whole area, which is or has been inhabited by rude races, we may obtain some idea of the thousands of places at which half-unconscious attempts at domestication are being made in each year. These thousands must themselves be multiplied many thousandfold, if we endeavour to calculate the number of similar attempts that have been made since men like ourselves began to inhabit the world.

My argument, strong as it is, admits of being considerably strengthened by the following consideration:—

The natural inclination of barbarians is often powerfully reinforced by an enormous demand for captured live animals on the part of their more civilised neighbours. A desire to create vast hunting-grounds and menageries and amphitheatrical shows, seems naturally to occur to the monarchs who preside over early civilisations, and travellers continually remark that, whenever there is a market for live animals, savages will supply them in any quantities. The means they employ to catch game for their daily food readily admits of their taking them alive. Pit-falls, stake-nets, and springs do not kill. If the savage captures an animal unhurt, and can make more by selling it alive than dead, he will doubtless do so. He is well fitted by education to keep a wild animal in captivity. His mode of pursuing game

requires a more intimate knowledge of the habits of beasts than is ever acquired by sportsmen who use more perfect weapons. A savage is obliged to steal upon his game, and to watch like a jackal for the leavings of large beasts of prey. His own mode of life is akin to that of the creatures he hunts. Consequently, the savage is a good gamekeeper; captured animals thrive in his charge, and he finds it remunerative to take them a long way to market. The demands of ancient Rome appear to have penetrated Northern Africa as far or farther than the steps of our modern explorers. The chief centres of import of wild animals were Egypt, Assyria (and other Eastern monarchies), Rome, Mexico, and Peru. I have not yet been able to learn what were the habits of Hindostan or China. The modern menagerie of Lucknow is the only considerable native effort in those parts with which I am acquainted.

[Egypt.]—The mutilated statistical tablet of Karnak (*Trans. R. Soc. Lit.*, 1847, p. 369, and 1863, p. 65) refers to an armed invasion of Armenia by Thothmes III., and the payment of a large tribute of antelopes and birds. When Ptolemy Philadelphus fêted the Alexandrians (*Athenæus*, v.), the Ethiopians brought dogs, buffaloes, bears, leopards, lynxes, a giraffe, and a rhinoceros. Doubtless this description of gifts was common. Live beasts are the one article of curiosity and amusement that barbarians can offer to civilised nations.

[Assyria.]—Mr. Fox Talbot thus translates (*Journal Asiatic Soc.*, xix. 124) part of the inscription on the black obelisk of Ashurakbal found in Nineveh and now in the British Museum:—

"He caught in hunter's toils (a blank number) of armi, turakhi, nali, and yadi. Every one of these animals he placed in separate enclosures. He brought up their young ones and counted them as carefully as young lambs. As to the creatures called burkish, utrati (dromedaries?), tishani, and dagari, he wrote for them and they came. The dromedaries he kept in enclosures, where he brought up their young ones. He entrusted each kind of animal to men of their own country to tend them. There were also curious animals of the Mediterranean Sea, which the King of Egypt sent as a gift and entrusted to the care of men of their own land. The very choicest animals were there in abundance, and birds of heaven with

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beautiful wings. It was a splendid menagerie, and all the work of his own hands. The names of the animals were placed beside them."

[Rome.]—The extravagant demands for the amphitheatre of ancient Rome must have stimulated the capture of wild animals in Asia, Africa, and the then wild parts of Europe, to an extraordinary extent. I will quote one instance from Gibbon:—

"By the order of Probus, a vast quantity of large trees torn up by the roots were transplanted into the midst of the circus. The spacious and shady forest was immediately filled with a thousand ostriches, a thousand stags, a thousand fallow-deer, and a thousand wild boars, and all this variety of game was abandoned to the riotous impetuosity of the multitude. The tragedy of the succeeding day consisted in the massacre of a hundred lions, an equal number of lionesses, two hundred leopards, and three hundred bears."

Farther on we read of a spectacle by the younger Gordian of "twenty zebras, ten elks, ten giraffes, thirty African hyenas, ten Indian tigers, a rhinoceros, an hippopotamus, and thirty-two elephants."

[Mexico.]—Gomara, the friend and executor of Herman Cortes, states:—

"There were here also many cages made of stout beams, in some of which there were lions (pumas); in others, tigers (jaguars); in others, ounces; in others, wolves; nor was there any animal on four legs that was not there. They had for their rations deer and other animals of the chase. There were also kept in large jars or tanks, snakes, alligators, and lizards. In another court there were cages containing every kind of birds of prey, such as vultures, a dozen sorts of falcons and hawks, eagles, and owls. The large eagles received turkeys for their food. Our Spaniards were astonished at seeing such a diversity of birds and beasts; nor did they find it pleasant to hear the hissing of the poisonous snakes, the roaring of the lions, the shrill cries of the wolves, nor the groans of the other animals given to them for food."

[Peru.]—Garcilasso de la Vega (*Commentarios Reales*, v. 10), the son of a Spanish conqueror by an Indian princess, born and bred in Peru, writes:—

"All the strange birds and beasts which the chiefs presented to the Inca were kept at court, both for grandeur and also to please the Indians who presented them. When I came to Cuzco, I remember there were some remains of places where they kept these creatures. One was the serpent conservatory, and another where they kept the pumas, jaguars, and bears."

[Syria and Greece.]—I could have said something on Solomon's apes and peacocks, and could have quoted at length the magnificent order given by Alexander the Great (Pliny, *Nat. Hist.*, viii. 16) towards supplying material for Aristotle's studies in natural history; but enough has been said to prove what I maintained, namely, that numerous cases occur, year after year, and age after age, in which every animal of note is captured and its capabilities of domestication unconsciously tested.

I would accept in a more stringent sense than it was probably intended to bear, the text of St. James, who wrote at a time when a vast variety and multitude of animals were constantly being forwarded to Rome and to Antioch for amphitheatrical shows. He says (James iii. 7), "Every kind of beasts, and of birds, and of serpents, and of things in the sea, is tamed, and hath been tamed of mankind."

I conclude from what I have stated that there is no animal worthy of domestication that has not frequently been captured, and might ages ago have established itself as a domestic breed, had it not been deficient in certain necessary particulars which I shall proceed to discuss. These are numerous and so stringent as to leave no ground for wonder that out of the vast abundance of the animal creation, only a few varieties of a few species should have become the companions of man.

It by no means follows that because a savage cares to take home a young fawn to amuse himself, his family, and his friends, that he will always continue to feed or to look after it. Such attention would require a steadiness of purpose foreign to the ordinary character of a savage. But herein lie two shrewd tests of the eventual destiny of the animal as a domestic species.

Hardiness.—It must be able to shift for itself and to thrive, although it is neglected; since, if it wanted much care, it would never be worth its keep.

The hardiness of our domestic animals is shown by the

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rapidity with which they establish themselves in new lands. The goats and hogs left on islands by the earlier navigators throve excellently on the whole. The horse has taken possession of the Pampas, and the sheep and ox of Australia. The dog is hardly repressible in the streets of an Oriental town.

Fondness of Man.—Secondly, it must cling to man, notwithstanding occasional hard usage and frequent neglect. If the animal had no natural attachment to our species, it would fret itself to death, or escape and revert to wildness. It is easy to find cases where the partial or total non-fulfilment of this condition is a corresponding obstacle to domestication. Some kinds of cattle are too precious to be discarded, but very troublesome to look after. Such are the reindeer to the Lapps. Mr. Campbell of Islay informed me that the tamest of certain herds of them look as if they were wild; they have to be caught with a lasso to be milked. If they take fright, they are off to the hills; consequently the Lapps are forced to accommodate themselves to the habits of their beasts, and to follow them from snow to sea and from sea to snow at different seasons. The North American reindeer has never been domesticated, owing, I presume, to this cause. The Peruvian herdsmen would have had great trouble to endure had the llama and alpaca not existed, for their cogeners, the huanacu and the vicuna, are hardly to be domesticated.

Zebras, speaking broadly, are unmanageable. The Dutch Boers constantly endeavour to break them to harness, and though they occasionally succeed to a degree, the wild mulish nature of the animal is always breaking out, and liable to balk them.

It is certain that some animals have naturally a greater fondness for man than others; and as a proof of this, I will again quote Hearne about the moose, who are considered by him to be the easiest to tame and domesticate of any of the deer tribe. Formerly the closely-allied European elks were domesticated in Sweden, and used to draw sledges, as they are now occasionally in Canada; but they have been obsolete for many years. Hearne says:—

"The young ones are so simple that I remember to have seen an Indian paddle his canoe up to one of them, and take it by the poll, without experiencing the least opposition, the poor harmless animal seeming at the same time as contented alongside the canoe as if swimming by the side of its dam, and looking up in our faces with the same fearless innocence that a house lamb would."

On the other hand, a young bison will try to dash out its brains against the tree to which it is tied, in terror and hatred of its captors.

It is interesting to note the causes that conduce to a decided attachment of certain animals to man, or between one kind of animal and another. It is notorious that attachments and aversions exist in nature. Swallows, rooks, and storks frequent dwelling houses; ostriches and zebras herd together; so do bisons and elks. On the other hand, deer and sheep, which are both gregarious, and both eat the same food and graze within the same enclosure, avoid one another. The spotted Danish dog, the Spitz dog, and the cat, have all a strong attachment to horses, and horses seem pleased with their company; but dogs and cats are proverbially discordant. I presume that two species of animals do not consider one another companionable, or clubable, unless their behaviour and their persons are reciprocally agreeable. A phlegmatic animal would be exceedingly disquieted by the close companionship of an excitable one. The movements of one beast may have a character that is unpleasing to the eyes of another; his cries may sound discordant; his smell may be repulsive. Two herds of animals would hardly intermingle, unless their respective languages of action and of voice were mutually intelligible. The animal which above all others is a companion to man is the dog, and we observe how readily their proceedings are intelligible to each other. Every whine or bark of the dog, each of his fawning, savage, or timorous movements is the exact counterpart of what would have been the man's behaviour, had he felt similar emotions. As the man understands the thoughts of the dog, so the dog understands the thoughts of the man, by attending to his natural voice, his countenance, and his actions. A man irritates a dog by an ordinary laugh, he frightens him by an angry look, or he calms him by a kindly bearing; but he has less spontaneous hold over an ox or a sheep. He must study their ways and tutor his behaviour

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before he can either understand the feelings of those animals or make his own intelligible to them. He has no natural power at all over many other creatures. Who, for instance, ever succeeded in frowning away a mosquito, or in pacifying an angry wasp by a smile?

Desire of Comfort.—This is a motive which strongly attaches certain animals to human habitations, even though they are unwelcome: it is a motive which few persons who have not had an opportunity of studying animals in savage lands are likely to estimate at its true value. The life of all beasts in their wild state is an exceedingly anxious one. From my own recollection, I believe that every antelope in South Africa has to run for its life every one or two days upon an average, and that he starts or gallops under the influence of a false alarm many times in a day. Those who have crouched at night by the side of pools in the desert, in order to have a shot at the beasts that frequent them, see strange scenes of animal life; how the creatures gambol at one moment and fight at another; how a herd suddenly halts in strained attention, and then breaks into a maddened rush, as one of them becomes conscious of the stealthy movements or rank scent of a beast of prey. Now this hourly life-and-death excitement is a keen delight to most wild creatures, but must be peculiarly distracting to the comfort-loving temperament of others. The latter are alone suited to endure the crass habits and dull routine of domesticated life. Suppose that an animal which has been captured and half-tamed, received ill-usage from his captors, either as punishment or through mere brutality, and that he rushed indignantly into the forest with his ribs aching from blows and stones. If a comfort-loving animal, he will probably be no gainer by the change, more serious alarms and no less ill-usage awaits him; he hears the roar of the wild beasts and the headlong gallop of the frightened herds, and he finds the buttings and the kicks of other animals harder to endure than the blows from which he fled. He has the disadvantage of being a stranger, for the herds of his own species which he seeks for companionship constitute so many cliques, into which he can only find admission by more fighting with their strongest members than he has spirit to undergo. As a set-off against these miseries, the

freedom of savage life has no charms for his temperament; so the end of it is, that with a heavy heart he turns back to the habitation he had quitted. When animals thoroughly enjoy the excitement of wild life, I presume they cannot be domesticated, they could only be tamed, for they would never return from the joys of the wilderness after they had once tasted them through some accidental wandering.

Gallinas, or guinea-fowl, have so little care for comfort, or indeed for man, that they fall but a short way within the frontier of domestication. It is only in inclement seasons that they take contentedly to the poultry-yards.

Elephants, from their size and power, are not dependent on man for protection; hence, those that have been reared as pets from the time they were calves, and have never learned to dread and obey the orders of a driver, are peculiarly apt to revert to wildness if they once are allowed to wander and escape to the woods. I believe this tendency, together with the cost of maintenance and the comparative uselessness of the beasts, are among the chief causes why Africans never tame them now; though they have not wholly lost the practice of capturing them when full-grown, and of keeping them imprisoned for some days alive. Mr. Winwood Reade's account of captured elephants, seen by himself near Glass Town in Equatorial Western Africa, is very curious.

Usefulness to Man.—To proceed with the list of requirements which a captured animal must satisfy before it is possible he could be permanently domesticated: there is the very obvious condition that he should be useful to man; otherwise, in growing to maturity, and losing the pleasing youthful ways which had first attracted his captors and caused them to make a pet of him, he would be repelled. As an instance in point, I will mention seals. Many years ago I used to visit Shetland, when those animals were still common, and I heard many stories of their being tamed: one will suffice:—A fisherman caught a young seal; it was very affectionate, and frequented his hut, fishing for itself in the sea. At length it grew self-willed and unwieldy; it used to push the children and snap at strangers, and it was voted a nuisance, but the people could not bear to kill it on account of its human ways. One day the fisherman took

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it with him in his boat, and dropped it in a stormy sea, far from home; the stratagem was unsuccessful; in a day or two the well-known scuffling sound of the seal, as it floundered up to the hut, was again heard; the animal had found its way home. Some days after the poor creature was shot by a sporting stranger, who saw it basking and did not know it was tame. Now had the seal been a useful animal and not troublesome, the fisherman would doubtless have caught others, and set a watch over them to protect them; and then, if they bred freely and were easy to tend, it is likely enough he would have produced a domestic breed.

The utility of the animals as a store of future food is undoubtedly the most durable reason for maintaining them; but I think it was probably not so early a motive as the chief's pleasure in possessing them. That was the feeling under which the menageries, described above, were established. Whatever the despot of savage tribes is pleased with becomes invested with a sort of sacredness. His tame animals would be the care of all his people, who would become skilful herdsmen under the pressure of fear. It would be as much as their lives were worth if one of the creatures were injured through their neglect. I believe that the keeping of a herd of beasts, with the sole motive of using them as a reserve for food, or as a means of barter, is a late idea in the history of civilisation. It has now become established among the pastoral races of South Africa, owing to the traffickings of the cattle-traders, but it was by no means prevalent in Damara-Land when I travelled there in 1852. I then was surprised to observe the considerations that induced the chiefs to take pleasure in their vast herds of cattle. They were valued for their stateliness and colour, far more than for their beef. They were as the deer of an English squire, or as the stud of a man who has many more horses than he can ride. An ox was almost a sacred beast in Damara-Land, not to be killed except on momentous occasions, and then as a sort of sacrificial feast, in which all bystanders shared. The payment of two oxen was hush-money for the life of a man. I was considerably embarrassed by finding that I had the greatest trouble in buying oxen for my own use, with the ordinary articles of barter. The possessor would

hardly part with them for any remuneration; they would never sell their handsomest beasts.

One of the ways in which the value of tamed beasts would be soon appreciated would be that of giving milk to children. It is marvellous how soon goats find out children and tempt them to suckle. I have had the milk of my goats, when encamping for the night in African travels, drained dry by small black children, who had not the strength to do more than crawl about, but nevertheless came to some secret understanding with the goats and fed themselves. The records of many nations have legends like that of Romulus and Remus, who are stated to have been suckled by wild beasts. These are surprisingly confirmed by General Sleeman's narrative of six cases where children were nurtured for many years by wolves in Oude. (*Journey through Oude in 1849–50*, i. 206.)

Breeding freely.—Domestic animals must breed freely under confinement. This necessity limits very narrowly the number of species which might otherwise have been domesticated. It is one of the most important of all the conditions that have to be satisfied. The North American turkey, reared from the eggs of the wild bird, is stated to be unknown in the third generation, in captivity. Our turkey comes from Mexico, and was abundantly domesticated by the ancient Mexicans.

The Indians of the Upper Amazon took turtle and placed them in lagoons for use in seasons of scarcity. The Spaniards who first saw them called these turtle "Indian cattle." They would certainly have become domesticated like cattle, if they had been able to breed in captivity.

Easy to tend.—They must be tended easily. When animals reared in the house are suffered to run about in the companionship of others like themselves, they naturally revert to much of their original wildness. It is therefore essential to domestication that they should possess some quality by which large numbers of them may be controlled by a few herdsmen. The instinct of gregariousness is such a quality. The herdsman of a vast troop of oxen grazing in a forest, so long as he is able to see one of them, knows pretty surely that they are all within reach. If oxen are frightened and gallop off, they do not scatter, but remain in

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a single body. When animals are not gregarious, they are to the herdsman like a falling necklace of beads whose string is broken, or as a handful of water escaping between the fingers.

The cat is the only non-gregarious domestic animal. It is retained by its extraordinary adhesion to the comforts of the house in which it is reared.

An animal may be perfectly fitted to be a domestic animal, and be peculiarly easy to tend in a general way, and yet the circumstances in which the savages are living may make it too troublesome for them to maintain a breed. The following account, taken from Mr. Scott Nind's paper on the Natives of King George's Sound in Australia, and printed in the first volume of the *Journal of the Geographical Society*, is particularly to the point. He says:—

"In the chase the hunters are assisted by dogs, which they take when young and domesticate; but they take little pains to train them to any particular mode of hunting. After finding a litter of young, the natives generally carry away one or two to rear; in this case, it often occurs that the mother will trace and attack them; and, being large and very strong, she is rather formidable. At some periods, food is so scanty as to compel the dog to leave his master and provide for himself; but in a few days he generally returns."

I have also evidence that this custom is common to the wild natives of other parts of Australia.

The gregariousness of all our domestic species is, I think, the primary reason why some of them are extinct in a wild state. The wild herds would intermingle with the tame ones, some would become absorbed, the others would be killed by hunters, who used the tame cattle as a shelter to approach the wild. Besides this, comfort-loving animals would be less suited to fight the battle of life with the rest of the brute creation; and it is therefore to be expected that those varieties which are best fitted for domestication, would be the soonest extinguished in a wild state. For instance, we could hardly fancy the camel to endure in a land where there were large wild beasts.

Selection.—The irreclaimably wild members of every flock would escape and be utterly lost; the wilder of those that

remained would assuredly be selected for slaughter, whenever it was necessary that one of the flock should be killed. The tamest cattle—those that seldom ran away, that kept the flock together and led them homewards—would be preserved alive longer than any of the others. It is therefore these that chiefly become the parents of stock, and bequeath their domestic aptitudes to the future herd. I have constantly witnessed this process of selection among the pastoral savages of South Africa. I believe it to be a very important one, on account of its rigour and its regularity. It must have existed from the earliest times, and have been in continuous operation, generation after generation, down to the present day.

Exceptions.—I have already mentioned the African elephant, the North American reindeer, and the apparent, but not real exception of the North American turkey. I should add the ducks and geese of North America, but I cannot consider them in the light of a very strong case, for a savage who constantly changes his home is not likely to carry aquatic birds along with him. Beyond these few, I know of no notable exceptions to my theory.

Summary.

I see no reason to suppose that the first domestication of any animal, except the elephant, implies a high civilisation among the people who established it. I cannot believe it to have been the result of a preconceived intention, followed by elaborate trials, to administer to the comfort of man. Neither can I think it arose from one successful effort made by an individual, who might thereby justly claim the title of benefactor to his race; but, on the contrary, that a vast number of half-unconscious attempts have been made throughout the course of ages, and that ultimately, by slow degrees, after many relapses, and continued selection, our several domestic breeds became firmly established.

I will briefly restate what appear to be the conditions under which wild animals may become domesticated:—1, they should be hardy; 2, they should have an inborn liking for man; 3, they should be comfort-loving; 4, they should be found useful to the savages; 5, they should breed freely; 6, they should be easy to tend.

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It would appear that every wild animal has had its chance of being domesticated, that those few which fulfilled the above conditions were domesticated long ago, but that the large remainder, who fail sometimes in only one small particular, are destined to perpetual wildness so long as their race continues. As civilisation extends they are doomed to be gradually destroyed off the face of the earth as useless consumers of cultivated produce. I infer that slight differences in natural dispositions of human races may in one case lead irresistibly to some particular career, and in another case may make that career an impossibility.

The Observed Order of Events.

There is nothing as yet observed in the order of events to make us doubt that the universe is bound together in space and time, as a single entity, and there is a concurrence of many observed facts to induce us to accept that view. We may, therefore, not unreasonably profess faith in a common and mysterious whole, and of the laborious advance, under many restrictions, of that infinitely small part of it which falls under our observation, but which is in itself enormously large, and behind which lies the awful mystery of the origin of all existence.

The conditions that direct the order of the whole of the living world around us, are marked by their persistence in improving the birthright of successive generations. They determine, at much cost of individual comfort, that each plant and animal shall, on the general average, be endowed at its birth with more suitable natural faculties than those of its representative in the preceding generation. They ensure, in short, that the inborn qualities of the terrestrial tenantry shall become steadily better adapted to their homes and to their mutual needs. This effect, be it understood, is not only favourable to the animals who live long enough to become parents, but is also favourable to those who perish in earlier life, because even they are on the whole better off during their brief career than if they had been born still less adapted to the conditions of their existence. If we summon before our imagination in a single mighty host, the whole number of living things from the earliest date at which

terrestrial life can be deemed to have probably existed, to the latest future at which we may think it can probably continue, and if we cease to dwell on the miscarriages of individual lives or of single generations, we shall plainly perceive that the actual tenantry of the world progresses in a direction that may in some sense be described as the greatest happiness of the greatest number.

We also remark that while the motives by which individuals in the lowest stages are influenced are purely self regarding, they broaden as evolution goes on. The word "self" ceases to be wholly personal, and begins to include subjects of affection and interest, and these become increasingly numerous as intelligence and depth of character develop, and as civilisation extends. The sacrifice of the personal desire for repose to the performance of domestic and social duties is an everyday event with us, and other sacrifices of the smaller to the larger self are by no means uncommon. Life in general may be looked upon as a republic where the individuals are for the most part unconscious that while they are working for themselves they are also working for the public good.

We may freely confess ignorance of the outcome in the far future of that personal life to which we each cling passionately in the joyous morning of the affections, but which, as these and other interests fail, does not seem so eminently desirable in itself. We know that organic life can hardly be expected to flourish on this earth of ours for so long a time as it has already existed, because the sun will in all probability have lost too much of its heat and light by then, and will have begun to grow dark and therefore cold, as other stars have done. The conditions of existence here, which are now apparently in their prime, will have become rigorous and increasingly so, and there will be retrogression towards lower types, until the simplest form of life shall have wholly disappeared from the ice-bound surface. The whole living world will then have waxed and waned like an individual life.

Neither can we discover whether organisms here are capable of attaining the average development of organisms in other of the planets that are probably circling round most

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of the myriads of stars, whose physical constitution, wherever it has as yet been observed spectroscopically, does not differ much from that of our sun. But we perceive around us a countless number of abortive seeds and germs; we find out of any group of a thousand men selected at random, some who are crippled, insane, idiotic, and otherwise born incurably imperfect in body or mind, and it is possible that this world may rank among other worlds as one of these.

We as yet understand nothing of the way in which our conscious selves are related to the separate lives of the billions of cells of which the body of each of us is composed. We only know that the cells form a vast nation, some members of which are always dying and others growing to supply their places, and that the continual sequence of these multitudes of little lives has its outcome in the larger and conscious life of the man as a whole. Our part in the universe may possibly in some distant way be analogous to that of the cells in an organised body, and our personalities may be the transient but essential elements of an immortal and cosmic mind.

Our views of the object of life have to be framed so as not to be inconsistent with the observed facts from which these various possibilities are inferred; it is safer that they should not exclude the possibilities themselves. We must look on the slow progress of the order of evolution, and the system of routine by which it has thus far advanced, as due to antecedents and to inherent conditions of which we have not as yet the slightest conception. It is difficult to withstand a suspicion that the three dimensions of space and the fourth dimension of time may be four independent variables of a system that is neither space nor time, but something else wholly unconceived by us. Our present enigma as to how a First Cause could itself have been brought into existence—how the tortoise of the fable, that bears the elephant that bears the world, is itself supported, —may be wholly due to our necessary mistranslation of the four or more variables of the universe, limited by inherent conditions, into the three unlimited variables of Space and the one of Time.

Our ignorance of the goal and purport of human life, and the mistrust we are apt to feel of the guidance of the

spiritual sense, on account of its proved readiness to accept illusions as realities, warn us against deductive theories of conduct. Putting these, then, at least for the moment, to one side, we find ourselves face to face with two great and indisputable facts that everywhere force themselves on the attention and compel consideration. The one is that the whole of the living world moves steadily and continuously towards the evolution of races that are progressively more and more adapted to their complicated mutual needs and to their external circumstances. The other is that the process of evolution has been hitherto apparently carried out with, what we should reckon in our ways of carrying out projects, great waste of opportunity and of life, and with little if any consideration for individual mischance. Measured by our criterion of intelligence and mercy, which consists in the achievement of result without waste of time or opportunity, without unnecessary pain, and with equitable allowance for pure mistake, the process of evolution on this earth, so far as we can judge, has been carried out neither with intelligence nor ruth, but entirely through the routine of various sequences, commonly called "laws," established or necessitated we know not how.

An incalculable amount of lower life has been certainly passed through before that human organisation was attained, of which we and our generation are for the time the holders and transmitters. This is no mean heritage, and I think it should be considered as a sacred trust, for, together with man, intelligence of a sufficiently high order to produce great results appears, so far as we can infer from the varied records of the prehistoric past, to have first dawned upon the tenantry of the earth. Man has already shown his large power in the modifications he has made on the surface of the globe, and in the distribution of plants and animals. He has cleared such vast regions of forest that his work that way in North America alone, during the past half century, would be visable to an observer as far off as the moon. He has dug and drained; he has exterminated plants and animals that were mischievous to him; he has domesticated those that serve his purpose, and transplanted them to great distances from their native places. Now that this new animal, man, finds himself somehow in existence, endowed

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with a little power and intelligence, he ought, I submit, to awake to a fuller knowledge of his relatively great position, and begin to assume a deliberate part in furthering the great work of evolution. He may infer the course it is bound to pursue, from his observation of that which it has already followed, and he might devote his modicum of power, intelligence, and kindly feeling to render its future progress less slow and painful. Man has already furthered evolution very considerably, half unconsciously, and for his own personal advantages, but he has not yet risen to the conviction that it is his religious duty to do so deliberately and systematically.

Selection and Race.

The fact of an individual being naturally gifted with high qualities, may be due either to his being an exceptionally good specimen of a poor race, or an average specimen of a high one. The difference of origin would betray itself in his descendants; they would revert towards the typical centre of their race, deteriorating in the first case but not in the second. The two cases, though theoretically distinct, are confused in reality, owing to the frequency with which exceptional personal qualities connote the departure of the entire nature of the individual from his ancestral type, and the formation of a new strain having its own typical centre. It is hardly necessary to add that it is in this indirect way that natural selection improves a race. The two events of selection and difference of race ought, however, to be carefully distinguished in broad practical considerations, while the frequency of their concurrence is borne in mind and allowed for.

So long as the race remains radically the same, the stringent selection of the best specimens to rear and breed from, can never lead to any permanent result. The attempt to raise the standard of such a race is like the labour of Sisyphus in rolling his stone uphill; let the effort be relaxed for a moment, and the stone will roll back. Whenever a new typical centre appears, it is as though there was a facet upon the lower surface of the stone, on which it is capable of resting without rolling back. It affords a temporary sticking-point in the forward progress of evolution.

The causes that check the unlimited improvement of highly-bred animals, so long as the race remains unchanged, are many and absolute.

In the first place there is an increasing delicacy of constitution; the growing fineness of limb and structure end, after a few generations, in fragility. Overbred animals have little stamina; they resemble in this respect the "weedy" colts so often reared from first-class racers. One can perhaps see in a general way why this should be so. Each individual is the outcome of a vast number of organic elements of the most various species, just as some nation might be the outcome of a vast number of castes of individuals, each caste monopolising a special pursuit. Banish a number of the humbler castes—the bakers, the bricklayers, and the smiths, and the nation would soon come to grief. This is what is done in high breeding; certain qualities are bred for, and the rest are diminished as far as possible, but they cannot be dispensed with entirely.

The next difficulty lies in the diminished fertility of highly-bred animals. It is not improbable that its cause is of the same character as that of the delicacy of their constitution. Together with infertility is combined some degree of sexual indifference, or when passion is shown, it is not unfrequently for some specimen of a coarser type. This is certainly the case with horses and with dogs.

It will be easily understood that these difficulties, which are so formidable in the case of plants and animals, which we can mate as we please and destroy when we please, would make the maintenance of a highly-selected breed of men an impossibility.

Whenever a low race is preserved under conditions of life that exact a high level of efficiency, it must be subjected to rigorous selection. The few best specimens of that race can alone be allowed to become parents, and not many of their descendants can be allowed to live. On the other hand, if a higher race be substituted for the low one, all this terrible misery disappears. The most merciful form of what I ventured to call "eugenics" would consist in watching for the indications of superior strains or races, and in so favouring them that their progeny shall outnumber and gradually

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replace that of the old one. Such strains are of no infrequent occurrence. It is easy to specify families who are characterised by strong resemblances, and whose features and character are usually prepotent over those of their wives or husbands in their joint offspring, and who are at the same time as prolific as the average of their class. These strains can be conveniently studied in the families of exiles, which, for obvious reasons, are easy to trace in their various branches.

The debt that most countries owe to the race of men whom they received from one another as immigrants, whether leaving their native country of their own free will, or as exiles on political or religious grounds, has been often pointed out, and may, I think, be accounted for as follows:—The fact of a man leaving his compatriots, or so irritating them that they compel him to go, is fair evidence that either he or they, or both, feel that his character is alien to theirs. Exiles are also on the whole men of considerable force of character; a quiet man would endure and succumb, he would not have energy to transplant himself or to become so conspicuous as to be an object of general attack. We may justly infer from this, that exiles are on the whole men of exceptional and energetic natures, and it is especially from such men as these that new strains of race are likely to proceed.

Influence of Man upon Race.

The influence of man upon the nature of his own race has already been very large, but it has not been intelligently directed, and has in many instances done great harm. Its action has been by invasions and migration of races, by war and massacre, by wholesale deportation of population, by emigration, and by many social customs which have a silent but widespread effect.

There exists a sentiment, for the most part quite unreasonable, against the gradual extinction of an inferior race. It rests on some confusion between the race and the individual, as if the destruction of a race was equivalent to the destruction of a large number of men. It is nothing of the kind when the process of extinction works silently and slowly through

the earlier marriage of members of the superior race, through their greater vitality under equal stress, through their better chances of getting a livelihood, or through their prepotency in mixed marriages. That the members of an inferior class should dislike being elbowed out of the way is another matter; but it may be somewhat brutally argued that whenever two individuals struggle for a single place, one must yield, and that there will be no more unhappiness on the whole, if the inferior yield to the superior than conversely, whereas the world will be permanently enriched by the success of the superior. The conditions of happiness are, however, too complex to be disposed of by *à priori* argument; it is safest to appeal to observation. I think it could be easily shown that when the differences between the races is not so great as to divide them into obviously different classes, and where their language, education, and general interests are the same, the substitution may take place gradually without any unhappiness. Thus the movements of commerce have introduced fresh and vigorous blood into various parts of England: the new-comers have intermarried with the residents, and their characteristics have been prepotent in the descendants of the mixed marriages. I have referred in the earlier part of the book to the changes of type in the English nature that have occurred during the last few hundred years. These have been effected so silently that we only know of them by the results.

One of the most misleading of words is that of "aborigines." Its use dates from the time when the cosmogony was thought to be young and life to be of very recent appearance. Its usual meaning seems to be derived from the supposition that nations disseminated themselves like colonists from a common centre about four thousand years, say 120 generations ago, and thenceforward occupied their lands undisturbed until the very recent historic period with which the narrator deals, when some invading host drove out the "aborigines." This idyllic view of the march of events is contradicted by ancient sepulchral remains, by language, and by the habits of those modern barbarians whose history we know. There are probably hardly any spots on the earth that have not, within the last few thousand years, been tenanted by very

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different races; none hardly that have not been tenanted by very different tribes having the character of at least sub-races.

The absence of a criterion to distinguish between races and sub-races, and our ethnological ignorance generally, makes it impossible to offer more than a very off-hand estimate of the average variety of races in the different countries of the world. I have, however, endeavoured to form one, which I give with much hesitation, knowing how very little it is worth. I registered the usually recognised races inhabiting each of upwards of twenty countries, and who at the same time formed at least half per cent of the population. It was, I am perfectly aware, a very rough proceeding, so rough that for the United Kingdom I ignored the prehistoric types and accepted only the three headings of British, Low Dutch, and Norman-French. Again, as regards India I registered as follows:—Forest tribes (numerous), Dravidian (three principal divisions), Early Arian, Tartar (numerous, including Afghans), Arab, and lastly European, on account of their political importance, notwithstanding the fewness of their numbers. Proceeding in this off-hand way, and after considering the results, the broad conclusion to which I arrived was that on the average at least three different recognised races were to be found in every moderately-sized district on the earth's surface. The materials were far too scanty to enable any idea to be formed of the rate of change in the relative numbers of the constituent races in each country, and still less to estimate the secular changes of type in those races.

It may be well to take one or two examples of intermixture. Spain was occupied in the earliest historic times by at least two races, of whom we know very little; it was afterwards colonised here and there by Phœnicians in its southern ports, and by Greeks in its eastern. In the third century B.C. it was invaded by the Carthaginians, who conquered and held a large part of it, but were afterwards supplanted by the Romans, who ruled it more or less completely for 700 years. It was invaded in the fifth century A.D. by a succession of German tribes, and was finally completely overrun by the Visigoths, who ruled it

for more than 200 years. Then came the invasion of the Moors, who rapidly conquered the whole of the Peninsula up to the mountains of Asturias, where the Goths still held their own, and whence they issued from time to time and ultimately recovered the country. The present population consists of the remnants of one or more tribes of ancient Iberians, of the still more ancient Basques, and of relics of all the invaders who have just been named. There is, besides, a notable proportion of Gypsies and not a few Jews.

This is obviously a most heterogeneous mixture, but to fully appreciate the diversity of its origin the several elements should be traced farther back towards their sources. Thus, the Moors are principally descendants of Arabs, who flooded the northern provinces of Africa in successive waves of emigration eastwards, both before and after the Hegira, partly combining with the Berbers as they went, and partly displacing them from the littoral districts and driving them to the oases of the Sahara, whence they in their turn displaced the Negro population, whom they drove down to the Soudan. The Gypsies, according to Sir Henry Rawlinson,[1] came from the Indo-Scythic tribes who inhabited the mouths of the Indus, and began to migrate northward, from the fourth century onward. They settled in the Chaldean marshes, assumed independence and defied the caliph. In A.D. 831 the grandson of Haroun al-Raschid sent a large expedition against them, which, after slaughtering ten thousand, deported the whole of the remainder first to Baghdad and thence onwards to Persia. They continued unmanageable in their new home, and were finally transplanted to the Cilician frontier in Asia Minor, and established there as a military colony to guard the passes of the Taurus. In A.D. 962 the Greeks, having obtained some temporary successes, drove the Gypsies back more into the interior, whence they gradually moved towards the Hellespont under the pressure of the advancing Seljukians, during the twelfth and thirteenth centuries. They then crossed over to Europe

[1] *Proceedings of the Royal Geographical Society*, vol. i. This account of the routes of the Gypsies is by no means universally accepted, nor, indeed, was offered as a complete solution of the problem of their migration, but it will serve to show how complex that problem is.

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and gradually overspread it, where they are now estimated to number more than three millions.

It must not be supposed that emigration on a large scale implies even a moderate degree of civilisation among those who emigrate, because the process has been frequently traced among the more barbarous tribes, to say nothing of the evidence largely derived from ancient burial-places. My own impression of the races in South Africa was one of a continual state of ferment and change, of the rapid development of some clan here and of the complete or almost complete suppression of another clan there. The well-known history of the rise of the Zulus and the destruction of their neighbours is a case in point. In the country with which I myself was familiar the changes had been numerous and rapid in the preceding few years, and there were undoubted signs of much more important substitutions of race in bygone times. The facts were briefly these: Damara Land was inhabited by pastoral tribes of the brown Bantu race who were in continual war with various alternations of fortune, and the several tribes had special characteristics that were readily appreciated by themselves. On the tops of the escarped hills lived a fugitive black people speaking a vile dialect of Hottentot, and families of yellow Bushmen were found in the lowlands wherever the country was unsuited for the pastoral Damaras. Lastly, the steadily encroaching Namaquas, a superior Hottentot race, lived on the edge of the district. They had very much more civilisation than the Bushmen, and more than the Damaras, and they contained a large infusion of Dutch blood.

The interpretation of all this was obviously that the land had been tenanted a long time ago by Negroes, that an invasion of Bushmen drove the Negroes to the hills, and that the supremacy of these lasted so long that the Negroes lost their own language and acquired that of the Bushmen. Then an invasion of a tribe of Bantu race supplanted the Bushmen, and the Bantus, after endless struggles among themselves, were being pushed aside at the time I visited them by the incoming Namaquas, who themselves are a mixed race. This is merely a sample of Africa; everywhere there are evidences of changing races.

The last 300 or 400 years, say the last ten generations of mankind, have witnessed changes of population on the largest scale, by the extension of races long resident in Europe to the temperate regions of Asia, Africa, America, and Australasia.

Siberia was barely known to the Russians of nine generations ago, but since that time it has been continuously overspread by their colonists, soldiers, political exiles, and transported criminals; already some two-thirds of its population are Sclaves.

In South Africa the settlement at the Cape of Good Hope is barely six generations old, yet during that time a curious and continuous series of changes has taken place, resulting in the substitution of an alien population for the Hottentots in the south and the Bantus in the north. One-third of it is white, consisting of Dutch, English, descendants of French Huguenot refugees, some Germans and Portuguese, and the remainder is a strange medley of Hottentot, Bantu, Malay, and Negro elements. In North Africa Egypt has become infiltrated with Greeks, Italians, Frenchmen, and Englishmen during the last two generations, and Algeria with Frenchmen.

In North America the change has been most striking, from a sparse Indian population of hunters into that of the present inhabitants of the United States and Canada; the former of these, with its total of fifty millions inhabitants, already contains more than forty-three millions of whites, chiefly of English origin; that is more of European blood than is to be found in any one of the five great European kingdoms of England, France, Italy, Germany, and Austria, and less than that of Russia alone. The remainder are chiefly black, the descendants of slaves imported from Africa. In the Dominion of Canada, with its much smaller population of four millions, there has been a less, but still a complete, swamping of the previous Indian element by incoming whites.

In South America, and thence upwards to Mexico inclusive, the population has been infiltrated in some parts and transformed in others, by Spanish blood and by that of the Negroes whom they introduced, so that not one half of its population can be reckoned as of pure Indian descent.

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The West Indian Islands have had their population absolutely swept away since the time of the Spanish Conquest, except in a few rare instances, and African Negroes have been substituted for them.

Australia and New Zealand tell much the same tale as Canada. A native population has been almost extinguished in the former and is swamped in the latter, under the pressure of an immigrant population of Europeans, which is now twelve times as numerous as the Maories. The time during which this great change has been effected is less than that covered by three generations.

To this brief sketch of changes of population in very recent periods, I might add the wave of Arab admixture that has extended from Egypt and the northern provinces of Africa into the Soudan, and that of the yellow races of China, who have already made their industrial and social influence felt in many distant regions, and who bid fair hereafter, when certain of their peculiar religious fancies shall have fallen into decay, to become one of the most effective of the colonising nations, and who may, as I trust, extrude hereafter the coarse and lazy Negro from at least the metaliferous regions of tropical Africa.

It is clear from what has been said, that men of former generations have exercised enormous influence over the human stock of the present day, and that the average humanity of the world now and in future years is and will be very different to what it would have been if the action of our forefathers had been different. The power in man of varying the future human stock vests a great responsibility in the hands of each fresh generation, which has not yet been recognised at its just importance, nor deliberately employed. It is foolish to fold the hands and to say that nothing can be done, inasmuch as social forces and self-interests are too strong to be resisted. They need not be resisted; they can be guided. It is one thing to check the course of a huge steam vessel by the shock of a sudden encounter when she is going at full speed in the wrong direction, and another to cause her to change her course slowly and gently by a slight turn of the helm.

Nay, a ship may be made to describe a half circle, and to end by following a course exactly opposite to the first, without attracting the notice of the passengers.

Population.

Over-population and its attendant miseries may not improbably become a more serious subject of consideration than it ever yet has been, owing to improved sanatation and consequent diminution of the mortality of children, and to the filling up of the spare places of the earth which are still void and able to receive the overflow of Europe. There are no doubt conflicting possibilities which I need not stop to discuss.

The check to over-population mainly advocated by Malthus is a prudential delay in the time of marriage; but the practice of such a doctrine would assuredly be limited, and if limited it would be most prejudicial to the race, as I have pointed out in *Hereditary Genius*, but may be permitted to do so again. The doctrine would only be followed by the prudent and self-denying; it would be neglected by the impulsive and self-seeking. Those whose race we especially want to have, would leave few descendants, while those whose race we especially want to be quit of, would crowd the vacant space with their progeny, and the strain of population would thenceforward be just as pressing as before. There would have been a little relief during one or two generations, but no permanent increase of the general happiness, while the race of the nation would have deteriorated. The practical application of the doctrine of deferred marriage would therefore lead indirectly to most mischievous results, that were overlooked owing to the neglect of considerations bearing on race. While criticising the main conclusion to which Malthus came, I must take the opportunity of paying my humble tribute of admiration to his great and original work, which seems to me like the rise of a morning star before a day of free social investigation. There is nothing whatever in his book that would be in the least offensive to this generation, but he wrote in advance of his time and consequently roused virulent attacks,

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notably from his fellow-clergymen, whose doctrinaire notions upon the paternal dispensation of the world were rudely shocked.

The misery check, as Malthus called all those influences that are not prudential, is an ugly phrase not fully justified. It no doubt includes death through inadequate food and shelter, through pestilence from overcrowding, through war, and the like; but it also includes many causes that do not deserve so hard a name. Population decays under conditions that cannot be charged to the presence or absence of misery, in the common sense of the word. These exist when native races disappear before the presence of the incoming white man, when after making the fullest allowances for imported disease, for brandy drinking, and other assignable causes, there is always a large residuum of effect not clearly accounted for. It is certainly not wholly due to misery, but rather to listlessness, due to discouragement, and acting adversely in many ways.

One notable result of dulness and apathy is to make a person unattractive to the opposite sex and to be unattracted by them. It is antagonistic to sexual affection, and the result is a diminution of offspring. There exists strong evidence that the decay of population in some parts of South America under the irksome tyranny of the Jesuits, which crushed what little vivacity the people possessed, was due to this very cause. One cannot fairly apply the term "misery" to apathy; I should rather say that strong affections restrained from marriage by prudential considerations more truly deserved that name.

Early and Late Marriages.

It is important to obtain a just idea of the relative effects of early and late marriages. I attempted this in *Hereditary Genius*, but I think the following is a better estimate. We are unhappily still deficient in collected data as regards the fertility of the upper and middle classes at different ages; but the facts collected by Dr. Matthews Duncan as regards the lower orders will serve our purpose approximately, by furnishing the required *ratios*, though not the absolute

values. The following are his results,[1] from returns kept at the Lying-in Hospital of St. Georges-in-the-East:—

Age of Mother at her Marriage.	Average Fertility.
15–19	9·12
20–24	7·92
25–29	6·30
30–34	4·60

The meaning of this Table will be more clearly grasped after a little modification of its contents. We may consider the fertility of each group to refer to the medium age of that group, as by writing 17 instead of 15–19, and we may slightly smooth the figures, then we have—

Age of Mother at her Marriage.	Approximate average Fertility.
17	9·00 = 6 × 1·5
22	7·50 = 5 × 1·5
27	6·00 = 4 × 1·5
32	4·50 = 3 × 1·5

which shows that the relative fertility of mothers married at the ages of 17, 22, 27, and 32 respectively is as 6, 5, 4, and 3 approximately.

The increase in population by a habit of early marriages is further augmented by the greater rapidity with which the generations follow each other. By the joint effect of these two causes, a large effect is in time produced.

Let us compute a single example. Taking a group of 100 mothers married at the age of 20, whom we will designate as A, and another group of 100 mothers married at the age of 29, whom we will call B, we shall find by interpolation that the fertility of A and B respectively would be about 8·2 and 5·4. We need not, however, regard their absolute fertility, which would differ in different classes of society, but will only consider their relative production of such female children as may live and become mothers, and we will suppose the number of such descendants in the first generation to be the same as that of the A and B mothers together

[1] *Fecundity, Fertility, Sterility*, etc., by Dr. Matthews Duncan A. & C. Black: Edinburgh, 1871, p. 143.

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—namely, 200. Then the number of such children in the A and B classes respectively, being in the proportion of 8·2 to 5·4, will be 115 and 85.

We have next to determine the average lengths of the A and B generations, which may be roughly done by basing it on the usual estimate of an average generation, irrespectively of sex, at a third of a century, or say of an average female generation at 31·5 years. We will further take 20 years as being 4·5 years earlier than the average time of marriage, and 29 years as 4·5 years later than it, so that the length of each generation of the A group will be 27 years, and that of the B group will be 36 years. All these suppositions appear to be perfectly fair and reasonable, while it may easily be shown that any other suppositions within the bounds of probability would lead to results of the same general order.

The least common multiple of 27 and 36 is 108, at the end of which term of years A will have been multiplied four times over by the factor 1·5, and B three times over by the factor 0·85. The results are given in the following Table :—

After Number of Years as below.	Number of Female Descendants who themselves become Mothers.	
	A Of 100 Mothers whose Marriages and those of their Daughters all take place at the Age of 20 Years. (Ratio of Increase in each successive Generation being 1·15.)	B Of 100 Mothers whose Marriages and those of their Daughters all take place at the Age of 29 Years. (Ratio of Decrease in each successive Generation being 0·85.
108	175	61
216	299	38
324	535	23

The general result is that the group B gradually disappears, and the group A more than supplants it. Hence if the races best fitted to occupy the land are encouraged to marry early, they will breed down the others in a very few generations.

Marks for Family Merit.

It may seem very reasonable to ask how the result proposed in the last paragraph is to be attained, and to add that the difficulty of carrying so laudable a proposal into effect lies wholly in the details, and therefore that until some working plan is suggested, the consideration of improving the human race is Utopian. But this requirement is not altogether fair, because if a persuasion of the importance of any end takes possession of men's minds, sooner or later means are found by which that end is carried into effect. Some of the objections offered at first will be discovered to be sentimental, and of no real importance—the sentiment will change and they will disappear; others that are genuine are not met, but are in some way turned or eluded; and lastly, through the ingenuity of many minds directed for a long time towards the achievement of a common purpose, many happy ideas are sure to be hit upon that would not have occurred to a single individual.

This being premised, it will suffice to faintly sketch out some sort of basis for eugenics, it being now an understanding that we are provisionally agreed, for the sake of argument, that the improvement of race is an object of first-class importance, and that the popular feeling has been educated to regard it in that light.

The final object would be to devise means for favouring individuals who bore the signs of membership of a superior race, the proximate aim would be to ascertain what those signs were, and these we will consider first.

The indications of superior breed are partly personal, partly ancestral. We need not trouble ourselves about the personal part, because full weight is already given to it in the competitive careers; energy, brain, morale, and health being recognised factors of success, while there can hardly be a better evidence of a person being adapted to his circumstances than that afforded by success. It is the ancestral part that is neglected, and which we have yet to recognise at its just value. A question that now continually arises is this: a youth is a candidate for permanent employment,

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his present personal qualifications are known, but how will he turn out in later years? The objections to competitive examinations are notorious, in that they give undue prominence to youths whose receptive faculties are quick, and whose intellects are precocious. They give no indication of the directions in which the health, character, and intellect of the youth will change through the development, in their due course, of ancestral tendencies that are latent in youth, but will manifest themselves in after life. Examinations deal with the present, not with the future, although it is in the future of the youth that we are especially interested. Much of the needed guidance may be derived from his family history. I cannot doubt, if two youths were of equal personal merit, of whom one belonged to a thriving and long-lived family, and the other to a decaying and short-lived family, that there could be any hesitation in saying that the chances were greater of the first-mentioned youth becoming the more valuable public servant of the two.

A thriving family may be sufficiently defined or inferred by the successive occupations of its several male members in the previous generation, and of the two grandfathers. These are patent facts attainable by almost every youth, which admit of being verified in his neighbourhood and attested in a satisfactory manner.

A healthy and long-lived family may be defined by the patent facts of ages at death, and number and ages of living relatives, within the degrees mentioned above, all of which can be verified and attested. A knowledge of the existence of longevity in the family would testify to the stamina of the candidate, and be an important addition to the knowledge of his present health in forecasting the probability of his performing a large measure of experienced work.

Owing to absence of data and the want of inquiry of the family antecedents of those who fail and of those who succeed in life, we are much more ignorant than we ought to be of their relative importance. In connection with this, I may mention some curious results published by Mr. F. M. Holland[1] of Boston, U.S., as to the antecedent family history of persons who were reputed to be more moral than the average, and of those who were the reverse. He has

[1] *Index Newspaper*, Boston, U.S. July 27, 1882.

been good enough to reply to questions that I sent to him concerning his criterion of morality, and other points connected with the statistics, in a way that seems satisfactory, and he has very obligingly furnished me with additional MS. materials. One of his conclusions was that morality is more often found among members of large families than among those of small ones. It is reasonable to expect this would be the case owing to the internal discipline among members of large families, and to the wholesome sustaining and restraining effects of family pride and family criticism. Members of small families are apt to be selfish, and when the smallness of the family is due to the deaths of many of its members at early ages, it is some evidence either of weakness of the family constitution, or of deficiency of common sense or of affection on the part of the parents in not taking better care of them. Mr. Holland quotes in his letter to me a piece of advice by Franklin to a young man in search of a wife, "to take one out of a bunch of sisters," and a popular saying that kittens brought up with others make the best pets, because they have learned to play without scratching. Sir William Gull[1] has remarked that those candidates for the Indian Civil Service who are members of large families are on the whole the strongest.

Far be it from me to say that any scheme of marks for family merit would not require a great deal of preparatory consideration. Careful statistical inquiries have yet to be made into the family antecedents of public servants of mature age in connection with their place in examination lists at the earlier age when they first gained their appointments. This would be necessary in order to learn the amount of marks that should be assigned to various degrees of family merit. I foresee no peculiar difficulty in conducting such an inquiry; indeed, now that competitive examinations have been in general use for many years, the time seems ripe for it, but of course its conduct would require much confidential inquiry and a great deal of trouble in verifying returns. Still, it admits of being done, and if the results, derived from different sources, should confirm one another, they could be depended on.

[1] *Blue Book C*—1446, 1876. On the Selection and Training of Candidates for the Indian Civil Service.

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Let us now suppose that a way was seen for carrying some such idea as this into practice, and that family merit, however defined, was allowed to count, for however little, in competitive examinations. The effect would be very great: it would show that ancestral qualities are of present current value; it would give an impetus to collecting family histories; it would open the eyes of every family and of society at large to the importance of marriage alliance with a good stock; it would introduce the subject of race into a permanent topic of consideration, which (on the supposition of its *bonâ fide* importance that has been assumed for the sake of argument) experience would show to be amply justified. Any act that first gives a guinea stamp to the sterling guinea's worth of natural nobility might set a great social avalanche in motion.

Endowments.

Endowments and bequests have been freely and largely made for various social purposes, and as a matter of history they have frequently been made to portion girls in marriage. It so happens that the very day that I am writing this, I notice an account in the foreign newspapers (September 19, 1882) of an Italian who has bequeathed a sum to the corporation of London to found small portions for three poor girls to be selected by lot. And again, a few weeks ago I read also in the French papers of a trial, in reference to the money adjudged to the "Rosière" of a certain village. Many cases in which individuals and states have portioned girls may be found in Malthus. It is therefore far from improbable that if the merits of good race became widely recognised and its indications were rendered more surely intelligible than they now are, that local endowments, and perhaps adoptions, might be made in favour of those of both sexes who showed evidences of high race and of belonging to prolific and thriving families. One cannot forecast their form, though we may reckon with some assurance that in one way or another they would be made, and that the better races would be given a better chance of marrying early.

A curious relic of the custom which was universal three or

four centuries ago, of entrusting education to celibate priests, forbade Fellows of Colleges to marry, under the penalty of losing their fellowships. It is as though the winning horses at races were rendered ineligible to become sires, which I need hardly say is the exact reverse of the practice. Races were established and endowed by "Queen's plates" and otherwise at vast expense, for the purpose of discovering the swiftest horses, who are thenceforward exempted from labour and reserved for the sole purpose of propagating their species. The horses who do not win races, or who are not otherwise specially selected for their natural gifts, are prevented from becoming sires. Similarly, the mares who win races as fillies, are not allowed to waste their strength in being ridden or driven, but are tended under sanatory conditions for the sole purpose of bearing offspring. It is better economy, in the long-run, to use the best mares as breeders than as workers, the loss through their withdrawal from active service being more than recouped in the next generation through what is gained by their progeny.

The college statutes to which I referred were very recently relaxed at Oxford, and have been just reformed at Cambridge. I am told that numerous marriages have ensued in consequence, or are ensuing. In *Hereditary Genius* I showed that scholastic success runs strongly in families; therefore, in all seriousness, I have no doubt, that the number of Englishmen naturally endowed with high scholastic faculties, will be sensibly increased in future generations by the repeal of these ancient statutes.

The English race has yet to be explored and their now unknown wealth of hereditary gifts recorded, that those who possess such a patrimony should know of it. The natural impulses of mankind would then be sufficient to ensure that such wealth should no more continue to be neglected than the existence of any other possession suddenly made known to a man. Aristocracies seldom make alliances out of their order, except to gain wealth. Is it less to be expected that those who become aware that they are endowed with the power of transmitting valuable hereditary gifts should abstain from squandering their future children's patrimony by

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marrying persons of lower natural stamp? The social consideration that would attach itself to high races would, it may be hoped, partly neutralise a social cause that is now very adverse to the early marriages of the most gifted, namely, the cost of living in cultured and refined society. A young man with a career before him commonly feels it would be an act of folly to hamper himself by too early a marriage. The doors of society that are freely open to a bachelor are closed to a married couple with small means, unless they bear patent recommendations such as the public recognition of a natural nobility would give. The attitude of mind that I should expect to predominate among those who had undeniable claims to rank as members of an exceptionally gifted race, would be akin to that of the modern possessors of ancestral property or hereditary rank. Such persons feel it a point of honour not to alienate the old place or make misalliances, and they are respected for their honest family pride. So a man of good race would shrink from spoiling it by a lower marriage, and every one would sympathise with his sentiments.

Conclusion.

It remains to sketch in outline the principal conclusions to which we seem to be driven by the results of the various inquiries contained in this volume, and by what we know on allied topics from the works of others.

We cannot but recognise the vast variety of natural faculty, useful and harmful, in members of the same race, and much more in the human family at large, all of which tend to be transmitted by inheritance. Neither can we fail to observe that the faculties of men generally, are unequal to the requirements of a high and growing civilisation. This is principally owing to their entire ancestry having lived up to recent times under very uncivilised conditions, and to the somewhat capricious distribution in late times of inherited wealth, which affords various degrees of immunity from the usual selective agencies.

In solution of the question whether a continual improvement in education might not compensate for a stationary or

even retrograde condition of natural gifts, I made inquiry into the life history of twins, which resulted in proving the vastly preponderating effects of nature over nurture.

The fact that the very foundation and outcome of the human mind is dependent on race, and that the qualities of races vary, and therefore that humanity taken as a whole is not fixed but variable, compels us to reconsider what may be the true place and function of man in the order of the world. I have examined this question freely from many points of view, because whatever may be the vehemence with which particular opinions are insisted upon, its solution is unquestionably doubtful. There is a wide and growing conviction among truth-seeking, earnest, humble-minded, and thoughtful men, both in this country and abroad, that our cosmic relations are by no means so clear and simple as they are popularly supposed to be, while the worthy and intelligent teachers of various creeds, who have strong persuasions on the character of those relations, do not concur in their several views.

The results of the inquiries I have made into certain alleged forms of our relations with the unseen world do not, so far as they go, confirm the common doctrines. One, for example, on the objective efficacy of prayer[1] was decidedly negative. It showed that while contradicting the commonly expressed doctrine, it concurred with the almost universal practical opinion of the present day. Another inquiry into visions showed that, however ill explained they may still be, they belong for the most part, if not altogether, to an order of phenomena which no one dreams in other cases of calling supernatural. Many investigations concur in showing the vast multiplicity of mental operations that are in simultaneous action, of which only a minute part falls within the ken of consciousness, and suggest that much of what passes for supernatural is due to one portion of our mind being contemplated by another portion of it, as if it had been that of another person. The term "individuality" is in fact a most misleading word.

I do not for a moment wish to imply that the few inquiries published in this volume exhaust the list of those that might be made, for I distinctly hold the contrary, but

[1] Not reprinted in this edition.

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I refer to them in corroboration of the previous assertion that our relations with the unseen world are different to those we are commonly taught to believe.

In our doubt as to the character of our mysterious relations with the unseen ocean of actual and potential life by which we are surrounded, the generally accepted fact of the solidarity of the universe—that is, of the intimate connections between distant parts that bind it together as a whole—justifies us, I think, in looking upon ourselves as members of a vast system which in one of its aspects resembles a cosmic republic.

On the one hand, we know that evolution has proceeded during an enormous time on this earth, under, so far as we can gather, a system of rigorous causation, with no economy of time or of instruments, and with no show of special ruth for those who may in pure ignorance have violated the conditions of life.

On the other hand, while recognising the awful mystery of conscious existence and the inscrutable background of evolution, we find that as the foremost outcome of many and long birth-throes, intelligent and kindly man finds himself in being. He knows how petty he is, but he also perceives that he stands here on this particular earth, at this particular time, as the heir of untold ages and in the van of circumstance. He ought therefore, I think, to be less diffident than he is usually instructed to be, and to rise to the conception that he has a considerable function to perform in the order of events, and that his exertions are needed. It seems to me that he should look upon himself more as a freeman, with power of shaping the course of future humanity, and that he should look upon himself less as the subject of a despotic government, in which case it would be his chief merit to depend wholly upon what had been regulated for him, and to render abject obedience.

The question then arises as to the way in which man can assist in the order of events. I reply, by furthering the course of evolution. He may use his intelligence to discover and expedite the changes that are necessary to adapt circumstance to race and race to circumstance, and his kindly sympathy will urge him to effect them mercifully.

When we begin to inquire, with some misgiving perhaps, as to the evidence that man has present power to influence the quality of future humanity, we soon discover that his past influence in that direction has been very large indeed. It has been exerted hitherto for other ends than that which is now contemplated, such as for conquest or emigration, also through social conditions whose effects upon race were imperfectly foreseen. There can be no doubt that the hitherto unused means of his influence are also numerous and great. I have not cared to go much into detail concerning these, but restricted myself to a few broad considerations, as by showing how largely the balance of population becomes affected by the earlier marriages of some of its classes, and by pointing out the great influence that endowments have had in checking the marriage of monks and scholars, and therefore the yet larger influence they might be expected to have if they were directed not to thwart but to harmonise with natural inclination, by promoting early marriages in the classes to be favoured. I also showed that a powerful influence might flow from a public recognition in early life of the true value of the probability of future performance, as based on the past performance of the ancestors of the child. It is an element of forecast, in addition to that of present personal merit, which has yet to be appraised and recognised. Its recognition would attract assistance in various ways, impossible now to specify, to the young families of those who were most likely to stock the world with healthy, moral, intelligent, and fair-natured citizens. The stream of charity is not unlimited, and it is requisite for the speedier evolution of a more perfect humanity that it should be so distributed as to favour the best-adapted races. I have not spoken of the repression of the rest, believing that it would ensue indirectly as a matter of course; but I may add that few would deserve better of their country than those who determine to live celibate lives, through a reasonable conviction that their issue would probably be less fitted than the generality to play their part as citizens.

It would be easy to add to the number of possible agencies by which the evolution of a higher humanity might be furthered, but it is premature to do so until the

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importance of attending to the improvement of our race shall have been so well established in the popular mind that a discussion of them would be likely to receive serious consideration.

It is hardly necessary to insist on the certainty that our present imperfect knowledge of the limitations and conditions of hereditary transmission will be steadily added to; but I would call attention again to the serious want of adequate materials for study in the form of life-histories. It is fortunately the case that many of the rising medical practitioners of the foremost rank are become strongly impressed with the necessity of possessing them, not only for the better knowledge of the theory of disease, but for the personal advantage of their patients, whom they now have to treat less appropriately than they otherwise would, through ignorance of their hereditary tendencies and of their illnesses in past years, the medical details of which are rarely remembered by the patient, even if he ever knew them. With the help of so powerful a personal motive for keeping life-histories, and of so influential a body as the medical profession to advocate its being done,[1] and to show how to do it, there is considerable hope that the want of materials to which I have alluded will gradually be supplied.

To sum up in a few words. The chief result of these Inquiries has been to elicit the religious significance of the doctrine of evolution. It suggests an alteration in our mental attitude, and imposes a new moral duty. The new mental attitude is one of a greater sense of moral freedom, responsibility, and opportunity; the new duty which is supposed to be exercised concurrently with, and not in opposition to the old ones upon which the social fabric depends, is an endeavour to further evolution, especially that of the human race.

[1] See an address on the Collective Investigation of Disease, by Sir William Gull, *British Medical Journal*, January 27, 1883, p. 143; also the following address by Sir James Paget, p. 144.

APPENDIX

A.—COMPOSITE PORTRAITURE.

THE object and methods of Composite Portraiture will be best explained by the following extracts from memoirs describing its successive stages, published in 1878, 1879, and 1881 respectively:—

I. COMPOSITE PORTRAITS, MADE BY COMBINING THOSE OF MANY DIFFERENT PERSONS INTO A SINGLE RESULTANT FIGURE.

[*Extract from Memoir read before the Anthropological Institute, in* 1878.]

I submit to the Anthropological Institute my first results in carrying out a process that I suggested last August [1877] in my presidential address to the Anthropological Subsection of the British Association at Plymouth, in the following words:—

"Having obtained drawings or photographs of several persons alike in most respects, but differing in minor details, what sure method is there of extracting the typical characteristics from them? I may mention a plan which had occurred both to Mr. Herbert Spencer and myself, the principle of which is to superimpose optically the various drawings, and to accept the aggregate result. Mr. Spencer suggested to me in conversation that the drawings reduced to the same scale might be traced on separate pieces of transparent paper and secured one upon another, and then held between the eye and the light. I have attempted this with some success. My own idea was to throw faint images of the several portraits, in succession, upon the same sensitised photographic plate. I may add that it is perfectly easy to superimpose optically two portraits by means of a stereoscope, and that a person who is used to handle instruments will find a common double eyeglass fitted with stereoscopic lenses to be almost as effectual and far handier than the boxes sold in shops."

Mr. Spencer, as he informed me, had actually devised an instrument, many years ago, for tracing mechanically, longitudinal, transverse, and horizontal sections of heads on transparent paper, intending to superimpose them, and to obtain an average result by transmitted light.

Since my address was published, I have caused trials to be made, and have found, as a matter of fact, that the photographic

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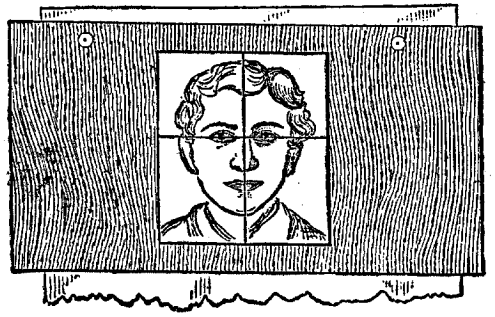
process of which I there spoke enables us to obtain with mechanical precision a generalised picture; one that represents no man in particular, but portrays an imaginary figure possessing the average features of any given group of men. These ideal faces have a surprising air of reality. Nobody who glanced at one of them for the first time would doubt its being the likeness of a living person, yet, as I have said, it is no such thing; it is the portrait of a type and not of an individual.

I begin by collecting photographs of the persons with whom I propose to deal. They must be similar in attitude and size, but no exactness is necessary in either of these respects. Then, by a simple contrivance, I make two pinholes in each of them, to enable me to hang them up one in front of the other, like a

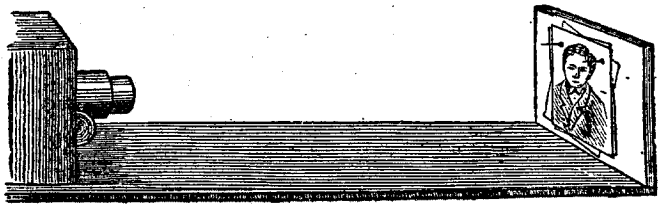


pack of cards, upon the same pair of pins, in such a way that the eyes of all the portraits shall be as nearly as possible superimposed; in which case the remainder of the features will also be superimposed nearly enough. These pinholes correspond to what are technically known to printers as "register marks." They are easily made: A slip of brass or card has an aperture cut out of its middle, and threads are stretched from opposite sides, making a cross.[1] Two small holes are drilled in the plate, one on either side of the aperture. The slip of brass is laid on the portrait with the aperture over its face. It is turned about until one of the cross threads cuts the pupils of both the eyes, and it is further adjusted until the other thread divides the interval between the pupils in two equal parts. Then it is held firmly, and a prick is made through each of the holes.

The portraits being thus arranged, a photographic camera is directed upon them. Suppose there are eight portraits in the pack, and that under existing circumstances it would require an

[1] I am indebted for the woodcuts to the Editor of *Nature*, in which journal this memoir first appeared.

exposure of eighty seconds to give an exact photographic copy of any one of them. The general principle of proceeding is this, subject in practice to some variations of detail, depending on the different brightness of the several portraits. We throw the image of each of the eight portraits in turn upon the same part of the sensitised plate for ten seconds. Thus, portrait No. 1 is in the front of the pack; we take the cap off the object glass of the camera for ten seconds, and afterwards replace it. We then remove No. 1 from the pins, and No. 2 appears in the front; we take off the cap a second time for ten seconds, and again replace it. Next we remove No. 2, and No. 3 appears in the front, which we treat as its predecessors, and so we go on to the last of the pack. The sensitised plate will now have had its total exposure of eighty seconds; it is then developed, and the print taken from it is the generalised picture of which I



speak. It is a composite of eight component portraits. Those of its outlines are sharpest and darkest that are common to the largest number of the components; the purely individual peculiarities leave little or no visible trace. The latter being necessarily disposed equally on both sides of the average, the outline of the composite is the average of all the components. It is a band and not a fine line, because the outlines of the components are seldom exactly superimposed. The band will be darkest in its middle whenever the component portraits have the same general type of features, and its breadth, or amount of blur, will measure the tendency of the components to deviate from the common type. This is so for the very same reason that the shot-marks on a target are more thickly disposed near the bull's-eye than away from it, and in a greater degree as the marksmen are more skilful. All that has been said of the outlines is equally true as regards the shadows; the result being that the composite represents an averaged figure, whose lineaments have been softly drawn. The eyes come out with appropriate distinctness, owing to the mechanical conditions under which the components are hung.

A composite portrait represents the picture that would rise before the mind's eye of a man who had the gift of pictorial

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imagination in an exalted degree. But the imaginative power even of the highest artists is far from precise, and is so apt to be biassed by special cases that may have struck their fancies, that no two artists agree in any of their typical forms. The merit of the photographic composite is its mechanical precision, being subject to no errors beyond those incidental to all photographic productions.

I submit several composites made for me by Mr. H. Reynolds. The first set of portraits are those of criminals convicted of murder, manslaughter, or robbery accompanied with violence. It will be observed that the features of the composites are much better looking than those of the components. The special villainous irregularities in the latter have disappeared, and the common humanity that underlies them has prevailed. They represent, not the criminal, but the man who is liable to fall into crime. All composites are better looking than their components, because the averaged portrait of many persons is free from the irregularities that variously blemish the looks of each of them.

I selected these for my first trials because I happened to possess a large collection of photographs of criminals, through the kindness of Sir Edmund Du Cane, the Director-General of Prisons, for the purpose of investigating criminal types. They were peculiarly adapted to my present purpose, being all made of about the same size, and taken in much the same attitudes. It was while endeavouring to elicit the principal criminal types by methods of optical superimposition of the portraits, such as I had frequently employed with maps and meteorological traces,[1] that the idea of composite figures first occurred to me.

The other set of composites are made from pairs of components. They are selected to show the extraordinary facility of combining almost any two faces whose proportions are in any way similar.

It will, I am sure, surprise most persons to see how well defined these composites are. When we deal with faces of the same type, the points of similarity far outnumber those of dissimilarity, and there is a much greater resemblance between faces generally than we who turn our attention to individual differences are apt to appreciate. A traveller on his first arrival among people of a race very different to his own thinks them closely alike, and a Hindu has much difficulty in distinguishing one Englishman from another.

The fairness with which photographic composites represent

Conference at the Loan Exhibition of Scientific Instruments, 1878. Chapman and Hall. Physical Geography Section, p. 312, *On Means of Combining Various Data in Maps and Diagrams*, by Francis Galton, F.R.S.

their components is shown by six of the specimens. I wished to learn whether the order in which the components were photographed made any material difference in the result, so I had three of the portraits arranged successively in each of their six possible combinations. It will be observed that four at least of the six composites are closely alike. I should say that in each of this set (which was made by the wet process) the last of the three components was always allowed a longer exposure

The accompanying woodcut is as fair a representation of one of the composites as is practicable in ordinary printing. It was photographically transferred to the wood, and the engraver has used his best endeavour to translate the shades into line engraving. This composite is made out of only three components, and its threefold origin is to be traced in the ears, and in the buttons to the vest. To the best of my judgment, the original photograph is a very exact average of its components; not one feature in it appears identical with that of any one of them, but it contains a resemblance to all, and is not more like to one of them than to another. However, the judgment of the wood engraver is different. His rendering of the composite has made it exactly like one of its components, which it must be borne in mind he had never seen. It is just as though an artist drawing a child had produced a portrait closely resembling its deceased father, having overlooked an equally strong likeness to its deceased mother, which was apparent to its relatives. This is to me a most striking proof that the composite is a true combination.

than the second, and the second than the first, but it is found better to allow an equal time to all of them.

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The stereoscope, as I stated last August in my address at Plymouth, affords a very easy method of optically superimposing two portraits, and I have much pleasure in quoting the following letter, pointing out this fact as well as some other conclusions to which I also had arrived. The letter was kindly forwarded to me by Mr. Darwin; it is dated last November, and was written to him by Mr. A. L. Austin, from New Zealand, thus affording another of the many curious instances of two persons being independently engaged in the same novel inquiry at nearly the same time, and coming to similar results :—

"INVERCARGILL, NEW ZEALAND,
"*November 6th*, 1877.

"To CHARLES DARWIN, Esq.

"SIR,—Although a perfect stranger to you, and living on the reverse side of the globe, I have taken the liberty of writing to you on a small discovery I have made in binocular vision in the stereoscope. I find by taking two ordinary carte-de-visite photos of two different persons' faces, the portraits being about the same sizes, and looking about the same direction, and placing them in a stereoscope, the faces blend into one in a most remarkable manner, producing in the case of some ladies' portraits, in every instance, a *decided improvement* in beauty. The pictures were not taken in a binocular camera, and therefore do not stand out well, but by moving one or both until the eyes coincide in the stereoscope the pictures blend perfectly. If taken in a binocular camera for the purpose, each person being taken on one half of the negative, I am sure the results would be still more striking. Perhaps something might be made of this in regard to the expression of emotions in man and the lower animals, &c. I have not time or opportunities to make experiments, but it seems to me something might be made of this by photographing the faces of different animals, different races of mankind, &c. I think a stereoscopic view of one of the ape tribe and some low-caste human face would make a very curious mixture; also in the matter of crossing of animals and the resulting offspring. It seems to me something also might result in photos of husband and wife and children, &c. In any case, the results are curious, if it leads to nothing else. Should this come to anything you will no doubt acknowledge myself as suggesting the experiment, and perhaps send me some of the results. If not likely to come to anything, a reply would much oblige me.

"Yours very truly,
"A. L. AUSTIN, C.E., F.R.A.S."

Dr. Carpenter informs me that the late Mr. Appold, the mechanician, used to combine two portraits of himself under the stereoscope. The one had been taken with an assumed stern expression, the other with a smile, and this combination produced a curious and effective blending of the two.

Convenient as the stereoscope is, owing to its accessibility, for determining whether any two portraits are suitable in size and attitude to form a good composite, it is nevertheless a makeshift

and imperfect way of attaining the required result. It cannot of itself combine two images; it can only place them so that the office of attempting to combine them may be undertaken by the brain. Now the two separate impressions received by the brain through the stereoscope do not seem to me to be relatively constant in their vividness, but sometimes the image seen by the left eye prevails over that seen by the right, and *vice versâ*. All the other instruments I am about to describe accomplish that which the stereoscope fails to do; they create true optical combinations. As regards other points in Mr. Austin's letter, I cannot think that the use of a binocular camera for taking the two portraits intended to be combined into one by the stereoscope would be of importance. All that is wanted is that the portraits should be nearly of the same size. In every other respect I cordially agree with Mr. Austin.

The best instrument I have as yet contrived and used for optical superimposition is a "double-image prism" of Iceland spar (see Fig., p. 228), formerly procured for me by the late Mr. Tisley, optician, Brompton Road. They have a clear aperture of a square, half an inch in the side, and when held at right angles to the line of sight will separate the ordinary and extraordinary images to the amount of two inches, when the object viewed is held at seventeen inches from the eye. This is quite sufficient for working with carte-de-visite portraits. One image is quite achromatic, the other shows a little colour. The divergence may be varied and adjusted by inclining the prism to the line of sight. By its means the ordinary image of one component is thrown upon the extraordinary image of the other, and the composite may be viewed by the naked eye, or through a lens of long focus, or through an opera-glass (a telescope is not so good) fitted with a sufficiently long draw-tube to see an object at that short distance with distinctness. Portraits of somewhat different sizes may be combined by placing the larger one farther from the eye, and a long face may be fitted to a short one by inclining and foreshortening the former. The slight fault of focus thereby occasioned produces little or no sensible ill effect on the appearance of the composite.

The front, or the profile, faces of two living persons sitting side by side or one behind the other, can be easily superimposed by a double-image prism. Two such prisms set one behind the other can be made to give four images of equal brightness, occupying the four corners of a rhombus whose acute angles are 45°. Three prisms will give eight images, but this is practically not a good combination; the images fail in distinctness, and are too near together for use. Again, each lens of a stereoscope of long focus can have one or a pair of these prisms attached to it, and four or eight images may be thus combined.

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Another instrument I have made consists of a piece of glass inclined at a very acute angle to the line of sight, and of a

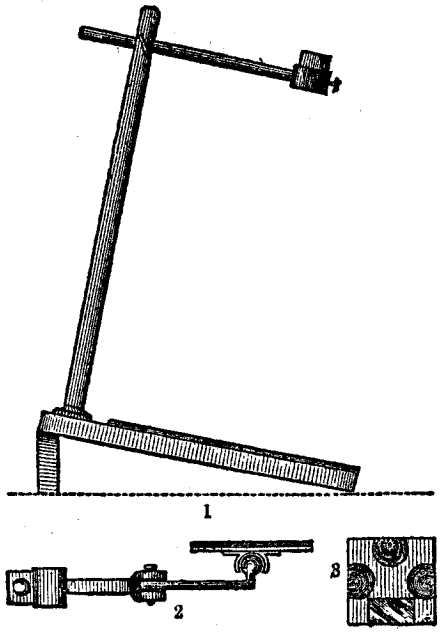

Fig. 1 shows the simple apparatus which carries the prism and on which the photograph is mounted. The former is set in a round box which can be rotated in the ring at the end of the arm and can be clamped when adjusted. The arm can be rotated and can also be pulled out or in if desired, and clamped. The floor of the instrument is overlaid with cork covered with black cloth, on which the components can easily be fixed by drawing-pins. When using it, one portrait is pinned down and the other is moved near to it, overlapping its margin if necessary, until the eye looking through the prism sees the required combination; then the second portrait is pinned down also. It may now receive its register-marks from needles fixed in a hinged arm, and this is a more generally applicable method than the plan with cross threads, already described, as any desired feature—the nose, the ear, or the hand, may thus be selected for composite purposes. Let A, B, C, . . . Y, Z, be the components. A is pinned down, and B, C, . . . Y, Z, are successfully combined with A, and registered. Then before removing Z, take away A and substitute any other of the already registered portraits, say B, by combining it with Z; lastly, remove Z and substitute A by combining it with B, and register it. Fig. 2 shows one of three similarly jointed arms, which clamp on to the vertical rod. Two of these carry a light frame covered with cork and cloth, and the other carries Fig. 3, which is a frame having lenses of different powers set into it, and on which, or on the third frame, a small mirror inclined at 45° may be laid. When a portrait requires foreshortening it can be pinned on one of these frames and be inclined to the line of sight; when it is smaller than its fellow it can be brought nearer to the eye and an appropriate lens interposed; when a right-sided profile has to be combined with a left-handed one, it must be pinned on one of the frames and viewed by reflection from the mirror in the other. The apparatus I have drawn is roughly made, and being chiefly of wood is rather clumsy, but it acts well.

mirror beyond it, also inclined, but in the opposite direction to the line of sight. Two rays of light will therefore reach the eye from each point of the glass; the one has been reflected from its surface, and the other has been first reflected from the mirror, and then transmitted through the glass. The glass used should be extremely thin, to avoid the blur due to double reflections; it may be a selected piece from those made to cover microscopic specimens. The principle of the instrument may be yet further developed by interposing additional pieces of glass, successively less inclined to the line of sight, and each reflecting a different portrait.

I have tried many other plans; indeed the possible methods of optically superimposing two or more images are very numerous. Thus I have used a sextant (with its telescope attached); also strips of mirrors placed at different angles, their several reflections being simultaneously viewed through a telescope. I have also used a divided lens, like two stereoscopic lenses brought close together, in front of the object glass of a telescope.

II. Generic Images.

[*Extract from Proceedings Royal Institution*, 25*th April* 1879.]

Our general impressions are founded upon blended memories, and these latter will be the chief topic of the present discourse. An analogy will be pointed out between these and the blended portraits first described by myself a year ago under the name of "Composite Portraits," and specimens of the latter will be exhibited.

The physiological basis of memory is simple enough in its broad outlines. Whenever any group of brain elements has been excited by a sense impression, it becomes, so to speak, tender, and liable to be easily thrown again into a similar state of excitement. If the new cause of excitement differs from the original one, a memory is the result. Whenever a single cause throws different groups of brain elements simultaneously into excitement, the result must be a blended memory.

We are familiar with the fact that faint memories are very apt to become confused. Thus some picture of mountain and lake in a country which we have never visited, often recalls a vague sense of identity with much we have seen elsewhere. Our recollections cannot be disentangled, though general resemblances are recognised. It is also a fact that the memories of persons who have great powers of visualising, that is, of seeing well-defined images in the mind's eye, are no less capable of being blended together. Artists are, as a class, possessed of the

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visualising power in a high degree, and they are at the same time pre-eminently distinguished by their gifts of generalisation. They are of all men the most capable of producing forms that are not copies of any individual, but represent the characteristic features of classes.

There is then, no doubt, from whatever side the subject of memory is approached, whether from the material or from the mental, and, in the latter case, whether we examine the experiences of those in whom the visualising faculty is faint or in whom it is strong, that the brain has the capacity of blending memories together. Neither can there be any doubt that general impressions are faint and perhaps faulty editions of blended memories. They are subject to errors of their own, and they inherit all those to which the memories are themselves liable.

Specimens of blended portraits will now be exhibited ; these might, with more propriety, be named, according to the happy phrase of Professor Huxley, "generic" portraits. The word generic presupposes a genus, that is to say, a collection of individuals who have much in common, and among whom medium characteristics are very much more frequent than extreme ones. The same idea is sometimes expressed by the word "typical," which was much used by Quetelet, who was the first to give it a rigorous interpretation, and whose idea of a type lies at the basis of his statistical views. No statistician dreams of combining objects into the same generic group that do not cluster towards a common centre ; no more should we attempt to compose generic portraits out of heterogeneous elements, for if we do so the result is monstrous and meaningless.

It might be expected that when many different portraits are fused into a single one, the result would be a mere smudge. Such, however, is by no means the case, under the conditions just laid down, of a great prevalence of the mediocre characteristics over the extreme ones. There are then so many traits in common, to combine and to reinforce one another, that they prevail to the exclusion of the rest. All that is common remains, all that is individual tends to disappear.

The first of the composites exhibited on this occasion is made by conveying the images of three separate portraits by means of three separate magic-lanterns upon the same screen. The stands on which the lanterns are mounted have been arranged to allow of nice adjustment. The composite about to be shown is one that strains the powers of the process somewhat too severely, the portraits combined being those of two brothers and their sister, who have not even been photographed in precisely the same attitudes. Nevertheless, the result is seen to be the production of a face, neither male nor female, but more regular and handsome than any of the component portraits, and in which

the common family traits are clearly marked. Ghosts of portions of male and female attire, due to the peculiarities of the separate portraits, are seen about and around the composite, but they are not sufficiently vivid to distract the attention. If the number of combined portraits had been large, these ghostly accessories would have become too faint to be visible.

The next step is to compare this portrait of two brothers and their sister which has been composed by optical means before the eyes of the audience, and concerning the truthfulness of which there can be no doubt, with a photographic composite of the same group. The latter is now placed in a fourth magic-lantern with a brighter light behind it, and its image is thrown on the screen by the side of the composite produced by direct optical superposition. It will be observed that the two processes lead to almost exactly the same result, and therefore the fairness of the photographic process may be taken for granted. However, two other comparisons will be made for the sake of verification, namely, between the optical and photographic composites of two children, and again between those of two Roman contadini.

The composite portraits that will next be exhibited are made by the photographic process, and it will now be understood that they are truly composite, notwithstanding their definition and apparent individuality. Attention is, however, first directed to a convenient instrument not more than 18 inches in length, which is, in fact, a photographic camera with six converging lenses and an attached screen, on which six pictures can be adjusted and brilliantly illuminated by artificial light. The effect of their optical combination can thus be easily studied ; any errors of adjustment can be rectified, and the composite may be photographed at once.

It must not be supposed that any one of the components fails to leave its due trace in the photographic composite, much less in the optical one. In order to allay misgivings on the subject, a small apparatus is laid on the table together with some of the results obtained by it. It is a cardboard frame, with a spring shutter closing an aperture of the size of a wafer, that springs open on the pressure of a finger, and shuts again as suddenly when the pressure is withdrawn. A chronograph is held in the other hand, whose index begins to travel the moment the finger presses a spring, and stops instantly on lifting the finger. The two instruments are worked simultaneously ; the chronograph checking the time allowed for each exposure and summing all the times. It appears from several trials that the effect of 1000 brief exposures is practically identical with that of a single exposure of 1000 times the duration of any one of them. Therefore each of a thousand components leaves its due photographic

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trace on the composite, though it is far too faint to be visible unless reinforced by many similar traces.

The composites now to be exhibited are made from coins or medals, and in most instances the aim has been to obtain the best likeness attainable of historical personages, by combining various portraits of them taken at different periods of their lives, and so to elicit the traits that are common to each series. A few of the individual portraits are placed in the same slide with each composite to give a better idea of the character of these blended representatives. Those that are shown are (1) Alexander the Great, from six components; (2) Antiochus, King of Syria, from six; (3) Demetrius Poliorcetes, from six; (4) Cleopatra, from five. Here the composite is as usual better looking than any of the components, none of which, however, give any indication of her reputed beauty; in fact, her features are not only plain, but to an ordinary English taste are simply hideous. (5) Nero, from eleven; (6) A combination of five different Greek female faces; and (7) A singularly beautiful combination of the faces of six different Roman ladies, forming a charming ideal profile.

My cordial acknowledgment is due to Mr. R. Stuart Poole, the learned curator of the coins and gems in the British Museum, for his kind selection of the most suitable medals, and for procuring casts of them for me for the present purpose. These casts were, with one exception, all photographed to a uniform size of four-tenths of an inch between the pupils of the eyes and the division between the lips, which experience shows to be the most convenient size on the whole to work with, regard being paid to many considerations not worth while to specify in detail. When it was necessary the photograph was reversed. These photographs were made by Mr. H. Reynolds; I then adjusted and prepared them for taking the photographic composite.

The next series to be exhibited consists of composites taken from the portraits of criminals convicted of murder, manslaughter, or crimes accompanied by violence. There is much interest in the fact that two types of features are found much more frequently among these than among the population at large. In one, the features are broad and massive, like those of Henry VIII., but with a much smaller brain. The other, of which five composites are exhibited, each deduced from a number of different individuals, varying four to nine, is a face that is weak and certainly not a common English face. Three of these composites, though taken from entirely different sets of individuals, are as alike as brothers, and it is found on optically combining any three out of the five composites, that is on combining almost any considerable number of the individuals, the result is closely the same. The combination of the three composites just alluded to will now be effected by means of the three converging magic-lanterns, and the result may be accepted as generic in respect of this particular type of criminals.

The process of composite portraiture is one of pictorial statistics. It is a familiar fact that the average height of even a dozen men of the same race, taken at hazard, varies so little, that for ordinary statistical purposes it may be considered constant. The same may be said of the measurement of every separate feature and limb, and of every tint, whether of skin, hair, or eyes. Consequently a pictorial combination of any one of these separate traits would lead to results no less constant than the statistical averages. In a portrait, there is another factor to be considered besides the measurement of the separate traits, namely, their relative position; but this, too, in a sufficiently large group, would necessarily have a statistical constancy. As a matter of observation, the resemblance between persons of the same "genus" (in the sense of "generic," as already explained) is sufficiently great to admit of making good pictorial composites out of even small groups, as has been abundantly shown.

Composite pictures, are, however, much more than averages; they are rather the equivalents of those large statistical tables whose totals, divided by the number of cases, and entered in the bottom line, are the averages. They are real generalisations, because they include the whole of the material under consideration. The blur of their outlines, which is never great in truly generic composites, except in unimportant details, measures the tendency of individuals to deviate from the central type. My argument is, that the generic images that arise before the mind's eye, and the general impressions which are faint and faulty editions of them, are the analogues of these composite pictures which we have the advantage of examining at leisure, and whose peculiarities and character we can investigate, and from which we may draw conclusions that shall throw much light on the nature of certain mental processes which are too mobile and evanescent to be directly dealt with.

III. Composite Portraiture.

[*Read before the Photographic Society, 24th June*, 1881.]

I propose to draw attention to-night to the results of recent experiments and considerable improvements in a process of which I published the principles three years ago, and which I have subsequently exhibited more than once.

I have shown that, if we have the portraits of two or more different persons, taken in the same aspect and under the same

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conditions of light and shade, and that if we put them into different optical lanterns converging on the same screen and carefully adjust them—first, so as to bring them to the same scale, and, secondly, so as to superpose them as accurately as the conditions admit—then the different faces will blend surprisingly well into a single countenance. If they are not very dissimilar, the blended result will always have a curious air of individuality, and will be unexpectedly well defined; it will exactly resemble none of its components, but it will have a sort of family likeness to all of them, and it will be an ideal and an averaged portrait. I have also shown that the image on the screen might be photographed then and there, or that the same result may be much more easily obtained by a method of successive photography, and I have exhibited many specimens made on this principle. Photo-lithographs of some of these will be found in the *Proceedings of the Royal Institution*, as illustrations of a lecture I gave there "On Generic Images" in 1879.

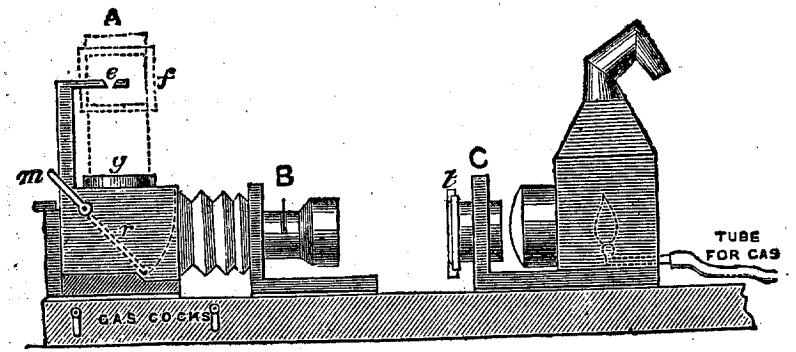
The method I now use is much better than those previously described; it leads to more accurate results, and is easier to manage. I will exhibit and explain the apparatus as it stands, and will indicate some improvements as I go on. The apparatus is here. I use it by gaslight, and employ rapid dry plates, which, however, under the conditions of a particularly small aperture and the character of the light, require sixty seconds of total exposure. The apparatus is 4 feet long and 6½ inches broad; it lies with its side along the edge of the table at which I sit, and it is sloped towards me, so that, by bending my neck slightly, I can bring my eye to an eye-hole, where I watch the effect of the adjustments which my hands are free to make. The entire management of the whole of these is within an easy arm's length, and I complete the process without shifting my seat.

The apparatus consists of three parts, A, B, and C. A is rigidly fixed; it contains the dark slide and the contrivances by which the position of the image can be viewed; the eye-hole, *e*, already mentioned, being part of A. B is a travelling carriage that holds the lens, and is connected by bellows-work with A. In my apparatus it is pushed out and in, and clamped where desired, but it ought to be moved altogether by pinion and rack-work.[1] The lens I use is a I B Dallmeyer. Its focal length is appropriate to the size of the instrument, and I find great convenience in a lens of wide aperture when making the adjustments, as I then require plenty of light; but, as to the photography, the smaller the aperture the better. The hole in my stop is only two-tenths of an inch in diameter, and I believe one-tenth would be more suitable.

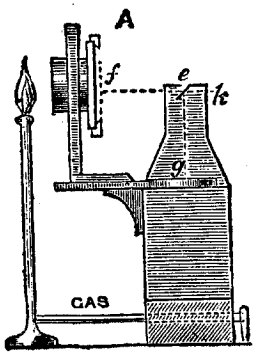
[1] I have since had a more substantial instrument made with these and similar improvements.

C is a travelling carriage that supports the portraits in turn, from which the composite has to be made. I work directly from the original negatives with transmitted light; but prints

DIAGRAM SHOWING THE ESSENTIAL PARTS.



Side View.



End View.

A the body of the camera, which is fixed.

B Lens on a carriage, which can be moved to and fro.

C Frame for the transparency, on a carriage that also supports the lantern; the whole can be moved to and fro.

r The reflector inside the camera.

m The arm outside the camera attached to the axis of the reflector; by moving it, the reflector can be moved up or down.

g A ground-glass screen on the roof, which receives the image when the reflector is turned down, as in the diagram.

e The eye-hole through which the image is viewed on *g*; a thin piece of glass immediately below *e*, reflects the illuminated fiducial lines in the transparency at *f*, and gives them the appearance of lying upon *g*,—the distances *f e* and *g e* being made equal, the angle *f e g* being made a right angle, and the plane of the thin piece of glass being made to bisect *f e g*.

f Framework, adjustable, holding the transparency with the fiducial lines on it.

t Framework, adjustable, holding the transparency of the portrait.

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can be used with light falling on their face. For convenience of description I will confine myself to the first instance only, and will therefore speak of C as the carriage that supports the frame that holds the negative transparencies. C can be pushed along the board and be clamped anywhere, and it has a rack and pinion adjustment; but it should have been made movable by rack and pinion along the whole length of the board. The frame for the transparencies has the same movements of adjustment as those in the stage of a microscope. It rotates round a hollow axis, through which a beam of light is thrown, and independent movements in the plane, at right angles to the axis, can be given to it in two directions, at right angles to one another, by turning two separate screws. The beam of light is furnished by three gas-burners, and it passes through a condenser. The gas is supplied through a flexible tube that does not interfere with the movements of C, and it is governed by a stop-cock in front of the operator.

The apparatus, so far as it has been described with any detail, and ignoring what was said about an eye-hole, is little else than a modified copying-camera, by which an image of the transparency could be thrown on the ordinary focusing-screen, and be altered in scale and position until it was adjusted to fiducial lines drawn on the screen. It is conceivable that this should be done, and that the screen should be replaced by the dark slide, and a brief exposure given to the plate; then, that a fresh transparency should be inserted, a fresh focusing adjustment made, and a second exposure given, and so on. This, I say, is conceivable, but it would be very inconvenient. The adjusting screws would be out of reach; the head of the operator would be in an awkward position; and though these two difficulties might be overcome in some degree, a serious risk of an occasional shift of the plate during the frequent replacement of the dark slide would remain. I avoid all this by making my adjustments while the plate continues in position with its front open. I do so through the help of a reflector temporarily interposed between it and the lens. I do not use the ordinary focusing-screen at all in making my adjustments, but one that is flush, or nearly so, with the roof of the camera. When the reflector is interposed, the image is wholly cut off from the sensitised plate, and is thrown upwards against this focusing-screen, *g*. When the reflector is withdrawn, the image falls on the plate. It is upon this focusing-screen in the roof that I see the fiducial lines by which I make all the adjustments. Nothing can be more convenient than the position of this focusing-screen for working purposes. I look down on the image as I do upon a book resting on a sloping desk, and all the parts of the apparatus are within an easy arm's length.

My reflector in my present instrument is, I am a little ashamed to confess, nothing better than a piece of looking-glass fixed to an axle within the camera, near its top left-hand edge. One end of the axle protrudes, and has a short arm; when I push the arm back, the mirror is raised; when I push it forward it drops down. I used a swing-glass because the swing action is very true, and as my apparatus was merely a provisional working model made of soft wood, I did not like to use sliding arrangements which might not have acted truly, or I should certainly have employed a slide with a rectangular glass prism, on account of the perfect reflection it affords. And let me say, that a prism of 2 inches square in the side is quite large enough for adjustment purposes, for it is only the face of the portrait that is wanted to be seen. I chose my looking-glass carefully, and selected a piece that was plane and parallel. It has not too high a polish, and therefore does not give troublesome double reflections. In fact, it answers very respectably, especially when we consider that perfection of definition is thrown away on composites. I thought of a mirror silvered on the front of the glass, but this would soon tarnish in the gas-light, so I did not try it. For safety against the admission of light unintentionally, I have a cap to the focusing-screen in the roof, and a slide in the fixed body of the instrument immediately behind the reflector and before the dark slide. Neither of these would be wanted if the reflector was replaced by a prism, set into one end of a sliding block that had a large horizontal hole at the other end, and a sufficient length of solid wood between the two to block out the passage of light both upwards and downwards whenever the block is passing through the half-way position.

As regards the fiducial lines, they might be drawn on the glass screen; but black lines are not, I find, the best. It is far easier to work with illuminated lines; and it is important to be able to control their brightness. I produce these lines by means of a vertical transparency, set in an adjustable frame, connected with A, and having a gas-light behind it. Below the eye-hole *e*, through which I view the glass-screen *g*, is a thin piece of glass set at an angle of 45°, which reflects the fiducial lines and gives them the appearance of lying on the screen, the frame being so adjusted that the distance from the thin piece of glass to the transparency and to the glass-screen *g* is the same. I thus obtain beautiful fiducial lines, which I can vary from extreme faintness to extreme brilliancy, by turning the gas lower or higher, according to the brightness of the image of the portrait, which itself depends on the density of the transparency that I am engaged upon. This arrangement seems as good as can be. It affords a gauge of the density of the negative, and

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enables me to regulate the burners behind it, until the image of the portrait on *g* is adjusted to a standard degree of brightness.

For convenience in enlarging or reducing, I take care that the intersection of the vertical fiducial line with that which passes through the pupils of the eyes shall correspond to the optical axis of the camera. Then, as I enlarge or reduce, that point in the image remains fixed. The uppermost horizontal fiducial line continues to intersect the pupils, and the vertical one continues to divide the face symmetrically. The mouth has alone to be watched. When the mouth is adjusted to the lower fiducial line, the scale is exact. It is a great help having to attend to no more than one varying element. The only inconvenience is that the image does not lie in the best position on the plate when the point between the eyes occupies its centre. This is easily remedied by using a larger back with a suitable inner frame. I have a more elaborate contrivance in my apparatus to produce the same result, which I need not stop to explain.

For success and speed in making composites, the apparatus should be solidly made, chiefly of metal, and all the adjustments ought to work smoothly and accurately. Good composites cannot be made without very careful adjustment in scale and position. An off-hand way of working produces nothing but failures.

I will first exhibit a very simple but instructive composite effect. I drew on a square card a circle of about 2½ inches in diameter, and two cross lines through its centre, cutting one another at right angles. Round each of the four points, 90° apart, where the cross cuts the circle, I drew small circles of the size of wafers and gummed upon each a disc of different tint. Finally I made a single black dot half-way between two of the arms of the cross. I then made a composite of the four positions of the card, as it was placed successively with each of its sides downwards. The result is a photograph having a sharply-defined cross surrounded by four discs of precisely uniform tint, and between each pair of arms of the cross there is a very faint dot. This photograph shows many things. The fact of its being a composite is shown by the four faint dots. The equality of the successive periods of exposure is shown by the equal tint of the four dots. The accuracy of adjustment is shown by the sharpness of the cross being as great in the composite as in the original card. We see the smallness of the effect produced by any trait, such as the dot, when it appears in the same place in only one of the components: if this effect be so small in a series of only four components, it would certainly be imperceptible in a much larger series. Thirdly, the uniformity of resulting tint in the composite wafer is quite irrespective of the

order of exposure. Let us call the four component wafers A, B, C, D, respectively, and the four composite wafers 1, 2, 3, 4; then we see, by the diagram, that the order of exposure has differed in each case.

Composite.		Successive places of the Components.							
1	2	A	B	D	A	C	D	B	C
4	3	D	C	C	B	B	A	A	D

In 1 it has been A, D, C, B,
„ 2 „ B, A, D, C,
„ 3 „ C, B, A, D,
„ 4 „ D, C, B, A,

yet the result is identical. Therefore the order of exposure has no effect on the result.

I will next show a series consisting of two portraits considerably unlike to one another, and yet not so very discordant as to refuse to conform, and of two intermediate composites. In making one of the composites I gave two-thirds of the total time of exposure to the first portrait, and one-third to the second portrait. In making the other composite, I did the converse. It will be seen how good is the result in both cases, and how the likeness of the longest exposed portrait always predominates.

The next is a series of four composites. The first consists of 57 hospital patients suffering under one or other of the many forms of consumption. I may say that, with the aid of Dr. Mahomed, I am endeavouring to utilise this process to elicit the physiognomy of disease. The composite I now show is what I call a hotch-pot composite; its use is to form a standard whence deviations towards any particular sub-type may be conveniently gauged. It will be observed that the face is strongly marked, and that it is quite idealised. I claim for composite portraiture, that it affords a method of obtaining *pictorial averages*, which effects simultaneously for every point in a picture what a method of numerical averages would do for each point in the picture separately. It gives, in short, the average tint of every unit of area in the picture, measured from the fiducial lines as co-ordinates. Now every statistician knows, by experience, that numerical averages usually begin to agree pretty fairly when we deal with even twenty or thirty cases. Therefore we should

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expect to find that any groups of twenty or thirty men of the same class would yield composites bearing a considerable likeness to one another. In proof that this is the case, I exhibit three other composites: the one is made from the first 28 portraits of the 57, the second from the last 27, and the third is made from 36 portraits taken indiscriminately out of the 57. It will be observed that all the four composites are closely alike.

I will now show a few typical portraits I selected out of 82 male portraits of a different series of consumptive male patients; they were those that had more or less of a particular wan look, that I wished to elicit. The selected cases were about 18 in number, and from these I took 12, rejecting about six as having some marked peculiarity that did not conform well with the remaining 12. The result is a very striking face, thoroughly ideal and artistic, and singularly beautiful. It is, indeed, most notable how beautiful all composites are. Individual peculiarities are all irregularities, and the composite is always regular.

I show a composite of 15 female faces, also of consumptive patients, that gives somewhat the same aspect of the disease; also two others of only 6 in each, that have in consequence less of an ideal look, but which are still typical. I have here several other typical faces in my collection of composites; they are all serviceable as illustrations of this memoir, but, medically speaking, they are only provisional results.

I am indebted to Lieutenant Leonard Darwin, R.E., for an interesting series of negatives of officers and privates of the Royal Engineers. Here is a composite of 12 officers; here is one of 30 privates. I then thought it better to select from the latter the men that came from the southern counties, and to again make a further selection of 11 from these, on the principle already explained. Here is the result. It is very interesting to note the stamp of culture and refinement on the composite officer, and the honest and vigorous but more homely features of the privates. The combination of these two, officers and privates together, gives a very effective physiognomy.

Let it be borne in mind that existing cartes-de-visite are almost certain to be useless. Among dozens of them it is hard to find three that fulfil the conditions of similarity of aspect and of shade. The negatives have to be made on purpose. I use a repeating back and a quarter plate, and get two good-sized heads on each plate, and of a scale that never gives less than four-tenths of an inch between the pupils of the eyes and the mouth. It is only the head that can be used, as more distant parts, even the ears, become blurred hopelessly.

It will be asked, of what use can all this be to ordinary photographers, even granting that it may be of scientific value in ethnological research, in inquiries into the physiognomy of

disease, and for other special purposes? I think it can be turned to most interesting account in the production of family likenesses. The most unartistic productions of amateur photography do quite as well for making composites as those of the best professional workers, because their blemishes vanish in the blended result. All that amateurs have to do is to take negatives of the various members of their families in precisely the same aspect (I recommend either perfect full-face or perfect profile), and under precisely the same conditions of light and shade, and to send them to a firm provided with proper instrumental appliances to make composites from them. The result is sure to be artistic in expression and flatteringly handsome, and would be very interesting to the members of the family. Young and old, and persons of both sexes can be combined into one ideal face. I can well imagine a fashion setting in to have these pictures.

Professional skill might be exercised very effectively in retouching composites. It would be easy to obliterate the ghosts of stray features that are always present when the composite is made from only a few portraits, and it would not be difficult to tone down any irregularity in the features themselves, due to some obtrusive peculiarity in one of the components. A higher order of artistic skill might be well bestowed upon the composites that have been made out of a large number of components. Here the irregularities disappear, the features are perfectly regular and idealised, but the result is dim. It is like a pencil drawing, where many attempts have been made to obtain the desired effect; such a drawing is smudged and ineffective; but the artist, under its guidance, draws his final work with clear bold touches, and then he rubs out the smudge. On precisely the same principle the faint but beautifully idealised features of these composites are, I believe, capable of forming the basis of a very high order of artistic work.

B.—THE RELATIVE SUPPLIES FROM TOWN AND COUNTRY FAMILIES TO THE POPULATION OF FUTURE GENERATIONS.

[*Read before the Statistical Society in* 1873.]

It is well known that the population of towns decays, and has to be recruited by immigrants from the country, but I am not aware that any statistical investigation has yet been attempted of the rate of its decay. The more energetic members of our race, whose breed is the most valuable to our nation, are attracted from the country to our towns. If residence in towns seriously

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interferes with the maintenance of their stock, we should expect the breed of Englishmen to steadily deteriorate, so far as that particular influence is concerned.

I am well aware that the only perfectly trustworthy way of conducting the inquiry is by statistics derived from numerous life-histories, but I find it very difficult to procure these data. I therefore have had recourse to an indirect method, based on a selection from the returns made at the census of 1871, which appears calculated to give a fair approximation to the truth. My object is to find the number of adult male representatives in this generation, of 1000 adult males in the previous one, of rural and urban populations respectively. The principle on which I have proceeded is this :—

I find (A) the number of children of equal numbers of urban and of rural mothers. The census schedules contain returns of the names and ages of the members of each "family," by which word we are to understand those members who are alive and resident in the same house with their parents. When the mothers are young, the children are necessarily very young, and nearly always (in at least those classes who are unable to send their children to boarding schools) live at home. If, therefore, we limit our inquiries to the census "families" of young mothers, the results may be accepted as practically identical with those we should have obtained if we had direct means of ascertaining the number of their living children. The limits of age of the mothers which I adopted in my selection were, 24 and 40 years. Had I to begin the work afresh, I should prefer the period from 20 to 35, but I have reason to feel pretty well contented with my present data. I correct the results thus far obtained on the following grounds :—(B) the relative mortality of the two classes between childhood and maturity; (C) the relative mortality of the rural and urban mothers during childbearing ages; (D) their relative celibacy; and (E) the span of a rural and urban generation. It will be shown that B is important, and C noteworthy, but that D and E may be disregarded.

In deciding on the districts to be investigated, it was important to choose well-marked specimens of urban and rural populations. In the former, a town was wanted where there were various industries, and where the population was not increasing. A town where only one industry was pursued would not be a fair sample, because the particular industry might be suspected of having a special influence, and a town that was increasing would have attracted numerous immigrants from the country, who are undistinguishable as such in the census returns. Guided by these considerations, I selected Coventry, where silk weaving, watch-making, and other industries are carried on, and whose population had scarcely varied during the decade

preceding the census of 1871.[1] It is an open town, in which the crowded alleys of larger places are not frequent. Its urban peculiarities are therefore minimised, and its statistical returns would give a picture somewhat too favourable of the average condition of life in towns. For specimens of rural districts, I chose small agricultural parishes in Warwickshire.

By the courteous permission of Dr. Farr, I was enabled to procure extracts from the census returns concerning 1000 "families" of factory hands at Coventry, in which the age of the mother was neither less than 24 nor more than 40 years, and concerning another 1000 families of agricultural labourers in rural parishes of Warwickshire, under the same limitations as to the age of the mother. When these returns were classified (see Table I., p. 246), I found the figures to run in such regular sequence as to make it certain that the cases were sufficiently numerous to give trustworthy results. It appeared that :—

(A) The 1000 families of factory hands comprised 2681 children, and the 1000 of agricultural labourers comprised 2911; hence, the children in the urban "families," the mothers being between the ages of 24 and 40, are on the whole about 8 per cent. less numerous than the rural. I see no reason why these numbers should not be accepted as relatively correct for families, in the ordinary sense of that word, and for mothers of all ages. An inspection of the table does indeed show that if the selection had begun at an earlier age than 24, there would have been an increased proportion of sterile and of small families among the factory hands, but not sufficient to introduce any substantial modification of the above results. It is, however, important to recollect that the small error, whatever its amount may be, is a concession in favour of the towns.

(B) I next make an allowance for the mortality between childhood and maturity, which will diminish the above figures in different proportions, because the conditions of town life are more fatal to children than those of the country. No life tables exist for Coventry and Warwickshire; I am therefore obliged to use statistics for similarly conditioned localities, to determine the amount of the allowance that should be made. The life tables of Manchester[2] will afford the data for towns, and those of the "Healthy Districts"[3] will suffice for the country. By applying these, we could calculate the number of the children of ages specified in the census returns who would attain maturity. I regret extremely that when I had the copies taken, I did not give instructions to have the ages of all the children inserted; but I did not, and it is too late now to remedy the omission. I

[1] It has greatly changed since this was written.
[2] "Seventh Annual Report of Registrar-General."
[3] Healthy Districts Life Table, by Dr. Farr. *Phil. Trans. Royal Society*, 1859.

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am therefore obliged to make a very rough, but not unfair, estimate. The average age of the children was about 3 years, and 25 years may be taken as representing the age of maturity. Now it will be found that 74 per cent. of children in Manchester, of the age of 3, reach the age of 25, while 86 per cent. of children do so in the "Healthy Districts." Therefore, if my rough method be accepted as approximately fair, the number of adults who will be derived from the children of the 1000 factory families should be reckoned at $\left(2681 \times \frac{74}{100}\right) = 1986$, and those from the 1000 agricultural at $\left(2911 \times \frac{86}{100}\right) = 2503$.

(C) The comparison we seek is between the total families produced by an equal number of urban and rural women who had survived the age of 24. Many of these women will not marry at all; I postpone that consideration to the next paragraph. Many of the rest will die before they reach the age of 40, and more of them will die in the town than in the country. It appears from data furnished by the above-mentioned tables, that if 100 women of the age of 24 had annually been added to a population, the number of those so added, living between the ages of 24 and 40 (an interval of seventeen years) would be 1539 under the conditions of life in Manchester, and 1585 under those of the healthy districts. Therefore the small factors to be applied respectively to the two cases, on account of this correction, are $\frac{1539}{17 \times 100}$ and $\frac{1585}{17 \times 100}$.

(D) I have no trustworthy data for the relative prevalence of celibacy in town and country. All that I have learned from the census returns is, that when searching them for the 1000 families, 131 bachelors were noted between the ages of 24 and 40, among the factory hands, and 144 among the agricultural labourers. If these figures be accepted as correct guides to the amount of celibacy among the women, it would follow that I must be considered to have discussed the cases of 1131 factory, and 1144 agricultural women, when dealing with those of 1000 mothers in either class. Consequently that the respective corrections to be applied, are given by the factors $\frac{1000}{1131}$ and $\frac{1000}{1141}$, or $\frac{88{\cdot}4}{1000}$, and $\frac{87{\cdot}6}{1000}$. This difference of less than 1 per cent. is hardly worth applying, moreover I do not like to apply it, because it seems to me erroneous and to act in the wrong direction, inasmuch as unmarried women can obtain employment more readily in the town than in the country, and celibacy is therefore more likely to be common in the former than in the latter.

(E) The possible difference in the length of an urban and

rural generation must not be forgotten. We, however, have reason to believe that the correction on this ground will be insignificant, because the length of a generation is found to be constant under very different circumstances of race, and therefore we should expect it to be equally constant in the same race under different conditions; such as it is, it would probably tell against the towns.

Let us now sum up the results. The corrections are not to be applied for (D) and (E), so we have only to regard (A) × (B) × (C), that this—

$$\frac{2681 \times \frac{74}{100} \times \frac{1539}{1700}}{2911 \times \frac{86}{100} \times \frac{1585}{1700}} = \frac{1796}{2334} = \frac{77}{100}.$$

In other words, the rate of supply in towns to the next adult generation is only 77 per cent., or, say, three-quarters of that in the country. This decay, if it continued constant, would lead to the result that the representatives of the townsmen would be less than half as numerous as those of the country folk after one century, and only about one fifth as numerous after two centuries, the proportions being $\frac{45}{100}$ and $\frac{21}{100}$ respectively.

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TABLE I.—*Census Returns of* 1000 *Families of Factory Hands in Coventry, and* 1000 *Families of Agricultural Labourers in Warwickshire, grouped according to the Age of the Mother and the Number of Children in the Family.*

Age of Mother.	Number of Children in Family.																			
	0.		1.		2.		3.		4.		5.		6.		7.		8.		9.	
	Factory.	Agricultural.	Factory.	Agricultural.	Factory.	Agricultural.	Factory.	Agricultural.	Factory.	Agricultural.	Factory.	Agricultural.	Factory.	Agricultural.	Factory.	Agricultural.	Factory.	Agricultural.	Factory.	Agricultural.
24 to 25	28	17	40	31	24	32	12	10	2	...	1	1	...	...	...	...	...	...	...	...
26 ,, 27	19	18	36	24	36	28	23	26	8	8	...	...	...	...	...	...	...	...	...	...
28 ,, 29	18	17	32	16	20[1]	33	36	23	14	23	6	6	4	1	2	...	...	...	...	...
30 ,, 31	13	4	23	18	24	21	28[1]	31	18	22	12	15	2	5	...	2	...	1	...	...
32 ,, 33	18	11	16	14	19	13	22[1]	27	23	26	21	25	9	5	...	1	...	2	...	...
34 ,, 35	14	15	11	6	17	16	28	18	31	34	14	18	12	9	5	3	...	1	...	...
36 ,, 37	12	17	4	11	10	13	22	14	16	20	15	25	12	10	4	5	5	2	...	...
38 ,, 39	8	6	9	15	14	17	16	21	22	23	14	22	10	15	6	7	...	2	1	...
40	8	7	3	10	8	9	13	14	8	10	7	11	3	9	7	7	2	1	...	...
Total within outline	96	67	158	109	116	111	171	149	...	...	...	...	...	...	...	...	...	...	...	...
Total between outlines	42	45	16	36	56	71	29	35	142	166	90	123	...	...	...	...	...	...	...	...
Total beyond outline	...	...	...	...	...	...	...	...	...	...	...	...	52	54	24	25	7	9	1	...
Total	138	112	174	145	172	182	200	184	142	166	90	123	52	54	24	25	7	9	1	...

[1] These three cases are anomalous, the Factory being less than the Agricultural. In the instance of 20–33, the anomaly is double, because the sequence of the figures shows that neither of these can be correct; certainly not the first of them.

Note.—It will be observed to the left of the outline, that is, in the upper and left hand of the table, where the mothers are young and the children few, the factory families predominate, while the agricultural are the most numerous between the outlines, that is especially in the middle of the table, where the mothers are less young, and the families are from four to five in number. The two are equally numerous to the right of the outlines, that is, to the right of the table, where the families are large.

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TABLE II.

	Number of Families.		Number of Children.	
	Factory.	Agricultural.	Factory.	Agricultural.
Within outline .	541	436	903	778
Between outlines .	375	476	1233	1562
Beyond ,, .	84	88	545	571
Total . .	1000	1000	2681	2911

C.—AN APPARATUS FOR TESTING THE DELICACY WITH WHICH WEIGHTS CAN BE DISCRIMINATED BY HANDLING THEM.

[*Read at the Anthropological Institute, Nov.* 14, 1882.]

I submit a simple apparatus that I have designed to measure the delicacy of the sensitivity of different persons, as shown by their skill in discriminating weights, identical in size, form, and colour, but different in specific gravity. Its interest lies in the accordance of the successive test values with the successive graduations of a true scale of sensitivity, in the ease with which the tests are applied, and the fact that the same principle can be made use of in testing the delicacy of smell and taste.

I use test-weights that mount in a series of "just perceptible differences" to an imaginary person of extreme delicacy of perception, their values being calculated according to Weber's law. The lowest weight is heavy enough to give a decided sense of weight to the hand when handling it, and the heaviest weight can be handled without any sense of fatigue. They therefore conform with close approximation to a geometric series; thus—

$$WR^0,\ WR^1,\ WR^2,\ WR^3,\ \text{etc.},$$

and they bear as register-marks the values of the successive indices, 0, 1, 2, 3, etc. It follows that if a person can just distinguish between any particular pair of weights, he can also just distinguish between any other pair of weights whose register-marks differ by the same amount. Example: suppose A can just distinguish between the weights bear ng the register-marks 2 and 4, then it follows from the construction of the apparatus

that he can just distinguish between those bearing the register-marks 1 and 3, or 3 and 5, or 4 and 6, etc.; the difference being 2 in each case.

There can be but one interpretation of the phrase that the dulness of muscular sense in any person, B, is twice as great as in that of another person, A. It is that B is only capable of perceiving one grade of difference where A can perceive two. We may, of course, state the same fact inversely, and say that the delicacy of muscular sense is in that case twice as great in A as in B. Similarly in all other cases of the kind. Conversely, if having known nothing previously about either A or B, we discover on trial that A can just distinguish between two weights such as those bearing the register-marks 5 and 7, and that B can just distinguish between another pair, say, bearing the register-marks 2 and 6; then since the difference between the marks in the latter case is twice as great as in the former, we know that the dulness of the muscular sense of B is exactly twice that of A. Their relative dulness, or if we prefer to speak in inverse terms, and say their relative sensitivity, is determined quite independently of the particular pair of weights used in testing them.

It will be noted that the conversion of results obtained by the use of one series of test-weights into what would have been given by another series, is a piece of simple arithmetic, the fact ultimately obtained by any apparatus of this kind being the "just distinguishable" fraction of real weight. In my own apparatus the unit of weight is 2 per cent.; that is, the register-mark 1 means 2 per cent.; but I introduce weights in the earlier part of the scale that deal with half units; that is, with differences of 1 per cent. In another apparatus the unit of weight might be 3 per cent., then three grades of mine would be equal to two of the other, and mine would be converted to that scale by multiplying them by $\frac{2}{3}$. Thus the results obtained by different apparatus are strictly comparable.

A sufficient number of test-weights must be used, or trials made, to eliminate the influence of chance. It might perhaps be thought that by using a series of only five weights, and requiring them to be sorted into their proper order by the sense of touch alone, the chance of accidental success would be too small to be worth consideration. It might be said that there are $5 \times 4 \times 3 \times 2$, or 120 different ways in which five weights can be arranged, and as only one is right, it must be 120 to 1 against a lucky hit. But this is many fold too high an estimate, because the 119 possible mistakes are by no means equally probable. When a person is tested, an approximate value for his grade of sensitivity is rapidly found, and the inquiry becomes narrowed to finding out whether he can surely pass a particular level. At this stage of the inquiry there is little fear of a gross

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mistake. He is little likely to make a mistake of double the amount in question, and it is almost certain that he will not make a mistake of treble the amount. In other words, he would never be likely to put one of the test-weights more than one step out of its proper place. If he had three weights to arrange in their consecutive order, 1, 2, 3, there are $3 \times 2 = 6$ ways of arranging them; of these, he would be liable to the errors of 1, 3, 2, and of 2, 1, 3, but he would hardly be liable to such gross errors as 2, 3, 1, or 3, 2, 1, or 3, 1, 2. Therefore of the six permutations in which three weights may be arranged three have to be dismissed from consideration, leaving three cases only to be dealt with, of which two are wrong and one is right. For the same reason there are only four reasonable chances of error in arranging four weights, and only six in arranging five weights, instead of the 119 that were originally supposed. These are—

12354	13245	13254
21345	21354	21435

But exception might be taken to two even of these, namely, those that appear in the third column, where 5 is found in juxtaposition with 2 in the first case, and 4 with 1 in the second. So great a difference between two adjacent weights would be almost sure to attract the notice of the person who was being tested, and make him dissatisfied with the arrangement. Considering all this, together with the convenience of carriage and manipulation, I prefer to use trays, each containing only three weights, the trials being made three or four times in succession. In each trial there are three possibilities and only one success, therefore in three trials the probabilities against uniform success are as 27 to 1, and in four trials at 81 to 1.

Values of the Weights.—After preparatory trials, I adopted 1000 grains as the value of W and 1020 as that of R, but I am now inclined to think that 1010 would have been better. I made the weights by filling blank cartridges with shot, wool, and wads, so as to distribute the weight equally, and I closed the cartridges with a wad, turning the edges over it with the instrument well known to sportsmen. I wrote the corresponding value of the index of R on the wad by which each of them was closed, to serve as a register number. Thus the cartridge whose weight was WR^4 was marked 4·. The values were so selected that there should be as few varieties as possible. There are thirty weights in all, but only ten varieties, whose Register Numbers are respectively 0, 1, 2, 3, $3\frac{1}{2}$, $4\frac{1}{2}$, 5, 6, 7, 9, 12. The reason of this limitation of varieties was to enable the weights to be interchanged whenever there became reason to suspect that the eye had begun to recognise the appearance of any one of them, and that the judgment might be influenced by that recognition, and cease to be wholly guided by the sense of weight.

We are so accustomed to deal with concurrent impressions that it is exceedingly difficult, even with the best intention of good faith, to ignore the influence of any corroborative impression that may be present. It is therefore right to take precautions against this possible cause of inaccuracy. The most perfect way would be to drop the weights, each in a little bag or sheath of light material, so that the operatee could not see the weights, while the ratio between the weights would not be sensibly changed by the additional weight of the bags. I keep little bags for this purpose, inside the box that holds the weights.

Arrangement of the Weights.—The weights are placed in sets of threes, each set in a separate shallow tray, and the trays lie in two rows in a box. Each tray bears the register-marks of each of the weights it contains. It is also marked boldly with a Roman numeral showing the difference between the register-marks of the adjacent weights. This difference indicates the grade of sensitivity that the weights in the tray are designed to test. Thus the tray containing the weights WR^0, WR^3, WR^6 is marked as in Fig. 1, and that which contains WR^2, WR^7, WR^{12} is marked as in Fig. 2.

III.
0, 3, 6.

Fig. 1.

V.
2, 7, 12.

Fig. 2.

The following is the arrangement of the trays in the box. The triplets they contain suffice for ordinary purposes.

Just perceptible Ratio.	Grade of Sensitivity.	Sequences of Weights.	Just perceptible Ratio.	Grade of Sensitivity.	Sequences of Weights.
1·020	I.	1, 2, 3	1·030	I.½	2, 3½, 5
1·040	II.	3, 5, 7	1·050	II.½	2, 4½, 7
1·061	III.	0, 3, 6	1·071	III.½	0, 3½, 7
1·082	IV.	1, 5, 9	1·082	IV.½	0, 4½, 9
1·104	V.	2, 5, 7	1·127	VI.	0, 6, 12

But it will be observed that sequences of ½ can also be obtained, and again, that it is easy to select doublets of weights for coarser tests, up to a maximum difference of XII., which may be useful in cases of morbidly diminished sensitivity.

Manipulation.—A tray is taken out, the three weights that it contains are shuffled by the operator, who then passes them on

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to the experimenter. The latter sits at ease with his hand in an unconstrained position, and lifts the weights in turn between his finger and thumb, the finger pressing against the top, the thumb against the bottom of the cartridge. Guided by the touch alone, he arranges them in the tray in what he conceives to be their proper sequence ; he then returns the tray to the operator, who notes the result, the operator then reshuffles the weights and repeats the trial. It is necessary to begin with coarse preparatory tests, to accustom the operatee to the character of the work. After a minute or two the operator may begin to record results, and the testing may go for several minutes, until the hand begins to tire, the judgment to be confused, and blunders to arise. Practice does not seem to increase the delicacy of perception after the first few trials, so much as might be expected.

D.—WHISTLES FOR TESTING THE UPPER LIMITS OF AUDIBLE SOUND IN DIFFERENT INDIVIDUALS.

The base of the inner tube of the whistle is the foremost end of a plug, that admits of being advanced or withdrawn by screwing it out or in ; thus the depth of the inner tube of the whistle can be varied at pleasure. The more nearly the plug is screwed home, the less is the depth of the whistle and the more shrill does its note become, until a point is reached at which, although the air that proceeds from it vibrates as violently as before, as shown by its effect on a sensitive flame, the note ceases to be audible.

The number of vibrations per second in the note of a whistle or other "closed pipe" depends on its depth. The theory of acoustics shows that the length of each complete vibration is four times that of the depth of the closed pipe, and since experience proves that all sound, whatever may be its pitch, is propagated at the same rate, which under ordinary conditions of temperature and barometric pressure may be taken at 1120 feet, or 13,440 inches per second,—it follows that the number of vibrations in the note of a whistle may be found by dividing 13,440 by four times the depth, measured in inches, of the inner tube of the whistle. This rule, however, supposes the vibrations of the air in the tube to be strictly longitudinal, and ceases to apply when the depth of the tube is less than about one and a half times its diameter. When the tube is reduced to a shallow pan, a note may still be produced by it, but that note has reference rather to the diameter of the whistle than to its depth, being sometimes apparently unaltered by a further decrease of depth. The necessity of preserving a fair proportion between the diameter and the depth of a whistle is the reason why these

instruments, having necessarily little depth, require to be made with very small bores.

The depth of the inner tube of the whistle at any moment is shown by the graduations on the outside of the instrument. The lower portion of the instrument as formerly made for me by the late Mr. Tisley, optician, Brompton Road,[1] is a cap that surrounds the body of the whistle, and is itself fixed to the screw that forms the plug. One complete turn of the cap increases or diminishes the depth of the whistle, by an amount equal to the interval between two adjacent threads of the screw. For mechanical convenience, a screw is used whose pitch is 25 to the inch ; therefore one turn of the cap moves the plug one twenty-fifth of an inch, or ten two hundred-and-fiftieths. The edge of the cap is divided into ten parts, each of which corresponds to the tenth of a complete turn ; and, therefore, to one two-hundred-and-fiftieth of an inch. Hence in reading off the graduations the tens are shown on the body of the whistle, and the units are shown on the edge of the cap.

The scale of the instrument having for its unit the two-hundred-and-fiftieth part of an inch, it follows that the number of vibrations in the note of the whistle is to be found by dividing $\frac{13440 \times 250}{4}$ or 84,000, by the graduations read off on its scale.

A short table is annexed, giving the number of vibrations calculated by this formula, for different depths, bearing in mind that the earlier entries cannot be relied upon unless the whistle has a very minute bore, and consequently a very feeble note.

Scale Readings (one division = $\frac{1}{250}$ of an inch).	Corresponding Number of Vibrations per Second.	Scale Readings (one division = $\frac{1}{250}$ of an inch).	Corresponding Number of Vibrations per Second.
10	84,000	75	11,200
15	56,000	80	10,500
20	42,000	85	9,882
25	33,600	90	9,333
30	28,000	95	8,842
35	24,000	100	8,400
40	21,000	105	8,000
45	18,666	110	7,591
50	16,800	115	7,305
55	15,273	120	7,000
60	14,000	125	6,720
65	12,923	130	6,461
70	12,000		

[1] Mr. Hawksley, surgical instrument maker, 307 Oxford Street, also makes thes whistles, and those he makes have much purity of tone.

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The largest whistles suitable for experiments on the human ear, have an inner tube of about 0·16 inches in diameter, which is equal to 40 units of the scale. Consequently in these instruments the theory of closed pipes ceases to be trustworthy when the depth of the whistle is less than about 60 units. In short, we cannot be sure of sounding with them a higher note than one of 14,000 vibrations to the second, unless we use tubes of still smaller bore. In some of my experiments I was driven to use very fine tubes indeed, not wider than those little glass tubes that hold the smallest leads for Mordan's pencils. I have tried without much success to produce a note that should be both shrill and powerful, and correspond to a battery of small whistles, by flattering a piece of brass tube, and passing another sheet of brass up it, and thus forming a whistle the whole width of the sheet, but of very small diameter from front to back. It made a powerful note, but not a very pure one. I also constructed an annular whistle by means of three cylinders, one sliding within the other two, and graduated as before.

When the limits of audibility are approached, the sound becomes much fainter, and when that limit is reached, the sound usually gives place to a peculiar sensation, which is not sound but more like dizziness, and which some persons experience to a high degree. Young people hear shriller sounds than older people, and I am told there is a proverb in Dorsetshire, that no agricultural labourer who is more than forty years old, can hear a bat squeak. The power of hearing shrill notes has nothing to do with sharpness of hearing, any more than a wide range of the key-board of a piano has to do with the sound of the individual strings. We all have our limits, and that limit may be quickly found by these whistles in every case. The facility of hearing shrill sounds depends in some degree on the position of the whistle, for it is highest when it is held exactly opposite the opening of the ear. Any roughness of the lining of the auditory canal appears to have a marked effect in checking the transmission of rapid vibrations when they strike the ear obliquely. I myself feel this in a marked degree, and I have long noted the fact in respect to the buzz of a mosquito. I do not hear the mosquito much as it flies about, but when it passes close by my ear I hear a "ping," the suddenness of which is very striking. Mr. Dalby, the aurist, to whom I gave one of these instruments, tells me he uses it for diagnoses. When the power of hearing high notes is wholly lost, the loss is commonly owing to failure in the nerves, but when very deaf people are still able to hear high notes if they are sounded with force, the nerves are usually all right, and the fault lies in the lining of the auditory canal.

E.—QUESTIONS ON VISUALISING AND OTHER ALLIED FACULTIES.

The Questions that I circulated were as follows; there was an earlier and uncomplete form, which I need not reproduce here.

The object of these Questions is to elicit the degree in which different persons possess the power of seeing images in their mind's eye, and of reviving past sensations.

From inquiries I have already made, it appears that remarkable variations exist both in the strength and in the quality of these faculties, and it is highly probable that a statistical inquiry into them will throw light upon more than one psychological problem.

Before addressing yourself to any of the Questions on the opposite page, think of some definite object—suppose it is your breakfast-table as you sat down to it this morning—and consider carefully the picture that rises before your mind's eye.

1. *Illumination.*—Is the image dim or fairly clear? Is its brightness comparable to that of the actual scene?

2. *Definition.*—Are all the objects pretty well defined at the same time, or is the place of sharpest definition at any one moment more contracted than it is in a real scene?

3. *Colouring.*—Are the colours of the china, of the toast, bread crust, mustard, meat, parsley, or whatever may have been on the table, quite distinct and natural?

4. *Extent of field of view.*—Call up the image of some panoramic view (the walls of your room might suffice), can you force yourself to see mentally a wider range of it than could be taken in by any single glance of the eyes? Can you mentally see more than three faces of a die, or more than one hemisphere of a globe at the same instant of time?

5. *Distance of images.*—Where do mental images appear to be situated? within the head, within the eye-ball, just in front of the eyes, or at a distance corresponding to reality? Can you project an image upon a piece of paper?

6. *Command over images.*—Can you retain a mental picture steadily before the eyes? When you do so, does it grow brighter or dimmer? When the act of retaining it becomes wearisome, in what part of the head or eye-ball is the fatigue felt?

7. *Persons.*—Can you recall with distinctness the features of all near relations and many other persons? Can you at will cause your mental image of any or most of them to sit, stand, or turn slowly round? Can you deliberately seat the image of a well-known person in a chair and see it with enough distinctness to enable you to sketch it leisurely (supposing yourself able to draw)?

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8. *Scenery.*—Do you preserve the recollection of scenery with much precision of detail, and do you find pleasure in dwelling on it? Can you easily form mental pictures from the descriptions of scenery that are so frequently met with in novels and books of travel?

9. *Comparison with reality.*—What difference do you perceive between a very vivid mental picture called up in the dark, and a real scene? Have you ever mistaken a mental image for a reality when in health and wide awake?

10. *Numerals and dates.*—Are these invariably associated in your mind with any peculiar mental imagery, whether of written or printed figures, diagrams, or colours? If so, explain fully, and say if you can account for the association?

11.—*Specialities.*—If you happen to have special aptitudes for mechanics, mathematics (either geometry of three dimensions or pure analysis), mental arithmetic, or chess-playing blindfold, please explain fully how far your processes depend on the use of visual images, and how far otherwise?

12. Call up before your imagination the objects specified in the six following paragraphs, numbered A to F, and consider carefully whether your mental representation of them generally, is in each group very faint, faint, fair, good, or vivid and comparable to the actual sensation :—

A. *Light and colour.*—An evenly clouded sky (omitting all landscape), first bright, then gloomy. A thick surrounding haze, first white, then successively blue, yellow, green, and red.

B. *Sound.*—The beat of rain against the window panes, the crack of a whip, a church bell, the hum of bees, the whistle of a railway, the clinking of tea-spoons and saucers, the slam of a door.

C. *Smells.*—Tar, roses, an oil-lamp blown out, hay, violets, a fur coat, gas, tobacco.

D. *Tastes.*—Salt, sugar, lemon juice, raisins, chocolate, currant jelly.

E. *Touch.*—Velvet, silk, soap, gum, sand, dough, a crisp dead leaf, the prick of a pin.

F. *Other sensations.*—Heat, hunger, cold, thirst, fatigue, fever, drowsiness, a bad cold.

13. *Music.*—Have you any aptitude for mentally recalling music, or for imagining it?

14. *At different ages.*—Do you recollect what your powers of visualising, etc., were in childhood? Have they varied much within your recollection?

General remarks.—Supplementary information written here, or on a separate piece of paper, will be acceptable.

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