The Comparative Longevity of Animals of Different Species, and of Man; and the Probable Causes which Mainly Conduce to Promote this Difference.

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many in this country, have been constructed during the stone age, and have continued in use until a much later period. From the *Station de Granville* there is a stone celt of the usual type, somewhat more pointed at the smaller end than the last-mentioned specimen, four and three-quarter inches in length, and two inches its greater breadth; and a fragment of pottery, apparently of the Roman or post-Roman age. From the Fort of *Pérran* there is a whetstone, artificially rubbed on three sides, and another showing also marks of use. There are fragments of red pottery from this station. With respect to the other stones composing the collection, I am unable, without personally inspecting the locality, to form any opinion as to the manner in which their surfaces have become worn.

The COMPARATIVE LONGEVITY of ANIMALS of DIFFERENT SPECIES, and of MAN; and the Probable Causes which mainly conduce to promote this Difference. By GEORGE HARRIS, F.S.A., Vice-President of the Anthropological Institute.

HISTORY, both sacred and profane, attributes to mankind who lived in the early ages of the world, a longevity very far exceeding what we have experience of in our day. To some extent this difference may possibly be accounted for by the different modes in which eras of time were calculated. Possibly also the planetary system by whose revolutions periods of life were reckoned, may have undergone certain changes during that space of time. Easton, however, appears to give entire credit to the literal interpretation of the statement as to the longevity recorded of the patriarchs, and accounts for the limitation of the period of life since their time by remarking that "the productions of the earth were then of a different nature. The surface of the globe was in the first ages of the world less solid and compact. The period of man's existence may have gradually diminished in proportion as the surface of the earth acquired more solidity by the constant action of gravity."*

Dr. Whewell, the late able and learned Master of Trinity, accounted for the longevity of the patriarchs by the fact that Adam and Eve had eaten of the tree of life, and that its virtue was transmitted through several successive generations, till at last it became dissipated and lost, and man was reduced to a miserable tithe of his first possession.†

Lord Bacon, referring to the general period of the life of man,

* "Human Longevity", *Introd.*, p. xxvii.

† "Life; its Nature, Varieties, and Phenomena". By Leo. H. Grindon. P. 114.

asserts that "man's age doth exceed the age of all other living creatures."*

In the early records of our own country accounts are preserved of people living to a much greater age than they now do. Among the ancient Britons people commonly lived to the age of one hundred and twenty years. There are isolated instances in modern times of men living much beyond this age.

An able and well-written article on the general subject of longevity is contained in the *Edinburgh Review* for January 1857, which is attributed to Sir Henry Holland. It, however, throws some doubt on the reality of the great age asserted to have been attained by Jenkins and the Countess of Desmond,—one hundred and sixty-nine and one hundred and forty-eight years respectively; but confirms the account given of the longevity of Thomas Parr, and refers to the dissection of his body by the celebrated Harvey, who concluded from its appearance that he might have lived much longer but for the surfeit of food and changes in his habits which followed his removal to London, and to the kitchen of the palace.

Extraordinary and perhaps extravagant notions were entertained by the ancients as to the longevity of certain animals. According to a passage in Hesiod, referred to by Sir Thomas Browne,† ninety-six is the period of the life of a man, while that of a deer extends to above three thousand, and that of a crow to considerably beyond that period. But naturalists also of high repute and great credit, modern as well as ancient, afford us extraordinary accounts of the longevity attained by certain animals. Smellie, in his "Philosophy of Natural History," alludes to the great longevity of certain animals. Elephants live beyond two hundred years.‡ "In proportion to the size of their bodies, birds live longer than either men or quadrupeds. Swans have been said to live three hundred years."§ A goose is said to live beyond one hundred years,|| as do also ravens.¶ "Gesner gives an instance of a carp in Germany which he knew to be one hundred years old. Buffon informs us that he had seen carps of one hundred and fifty years of age, and he mentions one which he supposed to be two hundred years old."** Pike have been known to live to two hundred and sixty-seven years.†† The tortoise is said to have attained one hundred and seventy-five years,‡‡ and the falcon one hundred and sixty-two years."§§ A Greenland whale, we are told, will live from three hundred to four hundred years.|||| Parrots and several other ani-

* "History of Life and Death".

† "Vulgar Errors".

‡ P. 283.

§ P. 512.

|| Ibid.

¶ Ibid.

** Smellie, p. 514.

†† Gesner, quoted by Yarrell.

‡‡ Grindon on Life.

§§ Hufeland, "Art of Prolonging Life".

|||| Grindon on Life.

mals, including some reptiles, are also said to afford extraordinary instances of longevity; while certain other animals, not apparently differing essentially in their nature and constitution from those to which I have referred, are as remarkable for the brief space to which their lives are ordinarily limited. Some trees are supposed capable of attaining an extraordinary age. The oak will live for fifteen hundred years, and the yew for three thousand two hundred.*

The opinions which have been entertained by different writers who have examined minutely into the subject, as to the principal causes of longevity both in animals and men, are deserving of attention, although no satisfactory conclusion has as yet been arrived at, and they differ essentially from one another in their theories on this topic. The famous Roger Bacon wrote a treatise entitled "The Cure of Old Age."† But the wonderful genius who six hundred years ago predicted travelling by carriages and by boats propelled by machinery, and navigating through the air, and to whom the inventions of printing and the telescope were also known, failed to produce any recipe for attaining long life beyond a few ordinary maxims regarding health. Paracelsus boasted that he could make a man live four hundred years or more if he might bring him up from his infancy, and diet him as he chose.‡ And Burton tells us in his "Anatomy of Melancholy" that some physicians hold that there is no certain period of man's life, but it may still by temperance and physic be prolonged.§ Lord Bacon, in his "History of Life and Death," discusses the causes of longevity, and he attributes the varieties in this respect to variations in the density of the vital spirits, and other causes affecting those spirits, and lays down the following maxims of prolonging life: "Alimentation from without, at least some other way than by the stomach, is most profitable to long life, if it can be done," canon xxiii; "Curing of diseases is effected by temporary medicines, but lengthening of life requireth observation of diet," canon xxx.

In his "Natural History"|| Lord Bacon also states that "It conduceth unto long life, and to the more placid motion of the spirits, which thereby do less prey and consume the juice of the body; either that man's actions be free and voluntary, that nothing be done *invita Minerva*, but *secundum genium*; or, on the other side, that the actions of men be full of regulation and commands within themselves, for then the victory and performing of the command giveth a good disposition to the spirits, especially if there be a proceeding from degree to degree, for then the sense of

* Grindon on Life.

† "De Retardandis Senectutis Accidentibus". Oxford, 1590.

‡ "Lib. de Vita Longâ."

§ Part i, sect. 2.

|| P. 292, "Experiment solitary touching prolongation of life".

the victory is the greater. An example of the former of these is in a country life; and of the latter in monks and philosophers, and such as do continually enjoy themselves."

Sir John Sinclair, in his "Code of Health and Longevity," vol. ii, gives a catalogue of one thousand four hundred and twenty "foreign publications on the subject of health and diet." In the "Appendix," vol. ii, to the above work are "rules by which a person will be enabled to prolong life to the latest period." Rule 10 advises people to refrain from dinner once a week.

Mr. Herbert Spencer* attributes the apparent absence of inherent decay in many trees, in fish, and in some reptiles, to their exceedingly small expenditure; trees and plants generally exhibiting no personal expenditure at all, whilst fish and certain cold-blooded reptiles show very little indeed.

The period occupied in the growth of an animal has sometimes been adopted as the test to what that of its life will extend. But this has been found to vary extensively in the case of different animals. Bodily strength, vigour, and health also fail to afford any certain indication as to the period to which life will reach, as the strongest and healthiest not unfrequently die early, while the frail and sickly turn out to be long-lived. Climate is said to occasion but little difference as to the period to which the lives of persons extend, although there is some difference of opinion in this respect, and certain climes appear to be peculiarly favourable to longevity. At one period Italy seems to have been remarkable in this respect. Cornwall, too, has been noted for longevity. Air and diet have always been supposed to exercise an important influence on longevity. Certain writers have attributed the longevity of the ante-diluvians to their sobriety and the simplicity of their manners, to their abstaining from eating flesh, and to the excellence of the fruits and herbs of those days, also to the purity of the air in those times.† But while some men who lived temperately, and even abstemiously, have lived to a great age, others who followed the very opposite course have been equally long-lived.‡ In general, however, notwithstanding a few exceptions, it appears to be generally admitted that "temperance, a placid and cheerful disposition, moderate exercise, and proper exertions of mind contribute in no uncommon degree to the prolongation of life."§

Some pursuits are also obviously much more favourable to longevity than are certain others. The clergy are proverbially long-lived; and, strange to say, the lawyers, too, frequently ex-

* "Principles of Biology".

† Rees's "Cycl." Art., Longevity.

‡ Smellie, p. 505.

§ Ibid.

hibit great tenacity with regard to life, as they do with regard to other matters also. According to averages taken by Dr. Caldwell, the lives of twenty mathematicians extended to seventy-five years, while those of twenty poets extended to only fifty-seven years.*

The quality of the air is thought by some to cause the chief difference in longevity.† It has indeed been proved by statistical returns that fresh air is one of the main conduces to it. In the case of wild winged birds, who partake of it to the utmost possible extent, this is probably one of the principal causes of their being so long-lived. And wild animals in general have the full benefit of it, and in its purest state. According to Easton, "fresh air is more immediately necessary to life than food."‡ He asserts also that "there is a vivifying principle contained in the atmosphere."§ In general there are more old men in high than in low countries.|| And yet in thickly-populated cities which are placed in a low situation some extraordinary instances of longevity may occasionally be observed.

Artificial food, both as regards meat and drink, may be supposed to be far less favourable to longevity than that which is in a natural state. Indeed, according to certain statements, the people of this highly-civilised age and country live mainly upon poison! Civilisation, however, may be presumed to be in many respects favourable to longevity, but that civilisation should be untainted by luxury. It should be such a state of civilisation as will provide against want, and afford regular exercise both to the mental and physical powers, but without leading mankind to indulge in those excesses of various kinds to which men in society are so frequently addicted.

Domestication appears to have a corresponding effect upon animals with what luxury has upon mankind. Lord Bacon tells us in his "History of Life and Death" that "in tame creatures their degenerate life corrupteth them; in wild creatures their exposing to all weathers also intercepteth them". But besides their exposure to the weather, wild animals are ever exposed to attacks from each other. But while tame animals are protected from many of these casualties, few domesticated animals are long-lived. The habits into which they are forced are contrary to nature. They take but little exercise. They feed on artificial diet, and their instincts become blunted. It is accordingly among wild animals that the extraordinary instances of longevity alluded to are afforded. Mr. Lankester, however, tells us that animals in

* Combe's "Principles of Physiology", p. 366; Cal'well on "Physical Education", pp. 84, 86.

† Smellie, p. 510.

‡ "Human Longevity", Introd., p. xxi.

§ Ibid.

|| Smellie, p. 510.

a domesticated state, which are supplied with food and protected from the attacks of other animals, may live much longer than in a state of nature.* But this proves nothing as regards their natural longevity. They are less liable to die from want or violence, which are mainly destructive in the case of wild animals, but their natural term of life is considerably abridged. In the case of wild animals there is, of course, much greater difficulty in ascertaining the precise period to which their lives are extended than in the case of those that are domesticated. This, however, may in many instances be successfully accomplished. Singular it is that in localities where wild animals abound we so seldom meet with instances of old and decrepit animals, and still less with the remains of animals that have died of old age. Among our domestic animals, instances of decrepitude from old age are very common, notwithstanding the alacrity with which they are killed off before they get too old to serve for domestic use. This apparent longevity of certain wild animals affords some support to the statements of the ancients as to the extraordinary longevity of certain animals, and also of the patriarchs, whose longevity has been accounted for by their living in a state of nature, as is the case with wild animals, feeding only on diet which is pure, simple, and unadulterated. On the other hand, savages, who certainly have certain advantages in this respect over civilised people, do not have their lives prolonged beyond the ordinary term. But then it should be borne in mind that savages, where they live in large hordes, have generally adopted some artificial habits which are at variance with nature and inimical to longevity; besides which, as is the case with the natives of New Zealand, they have often a difficulty in procuring sufficient and good food, and live in unwholesome dwellings, all which renders their case very different from that of the patriarchs.

Nevertheless, it cannot be doubted that if some particular animals do really enjoy a longevity far beyond the rest of their species, as to which there are assertions apparently well authenticated, there must necessarily be some special cause existing, either in their constitution or their mode of life, which occasions such longevity. And if this affects one animal, it will affect another; and if life may be prolonged in one case to a period far beyond its natural extent by the application of certain causes, it may be by a corresponding application in another case. If the life of a beast, or a bird, or a fish, may be extended to ten times its natural length by special agencies, is there any reason to suppose that the life of man is not subject to the same influences?

* “Comparative Longevity in Man and Animals”.

The late Dr. Monro went so far as to maintain, in his anatomical lectures, that "as far as he could observe the human body, as a machine, was perfect; that it bore within itself no marks by which we could possibly predicate its decay; that it was apparently calculated to go on for ever; and that we learned only by experience that it would not do so".*

Is it altogether irrational to suppose that some principle analogous to that of vaccination, or to that supposed to be contained in the very tree of life itself, may at some distant period in the progress of science be brought to light by which the animal frame may be revigorated and rescued from decay, and so fitted to endure, I will not presume to say for ever, but to an age corresponding with that to which we are told that both the patriarch and many animals have attained? Not improbably, indeed, there may be numerous natural medicines to which the instincts of wild animals spontaneously direct them, such as certain plants and springs, resort to which may have the effect at once of producing those particular results, and those alterations in their system, which capacitate it to endure for a long period. We see proof of this to a certain extent in certain cases, and it may reasonably be inferred that it exists to an extent considerably beyond our experience. If our science served us as efficiently as their instinct does them, we possibly might make corresponding discoveries with corresponding results. Possibly the patriarchs did possess this knowledge. Among certain savage tribes of men, whose instinctive powers are largely developed, while those of the reason are but little cultivated, a remarkable sagacity as to the medicinal properties of some natural productions has been occasionally exhibited.

In order to determine the points now at issue, we must inquire and ascertain as far as possible what is the real principle on which the comparative duration of life in every animated frame depends, and which appears to me to be as follows. In every such frame, commencing with the very germ itself, there is implanted a principle of growth or composition, by the operation of which, aided by nutrition and accretion, the frame goes on increasing and enlarging, rapidly at first, but gradually more slowly, and very languidly in old age. On the other hand, there is another principle contemporaneous with this, that of waste, or decay, or decomposition, which operates at first very slowly, but gradually increases in rapidity and strength, being very speedy and powerful in old age. The operation of these two principles is best and most clearly exhibited in the case of vegetable frames. But in those of animals and also of man it may be clearly perceived. So long as the growth in question exceeds

* Appendix to Combe on "The Constitution of Man", p. 434.

or keeps pace with decay, life is maintained; but whenever the progress of decay, or decomposition, exceeds that of growth, the frame declines, and death speedily ensues. Certain causes tend to promote the action of one of these principles, and certain causes tend to promote that of the other. Some of these causes are very powerful and obvious, and act in a direct manner. Others appear to be but feeble, and are scarcely perceptible, and act only indirectly. For instance, intemperance, incontinence, and irregularity of life, as also excessive toil, unwholesome food, and bad air, are directly calculated to hinder growth and promote decay. On the other hand, the opposite of these causes are as directly calculated to promote growth and retard decay.

The very essence of certain diseases is in reality but the triumph of decay, or waste, or decomposition, over growth or renovation; and therefore, if the complaint in question be of long continuance, it necessarily terminates in the dissolution of the frame, and in death. We see this more particularly and clearly evinced in the case of the disease termed consumption. People in reality die of old age, not when they have lived so many years, but when they are worn out—by the progress of waste and decay outstripping that of growth and renovation. As many, therefore, die of old age, from being worn out, at eighteen as at eighty.

It may, I think, be assumed that the real and only scientific test as to the capacity of any particular individual animal frame to last for a greater or less period of time, turns on the constitution of such frame, whether as regards its material texture, its temperament, its organisation, or its fluids, more especially the blood. Different animal frames no doubt differ extensively one from another in this respect. For instance, women are said to live longer than men, because “the bones, the cartilages, the muscles, as well as every other part of the body, are softer and less solid than those of men”.* But if animated beings of the same species differ one from another as regards their adaptation for longevity owing to a difference in their constitution, we may suppose that animated beings of a different species will differ far more extensively from the same cause. Thus fishes, we are told, “live during several centuries, because their bones and cartilages seldom acquire the density of those of other animals”.†

Comparative longevity, therefore, depends mainly on natural constitution. Nevertheless, inasmuch as whatever be the natural constitution, there are certain causes which will tend to abridge longevity, such as incontinence, intemperance, unwholesome diet,

* Smellie's “Philosophy of Nat. Hist.”, p. 509; Barr's Buffon, pp. 3, 4, 100.

† Smellie, p. 509.

and adopting many artificial habits; are there not also certain causes which in a corresponding manner, whatever be the natural constitution of the individual, will tend to increase longevity? To determine this point, we must decide the question how far artificial appliances are able to alter to any great extent those qualities of the frame already alluded to, on which longevity is supposed mainly to depend. In fact, the real and sole essential question at issue is this. Can any measure be adopted which will have the effect to any important extent of checking waste or expenditure, on the one hand, and of increasing growth or reproduction, on the other? This is a subject open to experiment in many ways of a most interesting kind. Certain waters, for instance, are said to have an effect upon the cartilages in the way stated; and it is to causes of this kind that the patriarchal longevity has been by some writers attributed. Probably their most powerful and direct effect is seen in the difference they appear to occasion in the duration of the life of animals that are domesticated and those that are wild.

Mr. Easton well observes that "the more a man follows nature, and is obedient to her laws, the longer he will live; and that the further he deviates from these, the shorter will be his existence".*

The question then arises, what are we to do in order completely and fully to follow nature, especially in our present highly-civilised, not to say luxurious, state of society, when so much that is entirely contrary to nature is peremptorily imposed upon us? Mr. Easton particularly recommends plenty of exercise, plain food, and fresh air. The two latter are, however, in many cases difficult to obtain.

The German writer, Hufeland, in his "Art of Prolonging the Life of Man," which is to a great extent based on Lord Bacon's work, already referred to, has arrived at certain conclusions as to the causes of the duration of life, which he considers to be dependent on the quantity of vital force contained in the body, and the promotion of the influences which contribute to decrease or diminish that force. He does not, however, even attempt to suggest any mode of producing or accelerating these influences, beyond stating that "a body which has the most perfect means of regeneration, both internal and external, will endure a longer time than one not provided with these means"; which is simply saying that a frame which is fitted to last a long time will last longer than one not so fitted, but without attempting to tell what we are to do to make the frame so last.

No doubt with our present limited scientific knowledge it appears far easier to shorten life than to prolong it. But if causes operate alike and with equal force in each direction, it must be

* "Human Longevity", *Introd.*, p. xi.

solely owing to our ignorance of the mode of rightly using these appliances that such is the case. We have proof positive, indeed, of the fact that "increased attention to the organic laws has greatly reduced the rate of mortality in Europe, and it cannot be supposed that further improvement is impracticable".* Considerable changes have accordingly taken place in the average duration of life in England during the last hundred years. At the early part of this period it was twenty-eight years. According to more recent tables it was thirty-two years; and it has been calculated that it may fairly be expected to extend to forty years.† From the tables of the average duration of life in Geneva during the last two hundred and sixty years, it appears that while from 1560 to 1600 the average was only eighteen years, from 1815 to 1826 it was nearly thirty-nine years.‡

Nevertheless, admitting all this, I must beg to suggest that it is clearly erroneous to contend that the increased average in the duration of human life affords any actual proof of increased longevity. All that it proves is, not that men are longer-lived than they used to be, but that owing to increased attention to sanitary laws, they are less frequently cut off by diseases resulting from the neglect of sanitary precautions. It is very possible, indeed, for mortality in a particular district to be very great, owing to the neglect of sanitary laws, and yet in the same district for remarkable instances of longevity to be found.

The entire question, therefore, resolves itself into the following simple points, the satisfactory solution of which will decide the whole matter at issue: 1. Are the statements which have been made to us by historians and naturalists as to the extraordinary longevity of the patriarchs, and other early inhabitants of the earth, as also of animals of a certain species, both in ancient and modern times, entitled to our credit? 2. Are the causes which have been assigned as occasioning the extraordinary longevity in question, such as may be reasonably supposed to have been productive of it? 3. Are these causes controllable in any way, and is it possible by any resort to artificial appliances extensively to increase or diminish longevity in the case of either man or animals?

The PHYSICAL CONDITION of CENTENARIANS, as derived from PERSONAL OBSERVATION in SIX GENUINE EXAMPLES. By SIR GEORGE DUNCAN GIBB, Bart., M.A., M.D., LL.D., F.G.S.

OPPORTUNITIES are seldom afforded of seeing centenarians, unless

* Combe's "Principles of Physiology", p. 387.

† Combe, "On the Constitution of Man", p. 234.

‡ Appendix to Combe "On the Constitution of Man", p. 434.