ritic. In the Libyan or Thugga, a cuneiform character was to be recognised, and there was a passage of hieratic and cuneiform through Cypriote. The system of survival was of wide application. He considered that in the present state of our knowledge, caution was required, and that we were not justified in attributing the origin of all alphabetic systems to the Phœnician. He called attention to the possible relations of the hieratic, cuneiform, square alphabet and magic or cabalistic character.

The author then replied.

The following paper was read by the author:—

STRICTURES *on* DARWINISM. PART II.—*The* EXTINCTION *of* TYPES. By H. H. HOWORTH.

HAVING dealt with one of the difficulties of Darwinism, I now proceed to another which is based on wider grounds, the objection being as much to the method as to the results of that system.

There are two methods of investigating scientific subjects, one is the empirical method, the other I would call the retrospective or historical method. The former is applicable to the investigation of a subject in which we can try experiments to test results. The other is a sounder and safer method, when we have to deal with the sequence of events in order of time, or when our problem is to discover the origin and progress of things; or to use a simile, the former is applicable to the study of the topography of nature, the latter to its genealogy.

Mr. Darwin's is a very profound and sublime attempt to trace out the genealogy of one aspect of nature, namely, that of life. No investigator that I know, ever approached the magnificent problem with anything like his power, ingenuity, wealth of illustration, and candour; but I believe that not only are his facts susceptible of a different reading, but that his method is faulty. I believe the problem can only be solved by the historical method, while he has attempted its solution empirically. He has employed an immense array of experiments to show how certain forms arise, and has then concluded that the laboratory of nature has been only an enlarged copy of his own laboratory and nothing more, and that "the increasing purpose that runs through all the ages," has been identical in aim and in results with the purpose that furnished naturalists with an encyclopædia of first-rate experiments, in the work on "The Variation of Animals and Plants under domestication." Mr. Darwin, on the other hand, has neglected that much more crooked and perverse method we must employ, if we start from the world of to-day, and work our way back to the origin of things, step by

step and link by link, as we do when we are writing the history of constitutions, of laws, of the arts, and of the progress of mankind generally. In all these we deem it a waste of ingenuity to argue what has been, from what may be, and the problem of the origin of life differs from such questions only in the kind of evidence, and not in the method of its investigation.

It may be said this is very true, and that the historical method is the best, but that it is extremely limited in its application; that while we deal with the narrow subject of man's history, we have evidence which enables us to construct a sound pedigree, but that when we go beyond this into the wider and more general problem, evidence of the same quality fails us, and we are left to analogies of a different kind altogether; and that instead of following the stream to its fountain head, we are forced by the limits of our problem to reason, *à priori*, from our experiments. I cannot admit this plea. That our evidence is scantier in the one case than in the other is partially due to the nature of the question, but much more largely to the elementary stage at which the discussion has as yet been carried. I cannot admit that because our facts are not so numerous as we should wish, we must therefore abandon them entirely in favour of such potentialities as we may deduce from our experiments. It may be true that one way of constructing a sphere which shall float about in space, is to blow a soap-bubble with a pipe; but my instinct revolts against deducing from this experiment, the result that this great sphere upon which we tread was similarly constructed. Just as my instinct revolts against the similar form of reasoning which would trace out the genealogy of life and its origin from experiments upon a few tame animals.

The moral of my argument is, that in investigating the problem of how one form of life *has been* substituted for another, we must neglect and cast aside, as worthless *for that purpose*, the evidence of experiments in our laboratory, and examine only those cases in which such substitution has actually taken place, and try to find out a cause from them—and thus test Mr. Darwin's theory. No part of that theory commends itself more thoroughly to scientific men, than that in which he bravely and most logically applies it to man. It cannot be seriously disputed, that man is in a great measure the creature of the circumstances that surround him, and that he is much less of a free agent in a great many turns of life, than was dreamed of in the days of the old philosophy; and especially is this true of man in a savage and barbarous condition. A civilised man can and does, in a great many ways, baffle the adverse influences that obstruct him. He can carry food with him to the desert, and make that desert habitable; but with the savage the case is different, with him

it is the same as with the lower animals. He is controlled very largely by the physical conditions that surround him. Æsthetic people who join the Alpine club, or hire yachts for cruising in the Greenland seas for the purposes of photography; benevolent people who go to Africa for the benefit of the black races (all honour to them), and *blazé* people who exchange coronets for seamen's clothes, and live the life of drudges behind the mast for years, are curiosities, but not very natural products of human caprice.

To the Esquimaux and Laplander it is a matter of profound surprise that men should be found willing to desert the sunny and abounding countries of the south, and to travel to their deserts, and they can scarcely overcome suspicion that some deep plot, or some folly does not underlie it all. They can understand emigration, when a country has become unendurable, because of the increasing rigour of the climate, the difficulty of getting food, or the redundancy of the population. Emigration then becomes a necessity; and although patriotism and love of country be virtues that develope in the inverse ratio of the pleasantness and ease of living, and like dogs, men become attached by misfortune, and by trouble, and a hard life to inhospitable homes, far more than by sunshine and ease, the limit is sometimes reached when they must go; just as the same limit is reached in the case of the migrating lemming and buffalo, the herring and the locust; and surely these external operating causes have been at the bottom of most of the great race migrations. Thus the Esquimaux have recently left large districts in Smith's Sound and the Arctic Archipelago, because of the encroachment of the ice, which in many places now occupies ground formerly more fertile and once thickly peopled. In Labrador, the Indian population has very largely migrated, and almost deserted the country, because the burning down of large forests has destroyed the game upon which they fed. Just as many hunting tribes of Indians in the interior have entirely changed their habitat, because they have had to follow the buffalo where he is to be found. The dreadful desiccation that is going on in the Kalahiri desert, in South Africa, has starved out the greater part of the bushman population, to receive tender mercy at the hands of the encroaching Boors.

It was the invasion of the sea that forced the Cimbri, according to their own account, to migrate; as it was some other natural phenomenon that eventually compelled the Avares to do the same. Biarmia, once a flourishing province, has become depopulated because of the increasing rigour of its climate. The potatoe famine drove the Irish in swarms across the Atlantic. It is the teeming homes and the vast fertility of the

population in England and in Russia that has forced the peopling of vast prairies in America, and river valleys in Siberia, just as the same cause probably drove the Norsemen to their well-known migrations; and so I might continue; and these facts show, that although the civilised man is more independent of circumstances than the savage, notwithstanding some superficial difficulties, both are subject to one general law, namely, that when one race of man invades and occupies the area previously occupied by another race, he is forced to move by some external pressure. Not only so, he is only one unit in a migration which affects the lower animals, and the plants as well. He is generally the precursor of a migration by which not only the race of men is changed, but the greater part of the fauna and flora are changed also. I shall revert to this presently. Meanwhile, let me deal with a superficial difficulty. The tendency in civilised countries seems to be to treat all plants and animals that do not minister to the wants or pleasures of men, as weeds and vermin, and it may enter into the dream of some philosophers, and with very great reason too, that when the whole earth shall be tenanted by a highly cultivated race, all the plants and animals which do not fulfil these objects will be eradicated, and we shall be living in an æra marked, palæontologically, by the remains of such men, and the animals and plants useful or pleasing to them only.

This utopian dream ought not to blind us to the real issue. If we examine the problem with some attention, we shall find that man's will has less to do with it than might be supposed. We shall find that although he carries his beeves and cattle with him, that even when the migration has taken place in the most artificial way, namely, across a wide ocean, the vermin of his own country travel with him—the fox and the rat, the cabbage butterfly and the thistle have also migrated despite his efforts, and where the migration has not been so artificial, namely, when it has taken place across the land, that man has only been a unit in it, and that the fauna and flora of one area have been bodily transferred to the other.

The ethnology of Asia (north of the Himalayahs and of Persia), and of Europe has been the subject of my special study for some years. The one grand fact which underlies the very puzzling migrations of the nomadic tribes that occupy a large portion of this area, is the uniform migration of one tribe after another, from north-east to south-west. The only exception being the sporadic migration of the Slaves from the ancient grand duchy of Muscovy. Putting this aside, the persistent direction of the migration has been very remarkable, and it has been, so far as we know, from the earliest times.

Here then we have a notable instance of the invasion of an ethnological province by the inhabitants of another, proceeding with a constant and continuous flow, and in order to trace back the stream, we have merely to unpeel, if I may use the phrase, the various layers of population that cluster round the Caucasus, or are to be found in the west of Europe, as we would unpeel an artichoke, until we arrive at the primitive, or rather at a primitive type. We may have no actual chronology at present as to many of these movements, but we cannot mistake their sequence, and in following their sequence we are adopting the historical method. Whether we depend upon the evidence of anatomy, or upon that of language, or upon that of art, and art remains for discriminating our types, we shall arrive at the same results—results which are far more satisfactory than *à priori* theories, or merely experimental conclusions. We can do this with man. Now, as I have already said, man is only a unit in such migrations. Let me cite a few examples.

To begin with the domestic animals. It is too much the fashion to treat our different breeds of domestic animals as products of the skilful breeding of our stock-keepers. The latter have caused some improvements in shape and other features, but they have done little to create really new types. It is a question which weaves itself very intimately with ethnological reasoning, but which has been hitherto much neglected in this country. Rutimeyer and others have had it too much their own way. Mr. Boyd Dawkins has shown reason for believing that the small black cattle of Wales and Ireland are descended from the bos longifrons, and further, that this bos longifrons was never wild in Britain, but was the domesticated cow of the Celtic and Roman inhabitants of this island. It is not found in the pleistocene deposits, and first appears in prehistoric times with the bronze using people. He has named it the Celtic shorthorn. During Celtic and Roman times, no other cattle appear to have existed in Britain than the small black shorthorn.

On the decay of the Roman empire in Britain, we find the northern parts of England occupied by a race which has not yet been properly discriminated. It is known in literature by the Arthurian legends, the poems of Merlin, etc., and quite a different set of traditions to those of the Roman provincials of either Gaul or Britain. It is known archæologically by a very unique and peculiar style of art, which has been especially studied by Mr. Franks, and which is known as neoceltic. I quote it, because with it apparently is associated the introduction of the semi-wild cattle with red ears, so much bepraised in the legends of the northern Welsh, whose laws fixed such a white cow as being worth one-and-a-half black ones, which once in-

habited the great northern forest, that stretched with unimportant breaks from Chillingham to Lyme in Cheshire, which was kept in the mediæval granges attached to the abbey of Whalley, and was hunted by the mediæval sportsmen, as many notices testify. In them they were styled bubuli and wild cattle. I believe no traces of it have been found in purely Celtic or Roman burials, and it would appear from all the evidence to have come in with the neoceltic folk. With the Teutonic peoples are especially associated the red cattle. In the Hebrides and other Western Islands, where the Norse element was the strongest, we have the so-called Scotch cattle in their greatest purity, and I learn from connoisseurs and natives, that the pure and proper colour of the Highland stall is russet and yellow red.

In Devonshire we have the same small red breed, only in a more cultivated condition, while on the border of Wales we have the Herefords, which would seem to be a cross between the white and red races. Mackenzie says the cattle of Iceland which must have been introduced by the Norsemen are very like the Scotch cattle, except that few of them have horns. Colour of hair has been deemed a sufficiently constant element in races of men to found distinctions upon, as for example in Professor Huxley's recent re-arrangement of Blumenbach's "Ethnography of the World", but this element has been much neglected in classifying cattle, although quite as constant in them. To proceed. The Lancashire long horn has given way quite recently and almost disappeared. It has been displaced by the shorthorn, not an improved strain of its own breed, but an invader from the north of Yorkshire and Durham. This again has been traced across the sea, and is probably the same as the big Holstein breed. This is a very bald summary of a very interesting and difficult question, which would I think well repay investigation. I quote it first to show that much which is popularly assigned to the breeder has a more remote origin, and further to show that when one type of ox has been supplanted by another it has not been by the creation of a new type by means of selection, but by the invasion of one area by the type existing in another, an invasion generally coincident with a human revolution of the same kind. What is true of the ox is true also of the sheep. I was told in Scotland that the four horned Highland sheep has almost disappeared, and is only to be seen in remote parts of Skye, etc. It has been displaced by the Cheviot, as the Highlandman has been dispossessed and had to migrate in great numbers and been replaced by the Lowlandman. The breed survives in out-of-the-way corners and also in Iceland. Sir George Mackenzie thus speaks of it. "The sheep of Iceland

appear to be the same as the old Highland sort, which is now nearly extinct. Many of them are entirely black, and a large proportion black and white." ("Mackenzie's Travels", 281.) It would seem, therefore, that the primitive breed of sheep as well as cattle in western Europe was black. Columella described long ago how the *black* rugged sheep of old Spain were improved (not by selection) but by the importation of Sardinian rams.

The old long-backed wiry big breed of pigs have been thrust aside in many places by the fat little breed which was, I believe, imported originally from China. I need hardly refer to the cases of dogs. How the pointer came from Spain, the smooth greyhound from Italy, and so on, or go over the list of fowls' names, which themselves show the many quarters of the globe whence they came. I shall consider how these varieties probably arose in the next paper, the moral I am pointing with them *now* is that as they exist in England they prove the migration of domestic races of animals, and are not instances of selection. Examples may be quoted from barbarous and savage no less than civilised life. Thus the invasion of the Kalmucks into Europe brought the Bactrian camel into Russia. The Esquimaux and the Indian tribes take their dogs with them when they migrate. The eastern mountain range of Manchuria has within the last two hundred years been occupied by nomadic Tungases called Oronchi. With them the same mountains have been invaded by the reindeer. On the banks of the middle and lower Lena live the Turkish tribe of the Yakuts. They are an intrusive race, and only went there recently. Travellers describe their tradition, how with them went their herds and horses, and that now the Yakut cattle and the white Yakut horse are a distinct feature in the country, and so I might continue. The history of domestic plants is the history of the introduction of the products of one country into another; we have certain cases of the improvement of indigenous wild stocks, but these are a very small proportion; *ex. gr.* the almond and the peach came from Persia, the damson plum from Damascus, maize and tobacco from America, six-rowed barley, I believe, from Egypt; and so I might fill volumes with the tedious list. Corn was probably imported into Central Europe with the Arians when they came from the Thibetan highlands, just as it crossed the Indian ocean to Australia and the Atlantic to America with the same race. As the balance of evidence goes to show that the restless Arabs imported the silkworm into Europe, they also probably brought the mulberry and the Tangierine orange.

We thus see that each race of invaders has been accompanied by a different breed of domestic animals, each breed successively and more or less displacing a previous one. If we extend our view

somewhat beyond the historic period into prehistoric times we shall find that the gradual invasion of Europe by the Arians, who hailed from the highlands of central Asia, was coincident with the displacement of the fauna known as prehistoric by a fauna whose original home was the cradle of the Indo-European race. We shall find that the various domestic animals and plants that came in with the Arians are properly indigenous to the highlands of Thibet and their surrounding country, the homeland of the Arian people. We shall find also, that as the previous inhabitants of Europe were driven into the mountainous and uninviting corners of that continent, so also were the characteristic animals of the earlier period. The elk and the bison into Lithuania and the Caucasus, the wolf and the bear into the Pyrenees and the South German forests, the reindeer into Scandinavia, etc. The latter class is now rapidly diminishing, and will probably soon be gone, and we shall have in Europe a fauna which has not been developed by any natural selection, but has come in as an invader from another area altogether, and has monopolised it. This is by no means confined to Europe. In Australia the kangaroo is giving place to the sheep, the emu to the turkey and goose. The parrot is gradually retiring before the sparrow, the ornithorhyncus before the rat, the bee and the cabbage butterfly are evicting the indigenous insects, and very probably before long the salmon and the European silurus will have replaced the native fishes. In Canada, the moose and the glutton are disappearing before the fat beeves and shepherds' dogs. At the Cape, a very diversified fauna has been almost eradicated contemporaneously with the disappearance of the Hottentot race. On the river Plate, vast herds of horses and cattle now pasture the formerly almost deserted pampas. In all these cases the Indo-European race has invaded fresh areas, and its advent has been the signal for a great revolution in the zoology of those countries, in which the ancient animals have been replaced by others having an entirely different pedigree. The same law holds good of plants. We are now witnessing in Lancashire the progress of one of these botanical revolutions, the yew, the oak, the ash, and the hazel, which formed the woods of mediæval times in that county, and whose remains are turned up in almost every bog, these are rapidly disappearing and giving place to elms, sycamores, beeches, and limes. These latter are comparatively recent migrants into that cold and damp county, and are not to be found in the few shreds of the old self-planted woods that still remain in retired corners. This is only a portion of a much wider revolution which has been examined by Sir Charles Lyell, the Danish antiquaries, and especially by Mr. Jones, in an essay printed in the "Geological and Natural His-

tory Repository", vol. i, 73, from which I shall freely borrow. Speaking of the well known succession of the pine, the oak, and the beech in Denmark as marking roughly the stone, bronze, and iron periods, he says, the earliest of the Scotch firs grew in Denmark subsequently to the glacial period and to the formation of a considerable depth of peat. It often attained three feet in diameter there, which proves that the soil and climate were well suited to it. The tree is not now a native of the Danish isles, and when introduced there has not thriven, although evidently indigenous during the human period. (Lyell's "Antiquity of Man," 9.) With this tree have been found remains of the Norway spruce fir, the white birch, the aspen, and the hazel, all of which are still its companions in the forests of Norway, from Christiania to Drontheim, and even further north. It grows best and attains the greatest size combined with strength and durability in high latitudes, or at corresponding altitudes on mountains. In great Britain it only attains full dimensions and perfection in the Scotch highlands. The Pyrenees are its southern limit.

Fragments of fir probably of this species have been found in a peat bed overlying the boulder clay at Hoxne in Suffolk, others have been found in a similar peat bed at the mouth of the river Cauche, which falls into the sea not far from the embouchure of the Somme. (Lyell, *op. cit.* 168, 169.) Again, "No tree now grows in Orkney or Shetland. The only ligneous things that do grow are the cetula alba and common juniper, both merely existing as shrubs; but at six feet beneath a peat bog, trees, branches, leaves, and cones ascribed to the silver fir have been found. One tree in particular of six feet in circumference and forty feet in height being recorded by Mr. Edmonstone as having been found in peat in Shetland. (Murray's "Geographical Distribution of Mammals", 40.) In regard to the species of abies, Mr. Jones goes on to say, that although their wood is said to occur abundantly in our ancient mosses, it is not a little singular that a reference to the commonly consulted botanical works of the day will go far to confirm the correctness of Cæsar's statement that of the trees found in Gaul the abies was wanting in Britain, as of all the species now cultivated in this country not one is claimed as indigenous. (Jones, *op. cit.* 75). Here then we have the disappearance of a whole botanical facies, namely, that of the linear leaved trees from very large areas in Europe; and as the evidence of the Danish bogs where the remains lie over one another in regular succession just showed us, they were succeeded by a facies of palmate leaved trees, oaks, etc.

It is interesting to travel somewhat further to the east and to see this very same displacement of the pines and firs by the

birches, etc., going on at the present moment. I shall extract from the pages of that most admirable traveller, Erman. Speaking of the predominance of the birch in certain parts of Siberia, he goes on to say: "A story handed down from the Mongolian aborigines is still currently received here to account for this striking distribution of forest trees. My Kosak's narrative was to this effect: the Buraets (Bratskie) were forewarned of the coming of the Russians by a miraculous event. A growth of white trees, birch, had suddenly sprung up and displaced the black or pine forests, an omen that the swarthy natives would fall under the yoke of the fair Russians. This tradition is preserved even in the written chronicles of Siberia, and is further elucidated by the fact which I first became acquainted with among the Ostyaks of the Obi. *In every instance where the linear-leaved genera of trees have been destroyed by fire, it has been remarked that they have been succeeded by those with expanded leaves.*" (Erman's "Travels", ii, 157.)

Here we have therefore, apparently, examples of a general law affecting the displacement of one set of forests by another of an entirely different genus, and found to apply to Britain, to Denmark, and to Siberia, a displacement concurrent in native tradition with a similar zoological revolution affecting man as well as the lower animals. The process is anything but that of natural selection. There is no gradual development of one form of forest tree from another, but the sudden disappearance of one form and the as sudden appearance of another entirely different and entirely unconnected with it. Further, there is no struggle, no elbowing out, but the decay and death of the one followed by the appearance of the other. Let us continue. When the firs and pines disappeared they were replaced by oaks and ashes. Such is the succession in the Danish bogs—such is the succession also, as far as we can make it out, in Britain. Sir Charles Lyell says: "It appears clear that the same Scotch fir was afterwards supplanted by the sessile variety of the common oak, of which many prostrate trunks occur in the peat at higher levels than the pines, and, still higher, the pedunculated variety of the same oak occurs with the alder, birch, and hazel. Other trees, as the white birch, characterise the lower part of the bogs, and disappear from the higher, while others again, like the aspen, occur at all levels, and still flourish in Denmark." (Lyell, *op. cit.* 9.)

Again, in the crannoges of Ireland, all the platforms are made of oak, so was the old log cabin found at Drumkelin, surrounded in the latter case by the stumps of the oak tree. The canoes also found there were of oak. As Mr. Jones suggests, if the fir had then existed in any quantity, it would assuredly have been

used for these purposes. The texture of the wood was not a matter of indifference when it had to be hewed with stone axes, and "the felling and splitting into planks of pines and firs, and the hollowing them out into canoes would have been comparatively easy, and we may reasonably conclude that when oak was used the wood of those trees was not immediately available. The oak vegetation continued in Denmark down to the close of the bronze period. It was succeeded by the beech forests, which coincide roughly with the iron period." In the time of the Romans, the Danish isles were covered as now with magnificent beech forests, yet, in the antecedent bronze period, there were no beech trees, or at most but a few stragglers, the country being then covered with oak. In Britain, the beech was probably a later introduction, for Cæsar mentions that in his day it was not known here; and, as Mr. Jones says, no mention is made of it as occurring in any of the geological formations with other trees now growing here. We have reason to suppose that it is a comparatively recent addition to our sylva as well as to that of Denmark, and that it never flourished here in any previous epoch to the present (*op. cit.* 78).

These cases of the forests are amply supported by the humbler plants. Is not the native brush of New Zealand, which is ruthlessly swept away by the settlers' fires, replaced by thistles and other European weeds, just as rye grass and clover are thrusting out the old prairie grasses of America. Have we not seen, even in a few years, large tracts of heath disappear, not by cultivation, but died out, as it is dying out in many parts of Lancashire, and being replaced by the bent grasses, etc.

Nor is the revolution at all limited to one area. Thus, Raggewin, in 1722, described Easter Island as full of trees which were in full fruit. Such trees are not now known there; but Mr. Palmer tells us that he saw boles of large trees, Edwardsia caco-palm and hibiscus decaying; while, from the size of some of the paddles and rapas, large trees must have once existed, while now the only approach to wood is found in the sheltered nooks, where bushes of ten and twelve feet high, of hibiscus Edwardsia, Broussonetia, etc., are to be found. Their rate of growth is very small. ("Journal Geographical Society", ii, 167 and 168).

In Mr. Bennett's "Journal of a Voyage Round the World," speaking of Tahiti, he says: "The guava shrub has overrun Tahiti in spite of every attempt to check its increase. Woodlands and bush for miles are composed solely of this shrub, which bears a profusion of large and delicious fruit. It was only introduced some twenty years ago (*i. e.* 1813-1816) from Norfolk Island. (Same Journal, vol. vii, 225.) This is almost a

parallel to the terrible invasion of the Cam and other rivers by the American water-weed so innocently introduced by the botanical professor.

These examples will suffice to prove that what is true of animals is true of plants also, namely, that when one type is supplanted by another, in a very great number of cases, it is not by the evolution of a fresh type from the old inhabitants by means of natural selection, but by the invasion of one area by the inhabitants of another. This is true of such cases as we can test as in progress now or recently; and if we search the geological record, and if we find there that after a certain time the fauna and flora of an area are suddenly changed, that successive strata are filled with the wreckage of entirely distinct faunas and floras, we shall be driven to the conclusion (tentative, perhaps, but the best we have), that the same law held good in all time, and that types then, as now, were supplanted in the main by types coming from other areas, and not by the evolution of fresh types from their own body. We will next inquire a little more closely into the *modus operandi* of this change. Putting aside the artificial conditions induced by civilisation, we shall find that the decay of one type and the aggrandisement of another are more closely co-ordinated than we might expect, and that both are probably due to an alteration in the climate and other life conditions in a country.

Let us begin with some very superficial and easy examples. It requires no philosophy to prove that what the strong covet and the weak cannot protect must eventually go to the strong. Nor does it need any philosophy to prove that where one race evicts another that it must be endowed with the balance of advantages in the struggle. The North American Indian and the Indian of the Spanish main have been driven out and destroyed in large areas by the white race of Europe, whose greater vigour, whose rifle and whose skill in war, *it is said*, have been too much for him.

The same is true of the Carib population of the West Indies and the Guanches of the Canary islands. In Australia Christian people in the bush are in the habit of hunting down the black man as they do kangaroos, a species of sport which seems also to have been favourably patronised by the Boors in south central Africa, who are making short work of the few remaining Bushmen (if they still survive). The Chinese have done the same good office for their barbarous relatives, the Miautze. The Maories for the previous occupants of New Zealand, a few of whom remain in the Chatham islands. The Mongols desolated whole empires and destroyed hecatombs of people in their invasions in the thirteenth century; and so we might continue.

The forcible supplanting of one race of men by another is an elementary postulate of history. These invasions by man have led to the destruction of large numbers of wild animals. We know how the wolf, the bear, the wild boar and the golden eagle have been extirpated from Britain. The books are too numerous on our shelves which describe the butcheries committed upon the South African animals, upon the American buffaloes, etc., etc., by benevolent sportsmen. While naturalists are proverbial in their greed for acquiring dried specimens to feed their moths upon, for their apt and cunning skill in exterminating rare animals and plants. Nor are civilised men alone in these feats. The New Zealand Maories are, according to the best authorities, a recent race of immigrants from the Sandwich Islands. With their arrival it is generally held that the doom of the great apterous birds of New Zealand was sealed, and that their greater skill and power led to the destruction. The Russian sealers are credited with the destruction of the Sirenia, etc., etc. Nor, again, is the feat confined to man only, the brown rat of Norway is supposed to have forcibly ejected the European black rat. The red-legged partridge has done the same for the English grey partridge in many districts, and so on. These and such as these are triumphantly quoted as instances of how a vigorous type has elbowed out a weaker type; but granting this to be so, it is anything but a support to Mr. Darwin; there has been no natural selection from the inhabitants of a country of a stronger and more vigorous element, but a displacement by strangers.

But it may be that in granting this we have granted too much. This method of displacement appeals at once to our casual observation, and we are apt to be misled into making it much more potent than it really is, or rather in mistaking one of the effects for the cause. The fact is, that when the invasion of one zoological or botanical province by the fauna and flora of another takes place, the original tenants have already begun to decay. It is an article of belief with many ornithologists, that the great auk disappeared entirely because of the ruthless conduct of the cod-fishermen, etc.; but the great auk that was killed so rapidly on the islets off the Labrador coast was only the expiring remnant of a bird that had a very wide range. Its remains have been found on the islands skirting Greenland, and other Arctic coasts where the ruthless fishermen have never been. There it has disappeared from some more remote cause than the destructive propensities of man. The same argument applies to the sirenia, whose romantic story has furnished material for so many Russian essays from the days of Steller to our own. The whale has deserted the shallowing coasts of Siberia and much of the Arctic borderland, not because of man's persistent persecution, for he could

hardly navigate the areas I refer to, but because of the gradual rise of the sea bottom and the shallowing of the water. The dodo was finally killed off by the Dutch, but we know that long before the Dutch knew the Mauritius, the islands of the Western Indian Ocean had lost several of their birds near relatives to the dodo, and that it was only an expiring fragment of an extensive avifauna that had passed away, and in searching for a cause we find the most probable one to be, that a vast continent has here sunk beneath the waves leaving only a few detached points above water, whose scanty surface typified the decay and disappearance of many forms of life, not by the mutual struggle of individuals but by the more potent cause of the invasion of the land by the sea. We cannot point our moral better than by instancing also the celebrated Californian big trees, and the solitary specimens of certain Baobabs and other African trees (the Dragon tree of Teneriffe being a notable example) which remain mere echoes of the world of yesterday. When naturalists and other destructive creatures shall have felled these relics, and hung and dried and labelled them in museums, *we* shall consider that they have merely finished the work which was already nearly complete, and shall by no means charge them with the heavy crime of having been the sole authors of the work. On turning to man, we find much important evidence on this subject. The Polynesians are rapidly disappearing from the South Sea islands. The census of several of them by the missionaries shews how frightfully they have diminished since Cook's voyage. In this case there has been no savage uprooting and killing, as in Australia and the Western States of America; but rather much fostering care on the part of the missionaries. Among the Indians of California the same result has taken place, and so elsewhere. Let me quote a passage or two. In some notes on Upper California by Mr. Coulter, in the sixth volume of the "Geographical Journal," he says:—"In Upper California the aboriginal inhabitants have diminished considerably, though in this case one would suppose they ought at least not to have lost ground, not having been driven from their homes as in the United States, nor having had ardent spirits at all within their reach until lately." Mr. Coulter then proceeds to shew, as I pointed out in the previous paper in the case of the Maories, that this gradual extinction is accompanied by a great diminution in the relative number of women to men. Again, in speaking of Pitcairn's Island, Mr. Bennett in the seventh volume of the same Journal, page 213, tells us there were inhabitants there before the mutineers from the "Bounty," skeletons and stone remains of an extinct race have been found on the island. Mr. Bennett not unnaturally is led to inquire what causes can have operated to extinguish this race in such a fruitful island, and

concludes that it was one of the epidemic diseases that occasionally scourge the Pacific islands. Here we meet with a cause of extinction which has been potent indeed, and which has been very much neglected so far as my knowledge goes by Mr. Darwin; but before treating of epidemics, let us consider a curious instance as a type of another class of cases.

The conditions under which animals thrive have never been treated in a scientific manner. Such a problem as the existence of the mammoth in Siberia has been treated in an extremely empirical manner. One school of writers will have it that the Mammoths must have lived in the subtropical parts of Asia, and been floated by the northern rivers to where their carcases are now found. Another set of inquirers point to the researches of Middendorf, and others to prove that the mammoth lived where his bones are now found; but the inquiry into the question of the conditions under which a mammoth, a hyæna, and a reindeer could live together has, if I am not mistaken, never been adequately made, and before it has, it is absurd to deal with the smaller question. Let us begin with the reindeer. Why will not the reindeer now live in Scotland? The attempt to introduce it has been made more than once, the experiment has been described in considerable detail in Mr. Arthur de Capell Brooke's "Travels in Lapland," 76, *et seq.* *Inter alia*, he says:—"The reindeer moss, contrary to expectation, was not only found abundantly in Scotland, but in most parts of England, particularly on Bagshot Heath, while the climate and even latitude of Scotland did not materially differ from the part of Norway whence they came. Notwithstanding these favourable circumstances, they died one by one, till I believe none remained in Scotland." It cannot be that the moss is not of the same quality, for, as Mr. Brooke says, the reindeer is by no means particular; it eats the leaves of the birch, sallow and aspen, particularly the former, and browses also upon the young herbage and the tender shoots of the mountain shrubs. He gives a long list of the plants upon which it habitually feeds in summer (*op. cit.*, 88 and 89). He also tells us that it is sometimes fed on hay in the winter. In this he is supported by Mr. Laing, who says, that it eats grass and hay as well as moss. It lives on moss because there is nothing else to live on in the Fjeld ("Residence in Norway," 264). There is, therefore, no reason in regard to its food why the reindeer should not now live in Scotland. On turning to Iceland we have a different tale to tell, twenty-four does were embarked from Hammerfest in Finmark for that island. They succeeded very well and were soon so abundant that Sir George Mackenzie, in his work on Iceland, says, they are not unfrequently seen there on the mountains in herds of sixty or one hundred together. It is more pertinent

and remarkable that in Scotland the reindeer existed in comparatively recent times. One of the Norse Sagas mentions the hunting of the reindeer in Caithness; and this allusion, which alone might be suspected, has been amply confirmed, as I have the authority of my friend Mr. Boyd Dawkins for saying, by the discovery of the broken bones of reindeer in the refuse heaps of the Pictish burghs.

It is clear, therefore, that some change has occurred recently in Scotland adverse to the mode of life of the reindeer. The obvious cause of this, at first sight, would be said to be that the reindeer thrives best in the coldest and most exposed situations. That Scotland and southern Norway are too warm for it, while Spitzbergen, Greenland, and Siberia are its more natural habitats, and this proves in some measure to be confirmed by the fact that reindeer formerly in not remote times lived in Scotland, at a time when we have many reasons for believing the climate there was much more severe than it is now. This view would be partially, but only partially correct. Mr. Capell Brooke tells us that at the same time when the imported reindeer were dying in Scotland others kept in confinement and experiencing the very opposite reverse to their former mode of life, not merely survived but remained healthy and vigorous, withstood the effects of a London season and an atmosphere most unusual to them, that of a room frequently crowded to suffocation, (*op. cit.* 79.) Reindeer thrive in the mountains north and east of Mandchuria, a comparatively temperate region, and lived until quite recently, if not now, in the southern Urals. On turning to Mr. Laing's most admirable narrative of a residence in Norway I find the following passage, which I believe solves the difficulty. Speaking of the hair and skin of the reindeer, he says, the former does not throw off wet well, and even parts from the skin after any continuance of moisture. With our damp climate and wet ground, the animal would be drenched through the hair to the skin for weeks together, and would die of cold or rot, as our sheep often do in wet seasons. In Norway the heavy rains occur in spring or autumn, at which seasons what is rain below is dry snow higher up in the Fjeldes. Our highest hills do not afford in summer this kind of refuge from rain and damp to an animal whose coat keeps any degree of cold, but will not stand continued moisture. (Laing's "Residence in Norway", 264). It is the damp of our latitudes nowadays that the reindeer cannot endure. It is strange that no use has been made of this fact hitherto in zoological reasoning; for it is a very potent reason why so many foreign animals die here. In our menageries the beasts do not suffer so much from cold and other assigned causes as from damp. Diseases of the lungs are the scourges

of such establishments, and these induced not by cold but damp. The camel, the tiger, etc., can endure the exceedingly bitter cold of the Thibetan plateau with impunity, because the cold is a dry parching cold. The lion, which lived in historical times in the rugged mountains of Thrace, need not fear the cold of our winters, but may well dread our damp seasons, which make such havoc even among our acclimatised people. That our climate has grown damper is probable from the contemporaneous extinction of the spruce fir with the reindeer, the former of which, as well as the other linear leaved trees, according to Ermann, especially likes a dry air. Such climatic changes would probably be first felt by the vegetation, and what affects it would naturally affect the animals feeding on it; and here we get to another cause of the extinction of certain types. With the disappearance of the forest, the forest animals disappear too, notably, the elk, the sable, etc. Let us now turn to the more obvious and patent destruction of types by epidemics, etc.

Few subjects of equal interest have received as little study as the curious and well-attested fact, that when small island communities are visited by strangers, although the latter may be in perfectly good health, the former are at once seized with complaints of various kinds, severe catarrhs, etc. The fact has been observed and commented upon not only in the Pacific islands, but so near home as St. Kilda. The very arrival of the invading colony being a danger to the indigenes. If this be so when the invaders are well, it becomes much more terrible when they are partially infected. Once Iceland was a thickly peopled and prosperous island. The story of its depopulation is not a bad type of other areas. "The eighteenth century was ushered in," says Sir George Mackenzie, "by a dreadful mortality, consequent upon the small-pox, which in 1707 raged with such epidemic violence as to destroy more than sixteen thousand of the inhabitants. The years between 1753 and 1757 were very inclement. The cattle perished in vast numbers, and a famine carried off nearly ten thousand people. In 1783 a terrible eruption occurred, in which more than eleven thousand people perished." Such ravage in such a harsh climate and position necessarily tends to the extinction of the inhabitants, and we cannot doubt that the once teeming cities of Mesopotamia and Persia were to a great extent cleared out by such visitations.

In reading the history of Asia and of America, there is no more painful chapter than that which deals with the ravage caused by small-pox, etc., among the indigenous tribes before the actual occupation of their territories by the Russian and Anglo-Saxon races. Let me quote a few examples. The Esquimaux are a race rapidly being extinguished by the small-pox. The

various accounts of Smith's Sound and other arctic districts speak of the great number of ruined huts, etc., existing in areas now nearly deserted by Esquimaux, while the burden of the tale is the same everywhere. Alas, said the Esquimaux Kalutunah to Dr. Hayes, we will soon be all gone. I told him that I would come back and that white men would live for many years near Etah. "Come back soon", said he, "or there will be none here to welcome you." Their number had greatly diminished since Dr. Kane was there. ("The Open Polar Sea," 386.) But the fact is confirmed by every Arctic explorer.

Franklin and others have told us the story of the depopulating of the Hudson's Bay territory, not by English muskets, but by the small-pox. The same is true of the Indians of the western prairies, of those west of the Rocky Mountains, of the Kamtkadales, of the various Siberian tribes, in fact, if I were to empty my notebook of its authorities, I might quote them from nearly every part of the world, and quote many cases where tribes like the Yeiniseians have actually been swept right out and only a few straggling individuals left. The small-pox is not alone in this, the whooping cough and measles have been almost as destructive in South America and the Pacific. The plague has gone before the white man and swept a clean road for him, so that when he has gone in to occupy he has had no struggle with another race, he has merely killed off the last perishing remnants of it and occupied its country. Is this natural selection by the mutual struggle of individuals, or an illustration of a deeper law by which one type disappears and is replaced by another from a foreign country? I cannot see the selection, for mark a curious fact hitherto unrecorded so far as I know. The small-pox, the cholera, etc., etc., have not carried off the weak and decrepit mainly. These generally survive the attack. In my own village, we have recently made an elaborate examination of every case during the epidemic, and we find that it was the strong, and hearty, and vigorous who died, like rotten sheep, while the sickly and weak recovered. This only confirms the fact that it is not in civilised communities, where man's physical qualities are so materially weakened, or in the population of our large towns, that we must search for proofs of the awful fatality of the small-pox, etc., but among the Tartars of the golden horde, the Siberian tribes, the Indians and Polynesians, the heartiest and strongest, and, generally speaking, healthiest of men. If, therefore, it be claimed paradoxically that this process of extinction is an element in natural selection, a claim which I can hardly credit will be made, I may at least add this to the cause urged in the previous paper of this series, which is constantly operating to reverse Mr.

Darwin's hypothetical law that the weak and decrepit are constantly being elbowed out by the strong. I have drawn attention to the effects of epidemics in extinguishing types of man, but this devastating of whole tribes and races by epidemics is by no means a mere human infirmity. The cattle plague, and other similar visitations, bear testimony to its being a much more general cause, one, too, affecting not only domestic animals, but wild ones also. When the epidemic carried off the Esquimaux, a contemporary attack also prostrated and killed their dogs. I find the following passage about the beaver of America in Richardson's "Northern Zoology." "In some seasons a great mortality occurs among the beavers from some unknown cause, many being found dead in their lodges."

It is not very long ago since our moors were devastated by the grouse disease. Still more lately the mortality of guillimots and razor-bills all round our coasts was the subject of much correspondence in the papers.

In King's Travels in Siam and Cambodea, "Journal of the Geographical Society", xxx, 181, it is said wild animals of the country are not so numerous as might be supposed. *The natives say that twenty years ago an epidemic swept off immense numbers of them.*

In Hayes' "Open Polar Sea", p. 196, I find this sentence:—"Disease had been for several years prevailing among the dogs of southern Greenland, and a large proportion of these useful animals had fallen victims to it. The cause was not determined, but he had reason to believe it was of local origin." Again, p. 260, an Esquimaux chief complained to Hayes that "Death had made fearful ravages among his people since I had seen them five years before. He complained bitterly of the hardships of the last winter in consequence of a great deficiency of dogs, the same distemper which swept mine off having attacked those of his people. *Indeed the disease appears to have been universal throughout the entire length of Greenland.*"

Mr. Owen kindly favoured me with the following note:—"Up to 1845, the wild pig was swarming in the Rohilcund Terain. When I went into that jungle in 1846, I only heard of two litters in the whole district I visited, they died out, so it was said, from a disease of the foot."

There are some cases of extinction which seem referable to this cause alone: thus the weasel was once found in Ireland, it is there no longer. It cannot have succumbed to a struggle for existence, nor are Irish gamekeepers cleverer at exterminating vermin than English ones.

Epidemics are not confined to animals, they also attack plants. The potato disease, the rust in corn, the blight in apple-trees,

are familiar cases among domesticated plants. Not long ago whole forests of larches in Scotland were stricken with disease and died; and if our examples are few, it is partly because our time is short and the subject has not been much studied. With the disappearance of the forests the forest creatures go too. It has been noted, both in America and Siberia, that the burning of forests has caused the desertion of large tracts of country by the elk, the sable, etc., and that these animals have returned again with the growth of the young trees. I believe that the chief cause of the extinction of the Irish elk was the destruction of the forests which we know to have covered Ireland at one time. It was probably the same cause which extinguished the capercailzie in Scotland, where we know it was found in prehistoric times.

There is a vast revolution going on in South Africa just now, which is fast extinguishing large herds of wild animals. The whole country is rapidly desiccating, rivers and pools are drying up, and the great Kalahari desert is spreading its borders very rapidly. Moffat and Livingstone have both collected large stores of facts on the subject. I will quote only one or two examples. "At Lapepe and other places on the road to Lake Ugami, as well as in Damara land and other places, but especially in the territory of the Bakwain tribes, this desiccation has gone on. Such streams as the Mahalapi river and those at Lopelale and at Porapora pass are pointed out where thousands and thousands of cattle formerly drank, but in which water never now flows, and where a single herd could not find fluid for its support. The same cause is assigned for the desertion of many parts of Labrador by the fur animals. In the Kuruman river, fourteen miles below the Kuraman Gardens, places are pointed out as having contained within the memory of men now living hippopotami, and pools sufficient to drown both men and cattle, where not a drop of water now flows.

Again, the traditions of the natives point to a more remote period when the country was far more fertile and much better watered than now, when the Kuruman and other rivers, with their impassable torrents, were something to boast of, etc., etc.; and, to confirm this, immense numbers of stumps and roots of enormous trunks of the acacia giraffe are to be found where scarcely a living specimen remains; and in the dried up beds of many ancient rivers, positive demonstration is to be seen of the former fertility of the Bechuana country." Similar accounts may be found of the rapid drying up of North Western India, of Khorasan and its borderland, of Australia, etc., etc., with the same result, namely, the extinction of a considerable flora and fauna. We do not read of any struggle for existence by which

new types are evolved more fitted to combat with the new condition of things, but the utter extinction and depopulation of whole areas, and their gradual invasion by another fauna and flora.

The extinction of the crocodile and the hippopotamus in Palestine, are puzzling examples, so is the hecatomb of mammoths, rhinoceros, etc., whose bones fill the Siberian tundras, and who died when in good condition apparently, not in solitary recesses of the forest, like the elephants of Asia, but in herds. Here probably we must invoke the influence of some epidemic, unless the whole were drowned by some sudden convulsion by which the deserts that extend from the Caspian to Mandchuria were emptied of their waters. In all these cases, nay, in every case I know, the extinction of species has not been due to the mutual struggles of individuals, but to some external widely operating physical cause.

I have now said enough for to-night. I have endeavoured to show, and I hope I have succeeded in showing, that when we leave the hypothetical cases and the empirical cases, which we have drawn, either from our *à priori* reasoning, or from our laboratory, and inquire into the actual cases which are occurring in the great laboratory of nature herself, we find that types of plants and animals are supplanted by other types, by no selection of survivors from a mutual strife among their members, but by the immigration of strangers and foreigners; and that this has probably been true of all time, and if so, I have called attention to a radical misreading of the evidence by the school of Mr. Darwin. I do not say that variation among individuals does not exist, and that types sometimes change insensibly. It would be monstrous to say so. I shall treat of this in my next paper of this series, on "Gradual Variations." But I say that in the great majority of cases of extinction of types which we can subject to criticism, the revolution has taken place through the operation of external cause, and not by natural selection.

Discussion.

Professor Rolleston said that Mr. Howorth had very clearly shown that in many cases, species and varieties had come into the possession of particular areæ by means, not of any change for the better in their own organisation, but of certain advantages which that organisation gave them when pitted against the earlier occupiers of the countries in question. But Mr. Darwin had never ignored these facts, and Mr. Howorth might see that in the case of one variety overcoming another variety of the same species, even on his own showing, the difficulty had been only put back one stage. For granting all his undeniable instances, one asked how had the one variety contrived to come to vary. Variation

within the limits of a species was a process which our lives were long enough to allow us to watch, and from what we did see of it, we reasoned to what, it was true, we did not see of the perfect manufacture of species. There were, he allowed, many facts in biology for which Mr. Darwin's doctrines had not furnished an explanation; such were the colouration of the eggs of birds and of the shells of bivalve molluscs.

The author replied and the meeting separated.

JUNE 17TH, 1873.

Professor BUSK, F.R.S., *President, in the Chair.*

THE Minutes of the last Meeting were read and confirmed.

The following presents were announced, and the thanks of the meeting voted to the respective donors; and a special vote was accorded to Mr. Winwood Reade.

FOR THE LIBRARY.

From the AUTHOR.—The Darwinian Theory. By J. L. Laird.
From the INSTITUTE.—The Canadian Journal, vol. xiii, No. 6.
From the COMMITTEE.—Eleventh Annual Report of the Free Libraries Committee, Birmingham, 1872.
From JAMES BURNS, Esq.—Human Nature for June 1873.
From the SOCIETY.—Proceedings of the American Philosophical Society, vol. xii, No. 89.
From the EDITOR.—Cosmos (an Italian Geographical Magazine), No. 2.
From the SOCIETY.—Proceedings of the Royal Society, vol. xxi, No. 144.
From the EDITOR.—The Food Journal for June 1873.
From the SOCIETY.—Transactions of the Orleans County Society, vol. 1, Nos. 4 and 5.
From the ACADEMY.—Fourth Annual Report of the Trustees of the Peabody Academy of Science, 1871.
From the COMMISSION.—U. S. Sanitary Commission in the Valley of the Mississippi, 1861-66.
From the EDITOR.—La Revue Scientifique, Nos. 49 and 50.
From the ASSOCIATION.—Journal of the East India Association, vol. vii, No. 1.
From the EDITOR.—The Spiritualist, for June 1st and 15th, 1873.
From the AUTHOR.—The African Sketch-Book, 2 vols. By Winwood Reade, Esq.