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SECTION D.

ZOOLOGY.

OPENING ADDRESS BY P. CHALMERS MITCHELL, D.Sc., F.R.S., PRESIDENT OF THE SECTION.

Zoological Gardens and the Preservation of Fauna.

In thinking over possible subjects for this Presidential Address, I was strongly tempted to enter on a discussion of the logical methods and concepts that we employ in zoology. The temptation was specially

strong to a Scot, speaking in Scotland, that he should devote the hour when the prestige of the presidential chair secured him attention, to putting his audience right on logic and metaphysics. But I reflected that zoology is doing very well, however its logic be wavering, and that as all lines subtend an equal angle at infinity, it would be of small moment if I were to postpone my remarks on metaphysics. And so I am to essay a more modest but a more urgent theme, and ask you to consider the danger that threatens the surviving land-fauna of this globe. A well-known example may serve to remind you how swift is the course of destruction. In 1867, when the British Association last met at Dundee, there were still millions of bison roaming over the prairies and forests of North America. In that year the building of the Union Pacific, the first great trans-continental railway, cut the herd in two. The southern division, consisting itself of several million individuals, was wiped out between 1871 and 1874, and the practical destruction of the northern herd was completed between 1880 and 1884. At present there are only two herds of wild bison in existence. In the Yellowstone Park only about twenty individuals remained in 1911, the greater part of the herd having been killed by poachers. A larger number, more than three hundred, still survive near the Great Slave Lake, and there are probably nearly two thousand in captivity, in various zoological gardens, private domains and State parks. It is only by the deliberate and conscious interference of man that the evil wrought by man has been arrested.

A second example that I may select is also taken from the continent of North America, but it is specially notable because it is sometimes urged, as in India, that migratory birds require no protection. Audubon relates that just a century ago passenger pigeons existed in countless millions, and that for four days at a time the sky was black with the stream of migration. The final extinction of this species has taken place since the last meeting of the Association in Dundee. In 1906 there were actually five single birds living, all of which had been bred in captivity, and I understand that these last survivors of a prolific species are now dead, although the birds ranged in countless numbers over a great continent.

It would be futile to discuss in detail the precise agencies by which the destruction of animal life is wrought, or the pretexts or excuses for them. The most potent factors are the perfection of the modern firearm and the enormous increase in its use by civilised and barbarous man. Sometimes the pretext is sport, sometimes wanton destructiveness rules. The extermination of beasts of prey, the clearing of soil for stock or crops, the securing of meat, the commercial pursuit of hides and horns and of furs and feathers, all play their part. Farmers and settlers on the outskirts of civilisation accuse the natives, and allege that the problem would be solved were no firearms allowed to any but themselves. Sportsmen accuse other sportsmen, whom they declare to be no real sportsmen, and every person whose object is not sport. The great museums, in the name of science, and the rich amateur collectors press forward to secure the last specimens of moribund species.

But even apart from such deliberate and conscious agencies, the near presence of man is inhospitable to wild life. As he spreads over the earth, animals wither before him, driven from their haunts, deprived of their food, perishing from new diseases. It is part of a general biological process. From time to time, in the past history of the world, a species, favoured by some happy kink of structure or fortunate accident of adaptability, has become dominant. It has increased greatly in numbers, outrunning its natal

bounds, and has radiated in every possible direction, conquering woodland and prairies, the hills and the plains, transcending barriers that had seemed impassable, and perhaps itself breaking up into new local races and varieties. It must be long since such a triumphant progress was unattended by death and destruction. When the first terrestrial animals crept out of their marshes into the clean air of the dry land, they had only plants and the avenging pressure of physical forces to overcome. But when the Amphibians were beaten by the Reptiles, and when from amongst the Reptiles some insignificant species acquired the prodigious possibility of transformation to Mammals, and still more when amongst the Mammals Eutherian succeeded Marsupial, Carnivore the Creodont, and Man the Ape, it could have been only after a fatal contest that the newcomers triumphed. The struggle, we must suppose, was at first most acute between animals and their nearest inferior allies, as similarity of needs brings about the keenest competition, but it must afterwards have been extended against lower and lower occupants of the coveted territory.

The human race has for long been the dominant terrestrial species, and man has a wider capacity for adaptation to different environments, and an infinitely greater power of transcending geographical barriers than have been enjoyed by any other set of animals. For a considerable time many of the more primitive tribes, especially before the advent of firearms, had settled down into a kind of natural equilibrium with the local mammalian fauna, but these tribes have been first driven to a keener competition with the lower animals, and then, in most parts of the world, have themselves been forced almost or completely out of existence. The resourceful and aggressive higher races have now reached into the remotest parts of the earth and have become the exterminators. It must now be the work of the most intelligent and provident amongst us to arrest this course of destruction, and to preserve what remains.

In Europe, unfortunately, there is little left sufficiently large and important to excite the imagination. There is the European bison, which has been extinct in Western Europe for many centuries, whilst the last was killed in East Prussia in 1755. There remains a herd of about seven hundred in the forests of Lithuania, strictly protected by the Tsar, whilst there are truly wild animals, in considerable numbers, in the Caucasus, small captive herds on the private estates of the Tsar, the Duke of Pless and Count Potocki, and a few individuals in various zoological gardens. There is the beaver, formerly widespread in Europe, now one of the rarest of living mammals, and lingering in minute numbers in the Rhone, the Danube, in a few Russian rivers, and in protected areas in Scandinavia. The wolf and the bear have shrunk to the recesses of thick forests and the remotest mountains, gluttons to the most barren regions of the north. The chamois survives by favour of game-laws and the vast inaccessible areas to which it can retreat, but the mouflon of Corsica and Sardinia and the ibex in Spain are on the verge of extinction. Every little creature, from the otter, wild cat, and marten to the curious desman, is disappearing.

India contains the richest, the most varied, and, from many points of view, the most interesting part of the Asiatic fauna. Notwithstanding the teeming human population it has supported from time immemorial, the extent of its area, its dense forests and jungles, its magnificent series of river valleys, mountains, and hills have preserved until recent times a fauna rich in individuals and species. The most casual glance at the volumes by sportsmen and naturalists

written forty or fifty years ago reveals the delight and wonder of travel in India so comparatively recently as the time when the Association last met in Dundee. Sir H. H. Johnston has borne witness that even in 1895 a journey "through almost any part of India was of absorbing interest to the naturalist." All is changed now, and there seems little doubt but that the devastation in the wonderful mammalian fauna has been wrought chiefly by British military officers and civilians, partly directly, and partly by their encouragement of the sporting instincts of the Mohammedan population and the native regiments, although the clearing of forests and the draining of marshlands have played an important contributory part. The tiger has no chance against the modern rifle. The one-horned rhinoceros has been nearly exterminated in Northern India and Assam. The magnificent gaur, one of the most splendid of living creatures, has been almost killed off throughout the limits of its range—southern Indian and the Malay Peninsula. Bears and wolves, wild dogs and leopards are persecuted remorselessly. Deer and antelope have been reduced to numbers that alarm even the most thoughtless sportsmen, and wild sheep and goats are being driven to the utmost limits of their range.

When I speak of the fauna of Africa, I am always being reminded of the huge and pathless areas of the Dark Continent, and assured that lions and leopards, elephants and giraffe still exist in countless numbers, nor do I forget the dim recesses of the tropical forests where creatures still lurk of which we have only the vaguest rumour. But we know that South Africa, less than fifty years ago, was a dream that surpassed the imagination of the most ardent hunter. And we know what it is now. It is traversed by railways, it has been rolled over by the devastations of war. The game that once covered the land in unnumbered millions is now either extinct, like the quagga and the black wildebeeste, or its scanty remnant lingers in a few reserves and on a few farms. The sportsman and the hunter have been driven to other parts of the continent, and I have no confidence in the future of the African fauna. The Mountains of the Moon are within range of a long vacation holiday. Civilisation is eating into the land from every side. All the great European countries are developing their African possessions. There are exploring expeditions, punitive expeditions, shooting and collecting expeditions. Railways are being pushed inland, water-routes opened up. The land is being patrolled and policed and taxed, and the wild animals are suffering. Let us go back for a moment to the Transvaal and consider what has happened since the Rand was opened, neglecting the reserves. Lions are nearly extinct. The hyæna has been trapped and shot and poisoned out of existence. The eland is extinct. The giraffe is extinct. The elephant is extinct. The rhinoceros is extinct. The buffalo is extinct. The bontebok, the red hartebeeste, the mountain zebra, the oribi, and the grysbok are so rare as to be practically extinct. And the same fate may at any time overtake the rest of Africa. The white man has learned to live in the tropics; he is mastering tropical diseases; he has need of the vegetable and mineral wealth that lie awaiting him, and although there is yet time to save the African fauna, it is in imminent peril.

When we turn to Australia, with its fauna of unique zoological interest, we come to a more advanced case of the same disease. In 1909 Mr. G. C. Shortridge, a very skilled collector, working for the British Museum, published in the Proceedings of the Zoological Society of London the results of an investigation he had carried out on the fauna of Western Australia south of the tropics, during the years 1904-7.

He gave a map showing the present and comparatively recent distribution for each of the species of Marsupials and Monotremes indigenous to that locality. West Australia as yet has been very much less affected by civilisation than Queensland, New South Wales, or Victoria, and yet in practically every case there was found evidence of an enormous recent restriction of the range of the species. Marsupials and Monotremes are, as you know, rather stupid animals, with small powers of adaptation to new conditions, and they are in the very gravest danger of complete extinction. In the island of Tasmania, the thylacine, or marsupial wolf, and the Tasmanian devil have unfortunately incurred the just hostility of the stock raiser and poultry farmer, and the date of their final extermination is approaching at a pace that must be reckoned by months rather than by years.

The development of the continent of North America has been one of the wonders of the history of the world, and we on this side of the Atlantic almost hold our breath as we try to realise the material wealth and splendour and the ardent intellectual and social progress that have turned the United States into an imperial nation. But we know what has happened to the American bison. We know the danger that threatens the pronghorn, one of the most isolated and interesting of living creatures, the Virginian deer, the mule-deer, and the bighorn sheep. Even in the wide recesses of Canada, the bighorn, the caribou, the elk, the wapiti, the white mountain goat, and the bears are being rapidly driven back by advancing civilisation. In South America less immediate danger seems to threaten the jaguar and maned wolf, the tapirs and ant-eaters and sloths, but the energy of the rejuvenated Latin races points to a huge encroachment of civilisation on wild nature at no distant date.

You will understand that I am giving examples and not a catalogue even of threatened terrestrial mammals. I have said nothing of the aquatic carnivores, nothing of birds, or of reptiles, or of batrachians and fishes. And to us who are zoologists, the vast destruction of invertebrate life, the sweeping out, as forests are cleared and the soil tilled, of innumerable species that are not even named or described is a real calamity. I do not wish to appeal to sentiment. Man is worth many sparrows; he is worth all the animal population of the globe, and if there were not room for both, the animals must go. I will pass no judgment on those who find the keenest pleasure of life in gratifying the primeval instinct of sport. I will admit that there is no better destiny for the lovely plumes of a rare bird than to enhance the beauty of a beautiful woman. I will accept the plea of those who prefer a well-established trinomial to a moribund species. But I do not admit the right of the present generation to careless indifference or to wanton destruction. Each generation is the guardian of the existing resources of the world; it has come into a great inheritance, but only as a trustee. We are learning to preserve the relics of early civilisations, and the rude remains of man's primitive arts and crafts. Every civilised nation spends great sums on painting and sculpture, on libraries and museums. Living animals are of older lineage, more perfect craftsmanship and greater beauty than any of the creations of man. And although we value the work of our forefathers, we do not doubt but that the generations yet unborn will produce their own artists and writers, who may equal or surpass the artists and writers of the past. But there is no resurrection or recovery of an extinct species, and it is not merely that here and there one species out of many is threatened, but that whole genera, families, and orders are in danger.

Now let me turn to what is being done and what has been done for the preservation of fauna. I must begin by saying, and this was one of the principal reasons for selecting the subject of my address, that we who are professional zoologists, systematists, anatomists, embryologists, and students of general biological problems, in this country at least, have not taken a sufficiently active part in the preservation of the realm of nature that provides the reason for our existence. The first and most practical step of world-wide importance was taken by a former president of the British Association, the late Lord Salisbury, one of the few in the long roll of English statesmen whose mind was attuned to science. In 1899 he arranged for a convention of the Great Powers interested in Africa to consider the preservation of what were curiously described as the "Wild Animals, Birds and Fish" of that continent. The convention, which did most important pioneer work, included amongst its members another president of this Association, Sir Ray Lankester, whom we hold in high honour in this section as the living zoologist who has taken the widest interest in every branch of zoology. But it was confined in its scope to creatures of economic or of sporting value. And from that time on the central authorities of the Great Powers and the local administrators, particularly in the case of tropical possessions, seem to have been influenced in the framing of their rules and regulations chiefly by the idea of preserving valuable game animals. Defining the number of each kind of game that can be killed, charging comparatively high sums for shooting-permits, and the establishment of temporary or permanent reserved tracts in which the game may recuperate, have been the principal methods selected. On these lines, narrow although they are, much valuable work has been done, and the parts of the world where unrestricted shooting is still possible are rapidly being limited. I may take the proposed new Game Act of our Indian Empire, which has recently been explained, and to a certain extent criticised, in the Proceedings of the Zoological Society of London, by Mr. E. P. Stebbing, an enlightened sportsman-naturalist, as an example of the efforts that are being made in this direction, and of their limitations.

The Act is to apply to all India, but much initiative is left to local governments as to the definition of the important words "game" and "large animal." The Act, however, declares what the words are to mean in the absence of such local definitions, and it is a fair assumption that local interpretations will not depart widely from the lead given by the central authority. Game is to include the following in their wild state:—Pigeons, sandgrouse, peafowl, jungle-fowl, pheasants, partridges, quail, spurfowl, florican and their congeners; geese, ducks and their congeners; woodcock and snipe. So much for birds. Mammals include hares and "large animals" defined as "all kinds of rhinoceros, buffalo, bison, oxen; all kinds of sheep, goats, antelopes and their congeners; all kinds of gazelle and deer."

The Act does not affect the pursuit, capture, or killing of game by non-commissioned officers or soldiers on whose behalf regulations have been made, or of any animal for which a reward may be claimed from Government, of any large animal in self-defence, or of any large animal by a cultivator or his servants, whose crops it is injuring. Nor does it affect anything done under licence for possessing arms and ammunition to protect crops, or for destroying dangerous animals, under the Indian Arms Act. Then follow prohibitory provisions, all of which refer to the killing or to the sale or possession of game or fish, and provisions as to licences for sportsmen, the sums

to be paid for which are merely nominal, but which carry restrictions as to the number of head that may be killed. I need not enter upon detailed criticism as to the vagueness of this Act from the zoological point of view, or as to the very large loopholes which its provisions leave to civil and military sportsmen; these have been excellently set forth by Mr. Stebbing, who has full knowledge of the special conditions which exist in India. What I desire to point out is that it conceives of animals as game rather than as animals, and that it does not even contemplate the possibility of the protection of birds of prey and beasts of prey, and still less of the enormous number of species of animals that have no sporting or economic value.

Mr. Stebbing's article also gives a list of the very large number of reserved areas in India which are described as "Game Sanctuaries." His explanation of them is as follows:—"With a view to affording a certain protection to animals of this kind (the elephant, rhinoceros, ruminants, &c.), and of giving a rest to species which have been heavily thinned in a district by indiscriminate shooting in the past, or by anthrax, drought, &c., the idea of the Game Sanctuary was introduced into India (and into other parts of the world) and has been accepted in many parts of the country. The sanctuary consists of a block of country, either of forest or of grassland, &c., depending on the nature of the animal to which sanctuary is required to be given; the area has rough boundaries such as roads, fire lines, nullahs, &c., assigned to it, and no shooting of any kind is allowed in it, if it is a sanctuary pure and simple; or the shooting of carnivora may be permitted, or of these latter and of everything else save certain specified animals."

Mr. Stebbing goes on to say that sanctuaries may be formed in two ways. The area may be automatically closed and reopened for certain definite periods of years, or be closed until the head of game has become satisfactory, the shooting on the area being then regulated, and no further closing taking place, save for exceptional circumstances. The number of such sanctuary blocks, both in British India and in the Native States, will cause surprise and pleasure to most readers, and it cannot be doubted but that they will have a large effect on the preservation of wild life. The point, however, that I wish to make is that in the minds of those who have framed the Game Act, and of those who have caused the making of the sanctuaries—as indeed in the minds of their most competent critics—the dominant idea has been the husbanding of game animals, the securing for the future of sport for sportsmen. I do not forget that there is individual protection for certain animals; no elephant, except a rogue elephant, may be shot in India, and there are excellent regulations regarding birds with plumage of economic value. The fact remains that India, a country which still contains a considerable remnant of one of the richest faunas of the world, and which also is probably more efficiently under the autocratic control of a highly educated body of permanent officials, central and local, than any other country in the world, has no provision for the protection of its fauna simply as animals.

The conditions in Africa are very different from those in India. The land is portioned out amongst many Powers. The settled population is much less dense, and the hold of the white settler and the white ruler is much less complete. The possibility of effective control of native hunters and of European travellers and sportsmen is much smaller, and as there are fewer sources of revenue, the temptation to exploit the game for the immediate development of the

struggling colonies is much greater. Still, the lesson of the extinction of the South African fauna is being taken to heart. I have had the opportunity of going through the regulations made for the shooting of wild animals in Africa by this country, by our autonomic colonies, by France, Germany, Italy, Portugal, and Belgium, and, with the limitation that they are directed almost solely towards the protection of animals that can be regarded as game, they afford great promise for the future. But this limitation is still stamped upon them, and even so enthusiastic a naturalist as Major Stevenson-Hamilton, the warden of the Transvaal Government Game Reserves, who has advocated the substitution of the camera for the rifle, appears to be of the opinion that the platform of the convention of 1900 is sufficient. It included the sparing of females and immature animals, the establishment of close seasons and game sanctuaries, the absolute protection of rare species, restrictions on the export for trading purposes of skins, horns, and tusks, and the prohibition of pits, snares, and game traps. Certainly the rulers of Africa are seeing to the establishment of game reserves. As for British Africa, there are two in Somaliland, two in the Sudan, two in Uganda, and two in British East Africa (with separate reserves for eland, rhinoceros, and hippopotamus), two in Nyasaland, three in the Transvaal, seven in Rhodesia, several in Natal and in Cape Colony, and at least four in Nigeria. These are now administered by competent officials, who, in addition, are usually the executive officers of the game laws outside the reserved territory. Here again, however, the preservation of game animals and of other animals of economic value, and of a few named species, is the fundamental idea. In 1909 I had the honour of being a member of a deputation to the Secretary of State for the Colonies, arranged by the Society for the Preservation of the Wild Fauna of the Empire, one of the most active and successful bodies engaged in arousing public opinion on the subject. Among the questions on which we were approaching Lord Crewe was that of changes in the locality of reserves. Sometimes it had happened that for the convenience of settlers or because of railway extension, or for some other reason, proposals were made to open or clear the whole or part of a reserve. When I suggested that the substitution of one piece of ground for another, even of equivalent area, might be satisfactory from the point of view of the preservation of large animals, but was not satisfactory from the zoological point of view, that in fact pieces of primeval land and primeval forest contained many small animals of different kinds which would be exterminated once and for all when the land was brought under cultivation, the point was obviously new not only to the Colonial Secretary, who very courteously noted it, but to my colleagues.

This brings me to the general conclusion to which I wish to direct your attention, and for which I hope to engage your sympathy. We may safely leave the preservation of game animals, or rare species if these are well known and interesting, and of animals of economic value, to the awakened responsibility and the practical sense of the governing powers, stimulated as these are by the enthusiasm of special societies. Game laws, reserves where game may recuperate, close seasons, occasional prohibition and the real supervision of licence-holders are all doing their work effectively. But there remains something else to do, something which I think should interest zoologists particularly, and on which we should lead opinion. There exist in all the great continents large tracts almost empty of resident population, which still contain vegetation almost undisturbed by the ravages of man, and which still harbour a multitude of small

animals, and could afford space for the larger and better-known animals. These tracts have not yet been brought under cultivation, and are rarely traversed except by the sportsman, the explorer, and the prospector. On these there should be established, in all the characteristic faunistic areas, reservations which should not be merely temporary recuperating grounds for harassed game, but absolute sanctuaries. Under no condition should they be open to the sportsman. No gun should be fired, no animal slaughtered or captured save by the direct authority of the wardens of the sanctuaries, and for the direct advantage of the denizens of the sanctuaries, for the removal of noxious individuals, the controlling of species that were increasing beyond reason, the extirpation of diseased or unhealthy animals. The obvious examples are not the game reserves of the Old World, but the national parks of the New World and of Australasia. In the United States, for instance, there are now the Yellowstone National Park with more than two million acres, the Yosemite in California with nearly a million acres, the Grand Cañon Game Preserve with two million acres, the Mount Olympus National Monument in Washington with more than half a million acres, and the Superior Game and Forest Preserve with nearly a million acres, as well as a number of smaller reserves for special purposes, and a chain of coastal areas all round the shores for the preservation of birds. In Canada, in Alberta, there are the Rocky Mountains Park, the Yoho Park, Glacier Park, and Jasper Park, together extending to more than nine million acres, whilst in British Columbia there are smaller sanctuaries. These, so far as laws can make them, are inalienable and inviolable sanctuaries for wild animals. We ought to have similar sanctuaries in every country of the world, national parks secured for all time against all the changes and chances of the nations by international agreement. In the older and more settled countries the areas selected unfortunately must be determined by various considerations, of which faunistic value cannot be the most important. But certainly in Africa, and in large parts of Asia, it would still be possible that they should be selected in the first place for their faunistic value. The scheme for them should be drawn up by an international commission of experts in the geographical distribution of animals, and the winter and summer haunts of migratory birds should be taken into consideration. It is for zoologists to lead the way, by laying down what is required to preserve for all time the most representative and most complete series of surviving species without any reference to the extrinsic value of the animals. And it then will be the duty of the nations, jointly and severally, to arrange that the requirements laid down by the experts shall be complied with.

And now I come to the last side of my subject, that of zoological gardens, with which I have been specially connected in the last ten years. My friend M. Gustave Loisel, in his recently issued monumental "*Histoire des Ménageries*," has shown that in the oldest civilisations of which we have record, thousands of years before the Christian era, wild animals were kept in captivity. He is inclined to trace the origin of the custom to a kind of totemism. Amongst the ancient Egyptians, for instance, besides the bull and the serpent, baboons, hippopotami, cats, lions, wolves, ichneumons, shrews, wild goats, and wild sheep, and of lower animals, crocodiles, various fishes, and beetles were held sacred in different towns. These animals were protected, and even the involuntary killing of any of them was punished by the death of the slayer, but besides this general protection, the priests selected individuals which they recognised by infallible signs as being the divine animals, and tamed, guarded, and

fed in the sacred buildings, whilst the revenues derived from certain tracts of land were set apart for their support. The Egyptians were also famous hunters, and kept and tamed various wild animals, including cheetahs, striped hyænas, leopards, and even lions, which they used in stalking their prey. The tame lions were sometimes clipped, as in ancient Assyria, and used both in the chase and in war. The rich Egyptians of Memphis had large parks in which they kept not only the domestic animals we now know, but troops of gazelles, antelopes, and cranes, which were certainly tame and were herded by keepers with wands. So also in China at least fifteen centuries before our era, wild animals were captured in the far north by the orders of the Emperor and were kept in the royal parks. A few centuries later the Emperor Wen-Wang established a zoological collection between Peking and Nankin, his design being partly educational, as it was called the Park of Intelligence. In the valley of the Euphrates, centuries before the time of Moses, there were lists of sacred animals, and records of the keeping in captivity of apes, elephants, rhinoceroses, camels and dromedaries, gazelles and antelopes, and it may well be that the legend of the Garden of Eden is a memory of the royal menagerie of some ancient king. The Greeks, whose richest men had none of the wealth of the Egyptians or of the princes of the East, do not appear to have kept many wild animals, but the magnates of imperial Rome captured large numbers of leopards, lions, bears, elephants, antelopes, giraffes, camels, rhinoceroses and hippopotami, and ostriches and crocodiles, and kept them in captivity, partly for use in the arena, and partly as a display of the pomp and power of wealth. In later times royal persons and territorial nobles frequently kept menageries of wild animals, aviaries and aquaria, but all these have long since vanished.

Thus, although the taste for keeping wild animals in captivity dates from the remotest antiquity, all the modern collections are of comparatively recent origin, the oldest being the Imperial Menagerie of the palace of Schönbrunn, Vienna, which was founded about 1752, whilst some of the most important are only a few years old. These existing collections are of two kinds. A few are the private property of wealthy landowners, and their public importance is due partly to the opportunity they have afforded for experiments in acclimatisation on an extensive scale, and still more to the refuge they have given to the relics of decaying species. The European bison is one of the best-known cases of such preservation, but a still more extraordinary instance is that of Père David's deer, a curious and isolated type which was known only in captivity in the imperial parks of China. The last examples in China were killed in the Boxer war, and the species would be absolutely extinct but for the small herd maintained by the Duke of Bedford at Woburn Abbey. In 1909 this herd consisted of only twenty-eight individuals; it now numbers sixty-seven. The second and best-known types of collections of living animals are in the public zoological gardens and parks maintained by societies, private companies, States and municipalities. There are now more than a hundred of these in existence, of which twenty-eight are in the United States, twenty in the German Empire, five in England, one in Ireland, and none in Scotland. But perhaps I may be allowed to say how much I hope that the efforts of the Zoological Society of Scotland will be successful, and that before many months are over there will be a zoological park in the capital of Scotland. There is no reason of situation or of climate which can be urged against it. The smoke and fog of London are much more baleful to animals than the east winds of Edinburgh. The

gardens of North Germany and the excellent institution at Copenhagen have to endure winters much more severe than those of lowland Scotland, whilst the arctic winter and tropical summer of New York form a peculiarly unfortunate combination, and none the less the Bronx Park at New York is one of the most delightful menageries in existence. The Zoological Society of Scotland will have the great advantage of beginning where other institutions have left off; it will be able to profit by the experience and avoid the mistakes of others. The Zoological Society of London would welcome the establishment of a menagerie in Scotland, for scientific and practical reasons. As I am speaking in Scotland, I may mention two of the practical reasons. The first is that in Great Britain we labour under a serious disadvantage as compared with Germany with regard to the importation of rare animals. When a dealer in the tropics has rare animals to dispose of, he must send them to the best market, for dealing in wild animals is a risky branch of commerce. If he send them to this country, there are very few possible buyers, and it often happens that he is unable to find a purchaser. If he send them to Germany, one or other of the twenty gardens is almost certain to absorb them, and, failing Germany, Belgium and Holland are near at hand. Were there twenty prosperous zoological gardens in Great Britain, they could be better stocked, at cheaper rates, than those we have now. The second practical reason is that it is a great advantage to menageries to have easy opportunities of lending and exchanging animals; for it often happens that as a result of successful breeding or of gifts on one hand, or of deaths on the other, a particular institution is overstocked with one species or deficient in another.

One of the ideas strongly in the minds of those who founded the earlier of modern zoological gardens was the introduction and acclimatisation of exotic animals that might have an economic value. It is curious how completely this idea has been abandoned and how infertile it has proved. The living world would seem to offer an almost unlimited range of creatures which might be turned to the profit of man and as domesticated animals supply some of his wants. And yet I do not know of any important addition to domesticated animals since the remotest antiquity. A few birds for the coverts, fancy water-fowl for ponds and lakes, and brightly plumaged birds for cages or for aviaries have been introduced, chiefly through zoological societies, but we must seek other reasons for their existence than these exiguous gains.

Menageries are useful in the first place as educational institutions, in the widest sense of the word. Every new generation should have an opportunity of seeing the wonder and variety of animated nature, and of learning something that they cannot acquire from books or pictures or lectures about the chief types of wild animals. For that reason zoological gardens should be associated in some form with elementary and secondary education. We in London admit the children from elementary schools on five mornings in the week at the nominal charge of a penny for each child, and in co-operation with the Educational Committee of the London County Council, we conduct courses of lectures and demonstrations for the teachers, who will afterwards bring their children to visit the gardens.

Menageries provide one of the best schools for students of art, for nowhere else than amongst living animals are to be found such strange fantasies of colour, such play of light on contour and surface, such intricate and beautiful harmonies of function and structure. To encourage art the London society allows students of recognised schools of drawing and

painting, modelling and designing, to use the gardens at nominal rates.

Menageries provide a rich material for the anatomist, histologist, physiologist, parasitologist, and pathologist. It is surprising to note how many of the animals used by Lamarck and Cuvier, Johannes Müller and Wiedersheim, Owen and Huxley, were obtained from zoological gardens. At all the more important gardens increasing use is being made of the material for the older purposes of anatomical research and for the newer purposes of pathology and physiology.

There remains the fundamental reason for the existence of menageries, that they are collections of living animals, and therefore an essential material for the study of zoology. Systematic zoology, comparative anatomy, and even morphology, the latter the most fascinating of all the attempts of the human intellect to recreate nature within the categories of the human mind, have their reason and their justification in the existence of living animals under conditions in which we can observe them. And this leads me to a remark which ought to be a truism, but which, unfortunately, is still far from being a truism. The essential difference between a zoological museum and a menagerie is that in the latter the animals are alive. The former takes its value from its completeness, from the number of rare species of which it has examples, and from the extent to which its collections are properly classified and arranged. The value of a menagerie is not its zoological completeness, not the number of rare animals that at any moment it may contain, not even the extent to which it is duly labelled and systematically arranged, but the success with which it displays its inhabitants as living creatures under conditions in which they can exercise at least some of their vital activities.

The old ideal of a long series of dens or cages in which representatives of kindred species could mope opposite their labels is surely but slowly disappearing. It is a museum arrangement, and not an arrangement for living animals. The old ideal by which the energy and funds of a menagerie were devoted in the first place to obtaining species "new to the collection" or "new to science" is surely but slowly disappearing. It is the instinct of a collector, the craving of a systematist, but is misplaced in those who have the charge of living animals. Certainly we like to have many species, to have rare species, and even to have new species represented in our menageries. But what we are learning to like most of all is to have the examples of the species we possess, whether these be new or old, housed in such a way that they can live long, and live happily, and live under conditions in which their natural habits, instincts, movements, and routine of life can be studied by the naturalist and enjoyed by the lover of animals.

Slowly the new conditions are creeping in, most slowly in the older institutions hampered by lack of space, cumbered with old and costly buildings, oppressed by the habits of long years and the traditions established by men who none the less are justly famous in the history of zoological science. Space, open air, scrupulous attention to hygiene and diet, the provision of some attempt at natural environment are receiving attention that they have never received before. You will see the signs of the change in Washington and New York, in London and Berlin, in Antwerp and Rotterdam, and in all the gardens of Germany. It was begun simultaneously, or at least independently, in many places and under the inspiration of many men. It is, I think, part of a general process in which civilised man is replacing the old hard curiosity about nature by an attempt at sym-

pathetic comprehension. We no longer think of ourselves as alien from the rest of nature, using our lordship over it for our own advantage; we recognise ourselves as part of nature, and by acknowledging our kinship we are on the surest road to an intelligent mastery. But I must mention one name, that of Carl Hagenbeck, of Hamburg, to be held in high honour by all zoologists and naturalists, although he was not the pioneer, for the open-air treatment and rational display of wild animals in captivity were being begun in many parts of the world while the Thier-Park at Stellingen was still a suburban waste. He has brought a reckless enthusiasm, a vast practical knowledge, and a sympathetic imagination to bear on the treatment of living animals, and it would be equally ungenerous and foolish to fail to recognise the widespread and beneficent influence of his example.

However we improve the older menageries and however numerous and well-arranged the new menageries may be, they must always fall short of the conditions of nature, and here I find another reason for the making of zoological sanctuaries throughout the world. If these be devised for the preservation of animals, not merely for the recuperation of game, if they be kept sacred from gun or rifle, they will become the real zoological gardens of the future, in which our children and our children's children will have the opportunity of studying wild animals under natural conditions. I myself have so great a belief in the capacity of wild animals for learning to have confidence in man, or rather for losing the fear of him that they have been forced to acquire, that I think that man, innocent of the intent to kill, will be able to penetrate fearlessly into the sanctuaries, with camera and notebook and field-glass. In any event, all that the guardians of the future will have to do will be to reverse the conditions of our existing menageries and to provide secure enclosures for the visitors instead of for the animals.

I must end as I began this address, by pleading the urgency of the questions I have been submitting to you as an excuse for diverting your attention to a branch of zoology which is alien from the ordinary avocations of most zoologists, but which none the less is entitled to their fullest support. Again let me say to you that I do not wish to appeal to sentiment; I am of the old school, and, believing that animals are subject and inferior to man, I set no limits to human usufruct of the animal kingdom. But we are zoologists here, and zoology is the science of the living thing. We must use all avenues to knowledge of life, studying the range of form in systematic museums, form itself in laboratories, and the living animal in sanctuaries and menageries. And we must keep all avenues to knowledge open for our successors, as we cannot guess what questions they may have to put to nature.

SECTION E.

GEOGRAPHY.

FROM THE OPENING ADDRESS BY COLONEL SIR C. M. WATSON, K.C.M.G., C.B., PRESIDENT OF THE SECTION.

LEAVING the Sudan,¹ I would like to allude to a very important geographical undertaking which has made considerable progress during the past year. This is the production of the international map of the world on the scale of 1/10,000,000, a project which has been under the consideration of the leading geographers of the important countries for more than twenty years, since it was first proposed at the International Geographical Congress held at Berne in 1891. The question was discussed at succeeding geographical

¹ The main part of the address dealt with the geography of the Sudan and some important points in its history.

congresses, but did not take definite shape until the meeting held at Geneva in 1908, when a series of resolutions dealing with the subject were drawn up by a committee composed of distinguished men of many nations, which was appointed to formulate rules for the production of the maps, so as to ensure that they should be prepared upon a uniform system.

These resolutions were approved at a general meeting of the Geneva Congress, and were forwarded by the Swiss Government to the British Government for consideration, whereupon the latter issued invitations to the Governments of Austria-Hungary, France, Germany, Japan, Russia, Italy, Spain, and the United States of North America, asking them to nominate delegates to act as the members of an international committee to meet in London and debate the question. The committee assembled at the Foreign Office in November, 1909, and Colonel S. C. N. Grant, C.M.G., then Director-General of the British Ordnance Survey, was appointed president. The proceedings were opened by the Under-Secretary of State for Foreign Affairs, Sir Charles Hardinge, G.C.M.G., now Lord Hardinge, who, in his address, referred to the progress that had already been made with regard to the international map, and expressed the hope, on behalf of the British Government, that the great undertaking might be brought to a satisfactory conclusion.

The main business before the committee was to settle on the mode of execution of the map, especially as regards the size of the sheets, so as to ensure that adjacent sheets, published by different countries, should fit together; and also to settle upon the symbols, printing, and conventional signs to be used, in order that these should be uniform throughout. A series of resolutions, embodying the decisions arrived at concerning these various points, was approved and drawn up in English, French, and German, the first of these languages being taken as the authoritative text. As the map was to embrace the whole surface of the globe, the method of projection to be adopted was, of course, a very important consideration, and, after due deliberation, it was decided that a modified polyconic projection, with the meridians shown as straight lines, and with each sheet plotted independently on its central meridian, would prove the most satisfactory.

The surface of the sphere was divided into zones, each containing four degrees of latitude, commencing at the equator, and extending to 88° North and 88° South latitude. There were thus twenty-four zones on each side of the equator, and these were distinguished by the letters A to V north, and A to V south. This fixed the height of each sheet. For the width of the sheets, the surface of the sphere was divided into sixty segments, each containing six degrees of longitude, and numbered consecutively from one to sixty, commencing at longitude 180°. This arrangement made each sheet contain six degrees of longitude by four degrees of latitude; but, as the width of the sheets diminished as they approached the poles, it was decided that, beyond 60° North, or 60° South, two or more sheets could be combined. Each sheet could thus be given a clear identification number defining its position on the surface of the globe, without it being necessary to mention the country included in it, or the latitude and longitude. For example, the sheet containing the central part of England is called North, N 30.

In order to ensure that the execution of all the maps should be identical, a scheme of lettering and of conventional topographical signs was drawn up and attached to the resolutions; and it was decided that a scale of kilometres should be shown on each sheet, and also a scale of the national measure of length of the country concerned. As regards the representa-