

that all wild animals should be brought under the Protection of Animals Acts. Field sports should continue.

Regarding Red Deer: Hunting should continue as a valuable means of control. If it were stopped the deer would be destroyed, as a pest, by means involving more suffering than does hunting. All snaring of deer should be prohibited. Deer should be brought within the poaching acts of 1828, 1844, and 1862. In Scotland a close season should be imposed to include the sale of venison.

The Red Deer population of Exmoor before the war was about 2,000; it is now about 600. Strict control is necessary to keep numbers within the feeding capacity of the land, but there may be some truth in the suggestion that the damage done by Red Deer on Exmoor is greatly exaggerated.

THE BREEDING-BACK OF THE AUROCHS

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(Translated by Miss Winifred Felce)

Every lover of nature regrets that man has exterminated so many kinds of animals or that these have lost their means of living and become extinct through changes brought about on the earth's surface to meet Man's increasing needs.

Happily, however, there exist two methods of breeding, which we will call "new-breeding" and "breeding-back", which put tools into our hands for resurrecting extinct species. In "breeding-back" the aim is to direct the race back to a common ancestor; in "new-breeding" the process is directed forwards. Let us consider an example of the latter. The African steppe zebras¹ used to extend from Cape Colony northwards through the East African plains to the mountainous country of Abyssinia. Over this wide area of distribution the steppe zebras developed into a number of varieties with different striping. Thus, the steppe zebras of the Cape, the Quaggas, showed zebra striping only on the neck and the head and were otherwise of uniform colouring; further north were zebras that had few stripes on their bodies, then came some with the body more pronouncedly striped but with light, unstriped legs, and finally the most northerly representative of the steppe zebras, heavily striped

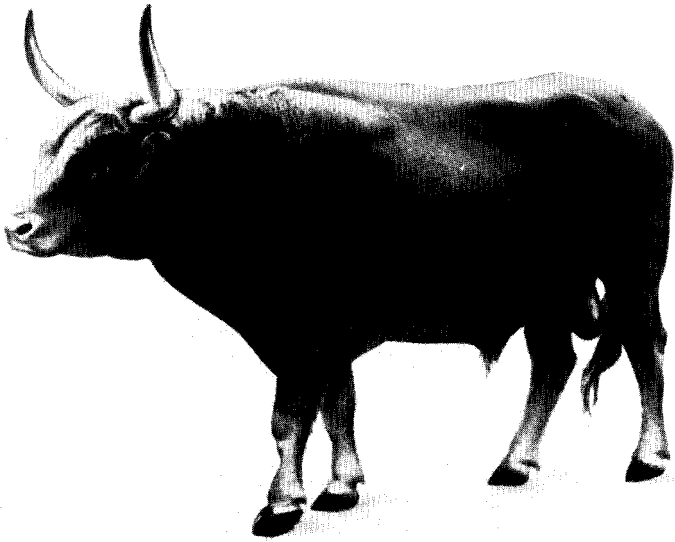
¹ "Steppe zebra" is a term coined by Heinz Heck to denote the horse-like zebras—Quagga, Burchell's, Chapman's, Boehm's, Grant's—now (with the exception of the extinct Quagga) generally known as Burchell's Zebra.—*Translator's note.*

right down to the hoofs : a fine series of animals in which one kind merges into the next with two termini of development and in which it is purely a matter of taste whether they are called species, sub-species, geographical varieties, or anything else.

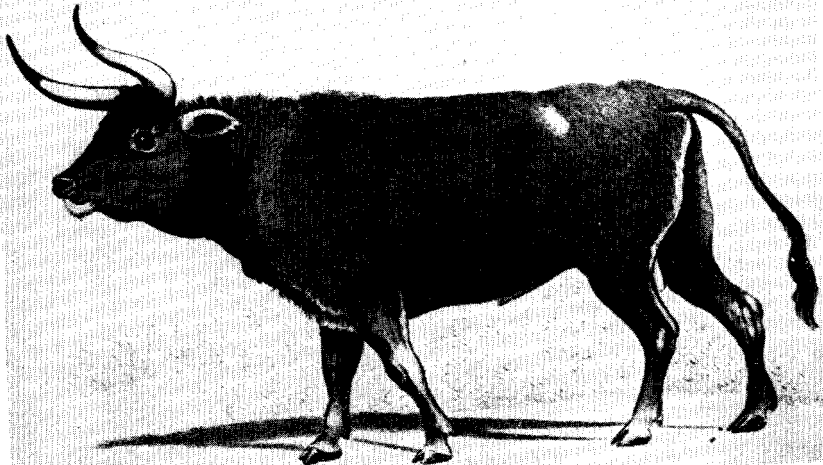
The steppe zebras of the south, the Quaggas, were on their way to giving up stripes and becoming uniform-coloured like the horse and the donkey (which are also descended from striped forebears) when man suddenly interrupted this development and exterminated the Quagga. If, now, to make good this misdeed of mankind's, the South African authorities concerned with the protection of wild life were to select some of the lesser striped specimens from herds of zebras still in existence a little further north and breed from these in a protected preserve, always removing the more heavily striped progeny, the Quagga would, within a reasonable period of time, come into being again. This would be a repetition of a process that has already taken place in nature and would probably be achieved fairly quickly. Such a process would be directed forwards, not backwards, and would be a "new-breeding". I know it is possible because in 1940, when I was breeding in this way from lightly striped zebras, I obtained a foal that had no stripes on the hind quarters. Unfortunately, this experiment was undone by the war.

It was with the Aurochs or Urus that I first tried breeding-back. The Aurochs was the wild ancestor of our tame cattle, and is, therefore, to our present cattle what the wild boar is to the domesticated pig, the wild horse to the domesticated horse, and the wild rabbit to the tame rabbit. We know exactly what the Aurochs looked like since its skeletal remains have frequently been found. From these we see that it had longer legs and bigger horns than its tame descendant and that in size it was as big as the largest breeds of to-day such as the Hungarian steppe cattle and when on favourable feeding grounds was even larger than these. The back was straight and flat, without the raised hump on the withers which is a feature of some other kinds of wild cattle, such as bison.

The adult Aurochs bull was black with a yellow-white stripe along the back, while the cow was red-brown in colouring with a darker neck. Similar differences in colouring between the two sexes are to be observed in many kinds of horn-bearing ruminants and in every case it is the male that is the darker. Both sexes were alike in the white colouring round the muzzle and both had long, strong, pale horns with black tips. We know how they were coloured because there are in existence a considerable number of contemporary paintings depicting it, and also some



AUROCHS BULL BRED-BACK IN TIERPARK HELLABRUN, MUNICH.



THE AUROCHS.

From a painting found in an Augsburg antique shop in 1827.

detailed descriptions. In summer the coat was as smooth and short as velvet, but in winter it grew long and shaggy. The head was adorned with a frontal curl.

The other kind of European wild cattle, the European Bison or Wisent, is utterly different in appearance. In this species both sexes are of the same brown colouring, the coat is long and woolly, and the brown horns are small. The very high withers make the animal appear tall in front and low at the back.

In contrast to the habits of the browsing, forest-dwelling Wisent, the Aurochs lived mainly on grass and herbs and was for that reason to be found in more open country in the pastures of river beds and to a much lesser extent in the woods. The cows, together with their calves, formed small herds headed by a leading cow and were joined in these by younger bulls. The older bulls lived alone or in the company of one or two bulls of their own age and joined the herds only in the rutting season, which came in August and September.

The Aurochs spread originally over the whole of Europe, Asia Minor, and North Africa and in this wide area of distribution developed into various geographical races. The Aurochsen of Egypt, which are depicted in the hunting pictures of the Pharaohs, were especially brightly coloured and the whitish stripe on their backs spread into a broad saddle. In some mountainous regions the oxen were very small but were, by contrast, particularly big in those places of rich pastures which are renowned to-day as good cattle-raising districts, such as the estuary of the Rhine, where owing to the mild maritime climate in winter there is grass almost all the year round.

In the Mediterranean countries, as a result of the high level of civilization, the Aurochs became extinct in antiquity. It disappeared from the countries of Western Europe in the early Middle Ages, and even in Eastern Europe it failed to survive much beyond the end of the Middle Ages. The last Aurochs, a cow, died in 1627 in a Polish park, and that was the end of one of the finest animals—the powerful and colourful wild ox, an animal to which mankind owes much, since our civilization can hardly be imagined without its most important domesticated animal, the cow. The last chapter in the history of the Aurochs seemed to have closed 300 years ago.

No animal, however, is utterly exterminated as long as some of its hereditary factors remain. The fact that these qualities may not be visible is shown by the laws of heredity to be unimportant, for what is hidden may be brought to light again

and, by cross-breeding, the original component parts may again be isolated. In the case of the Aurochs conditions are favourable since all its physical characteristics are still present and to be seen. They are, of course, divided between many different breeds of cattle, one having preserved a good aurochs horn, another its build, while a third has the characteristic colouring, and so on.

Wondering, in 1921, whether it might not be possible to breed-back the Aurochs, I began crossing all kinds of races of cattle in a way that would have horrified a pedigree breeder. Hungarian and Podolian steppe cattle and Scottish Highland cattle were mated with grey and brown Alpine breeds from Algau and Werdenfels and with piebald Friesians and Corsicans. To save time I bought a few crosses. All were thrown into one pot, so to speak, because each of the selected breeds showed some characteristic typical of the Aurochs that I wanted preserved. Success came incredibly quickly: by the spring of 1932 the first good specimens of the Aurochs of modern times, one of each sex, were born of this mixed breeding. Concentrated in them were the desired characteristics that in their grandparents' and great-grandparents' generations had been divided between so many different breeds. It was like a miracle. The first Aurochs for 300 years could be seen alive.

Almost more astonishing is what happened during the next few years. I thought that, although the first specimens were there all right, there would be a number of throw-backs among their children and grandchildren; derived from such a mixed bunch, I expected piebalds and all kinds of curious beasts to succeed them. But up to this day—and a great number of calves have been born—this has not happened, and there has not been one throw-back to any of the domestic breeds used. The calves are all as alike as slices of bread from one loaf. At most the shade of colouring varies slightly in the adult animals, sometimes lighter, sometimes darker, but that would have been the case with the original Aurochs just as to-day among our deer, hares, and foxes there is a measure of colour variation. Moreover, this very fact is mentioned in ancient descriptions of the animal. In coming decades, the breed can, of course, still be improved in appearance and stature, but the main job is done. To-day there are living between 37 and 41 Auroxen—the Aurochs is there.

Controls are there, too. My brother, Professor Lutz Heck, bred back the Aurochs in the Berlin Zoological Gardens a few years later from material quite different from mine. He

imported Spanish and French fighting breeds together with other Mediterranean races of cattle and cross-bred from these. The result was identical and one could not distinguish between the Auroxen bred in Berlin and those bred in Munich. All the Berlin stock in Germany was, unfortunately, lost through the hazards of war. But the fact that the Aurochs was twice and separately reconstituted proves that the principles on which this interesting experiment was based are sound.

In the course of the breeding-back experiments a number of observations were made that are highly interesting and we have learnt things about the wild progenitors that were not known previously. The Aurochs calves are not born with the colouring of the adults but are of a uniform brown. It is only after a few months that the bull calves begin to turn black and the heifer calves become more red and the white muzzle and other bright markings make their appearance. The animals are not fully coloured until they are sexually mature. Further, the colouring does not remain the same throughout life, and I have observed that the bulls become ever darker as they grow older and lose much of the bright markings: the old bull loses the white round the upper lip and nostrils and retains it only on the lower jaw; the stripe down the back becomes ever narrower so that old bulls are predominantly black. It is noteworthy that similar changes are seen in other kinds of wild cattle—for instance, the Indian Gaur and the North American Bison, in both of which the calves have a special coat, with the markings appearing later and in both of which the bulls become increasingly dark as they grow older.

Together with the physical characteristics obtained through back-breeding, typical mental properties have also made their reappearance. Auroxen are not at all easy to handle. The bulls are quick to attack when annoyed and they become annoyed with very little provocation; the cows are positively dangerous when they have young calves. In attacking they develop an agile celerity. My brother sent small herds of Auroxen first to Rominten, in East Prussia, and then, during the occupation, let some run wild in Bialowies. Almost at once they became very shy, and with the help of their excellent sense of smell, became aware of an approaching person from a great distance. They were more timid and more difficult to find than the red deer that lived there. If, however, someone took pains to stalk them quietly against the wind and then suddenly appeared in front of them the bulls were furious and attacked at once. It is probably thanks to these wild-animal characteristics that the

last remnant of the Berlin breed of Auroxen is to-day still alive in Bialowies.

The famous German geneticist, Baur, found that tame pigs which, instead of having the usual pinky-white, colourless skins, are the colour of wild swine but in all other respects are ordinary domesticated pigs, show great resistance to certain pig diseases, such as red murrain. I observed that my Auroxen, which are descended wholly from tame cattle, are almost immune to cattle diseases that cause havoc among domesticated herds, namely foot-and-mouth and rheumatic fever. As is known, some years before the war we had in Germany severe outbreaks of both these diseases and they were widespread among the cattle herds of Upper Bavaria and were thence, inevitably, carried into the Tierpark. Our highly bred milk cows became so seriously ill that they had to be slaughtered. The Auroxen were infected by both diseases, but in so slight a way that they were almost unaffected, and symptoms were detectable for a space of three days only.

These are certainly interesting observations concerning back-breeding which gave food for thought in many directions and which I did not, of course, foresee. I am often asked by animal breeders and specialists: "Why, exactly did you breed this animal? What is the point of it?" I could, of course, hold forth about the usefulness which this breed is going to have one day for the regeneration of our domestic breeds, when these have degenerated still further as a result of being bred for ever higher and higher productivity. But that was not how it was. I began this back-breeding for the following reasons: As a zooman, intimately connected with bringing natural history close to the people, I was vexed that, however often I talked about and described the two utterly different kinds of wild cattle that used to live in Germany, they were always being confused and the Wisent habitually called Aurochs. For that reason I wanted to show both kinds alive, side by side.¹ And it is a fact that the general knowledge about these animals has improved a lot since anyone interested has been able to go and see for himself what a European Bison and an Aurochs looked like. Besides, I myself was curious to know what these animals looked like. Another reason for doing it lay in the thought that if man cannot be halted in his mad rage for destruction of himself and all other creatures, it is at least a consolation if some of those kinds of animals he has already exterminated can be brought to life again.

¹ For full information of the European Bison or Wisent see S.P.F.E. (now Fauna Preservation Society) *Journal*, No. LIX.