JOURNAL OF

THE TRANSACTIONS

OF

The Victoria Institute,

OR,

Philosophical Society of Great Britain.

EDITED BY THE SECRETARY.

VOL. XXXIX.

LONDON:

(Published by the Institute, 8, Adelphi Terrace, Charing Cross, W.C.)

1907.

ORDINARY GENERAL MEETING.*

CAPTAIN G. P. HEATH, R.N. (RET.), IN THE CHAIR.

The Minutes of the previous Meeting were read and confirmed.

ELECTION.—Mrs. A. E. von Braun was elected a Member.

The following paper was then read by the Author :—

THE HISTORY OF THE SPREAD OF THE EUROPEAN FAUNA. By Professor J. LOGAN LOBLEY, F.G.S., F.R.G.S.

CONTENTS.

INTRODUCTION.

IT is impossible to adequately present the complex subject of the history of the spread of the European Fauna in a single paper. All that can be attempted is such a general conspectus as may serve to show the interest and importance of the enquiry, as well in itself as in the assistance it gives towards the solution of geographical and geological problems.

Although this subject received the attention of that great teacher of geology, Sir Charles Lyell, and was presented more fully by Professor Edward Forbes in 1846, followed by the biological and geographical work of Dr. Sclater and Dr. Russell Wallace, it is only lately that it has become prominent, and this largely due to the researches of German, Russian and

* Monday, February 18th, 1907.

French savants, and the writings and lectures of Dr. Scharff, of Dublin, who has gained for it wide recognition.*

The word *fauna* is used in science to include not only all forms of living animal organisms, the lowest as well as the highest, but also all animal organisms that have lived in past geological epochs, Palæozoic as well as Neozoic. But in this paper reference will necessarily be omitted to the lowest invertebrates, and to Man, the highest vertebrate, as well as to the vast number of species that have ceased to inhabit this part of the earth's surface before the Quaternary epoch.

In approaching the question of whence and by what routes came the animals of Europe, it is in the first place necessary to know their present habitats and dispersal, by which knowledge may be obtained some indication of the direction of their original homes. It is also requisite to know the proportion of species in many localities, that the region inhabited by the maximum number may be determined. Consideration must likewise be given to the causes that produce, facilitate, retard or hinder migration, both biologically and geographically.

The enquiry into geographical and climatal conditions, as well as of configuration both of land and sea, and of surface elevations and depressions, opens up the great question of the changes of land and sea areas, and of great alterations of temperature which have taken place in recent geological times; but for our particular and limited enquiry, the changes that have taken place in the Eurasian area, or, more precisely, in the Palæarctic region of Dr. Sclater will be sufficient.

These geographical changes having been produced by geological causes, and followed by geological results, can only be known by the study of the geology of the region affected, and the conclusions derived therefrom. This, of course, affords scope for much disputation as to details, but the general conclusions may be said to be well established.

The importance of geographical changes in determining the course of a migration of animals is obvious, since wide sea areas render impossible the passage of all vertebrates except birds, and of all invertebrates except some insects. The change therefore of a land area into a sea area, or of a sea area into a land area, will have most important distributional consequences. The elevation of land, too, is a powerful influence, since it is followed by a lowering of temperature, and if the elevation is great,

* A review by the Secretary of Dr. Scharff's lectures, in book form, will appear in the succeeding volume of *Transactions*, No. XL.

producing mountain ranges, a formidable obstacle is raised against animal migration. So also a wide area of waterless or desert land will present a difficulty effectually preventing the further travel of many species, and impeding the progress of many others. Even a river may bound the habitats of species. Dr. Russell Wallace found that in the Upper Amazon Valley* "several species of monkeys, birds and insects come up to the south bank of the river, but do not pass it, while allied species come to the north bank, which in like manner forms their boundary."

Again, there is the phenomenon of discontinuous areas of distribution in which the same genus or even species may occur, although the areas may be at great distances apart, without appearing in the intermediate areas. Of these Dr. Wallace says:—"The known and probable changes of sea and land, the known changes of climate, and the actual powers of dispersal of the different groups of animals, were such as would have enabled all the now disconnected groups to have once formed parts of a continuous series."†

Thus a wide field of enquiry is opened, and for complete results a very large amount of investigation and research will be required. The results here given must therefore only be regarded as partial, approximate, and very incomplete.

Geographical Changes.

Since the fauna of Europe has been ruled and regulated, advanced and retarded, by geographical changes, a brief sketch may be here given of these changes of land and sea in the Palæarctic region during recent geological times, so far as they appear to be indicated by geological and biological considerations.

This part of our subject has received considerable illumination from the work of Professor Hull, who, in papers to this Institute and elsewhere, has shown from soundings off the European coasts the former extension westwards of our continent. By this extension the south-west of Europe, or what is now Spain and Portugal, was united to England and Ireland, giving direct land communication with the south-west of our sister island, or what is now the County Kerry. The land area would then be so continuous that the British Islands would be part of the Continental area, and where is now

* *Island Life*, chap. ii, p. 18. † *Ibid.*, chap. iv, p. 70.

the North Sea, the English Channel and the Irish Sea, would all be land areas with the exception of a long lake between Ireland and the Isle of Man, giving a river flowing to the south between Ireland and Cornwall.

It is also concluded that much of Central and Southern Europe was covered by a sea in which the Miocene beds of those areas were deposited and above which the present Alpine mountainous region displayed itself only by some low hills.

The Mediterranean Sea would then be two or three inland seas or lakes, with Greece united to Syria, Sicily united to Africa, and Sardinia and Corsica to France. No Straits of Gibraltar would have existed, for the South of Spain would have been joined to the North of Africa by a land area that would include the Balearic Islands, but it would be cut off from Europe by a sea or straits occupying the present valley of the Guadalquivir, and the North of Africa would have been separated from equatorial Africa by the Sahara Sea, which there is evidence for concluding continued until recent times.

In the east, the Aralo-Caspian area has been occupied by a great sea which there is reason to believe extended northwards to the Arctic Ocean; while the Baltic marine area would extend to the White Sea on the north-east and cover the lower lands of the Scandinavian peninsula to the west.

Far to the north, and curving westwards round the northern end of the Western Ocean, there would have been a land area joining the then narrow but lofty Scandinavian land by way of Spitzbergen to Greenland and the American continent. At the same time, probably all Northern Europe, from Denmark eastwards, would have been under water.

But after the Miocene period, the central and southern parts of Europe were elevated, and continued to rise until the previous low hills in a watery plain gradually became an extensive hilly region; and then a great series of mountain ranges on elevated land forming the Pyrenean, Alpine and Balkan region, which is now the distinguishing feature of Central Europe. A land communication was thus established between France, Germany and Asia, south of the Caspian Sea.

The North-Eastern Sea appears to have advanced westwards and southwards as far as the eastern parts of England, and the Great Western Sea we call the Atlantic, advanced eastwards to the present shores of Portugal, Spain and France, with an incursion between Ireland and Cornwall along the direction of the Bristol Channel, and another between England and France along the direction of the English Channel.

Still later, it is contended, this sea advanced sufficiently westwards to cover the East and the North of England, the South of Scotland and a large part of Eastern and Central Ireland, while the West and North of Ireland remained connected with North Scotland and its islands on the west and north by continuous land. Subsequently a general elevation of Northern Europe laid bare an immense area of sea-bottom which established land communication between Western Europe and Asia, north of the Caspian Sea, and gave the configuration of land and water very much as it is at present, completed by the cutting through of the Straits of Dover and the Straits of Gibraltar.

Autochthonous Species.

By far the greater number of the animals at present or recently living in Europe, and those now extinct but which lived in the European area during the Pleistocene or Prehistoric Quaternary period, have had for their original homes areas outside European boundaries. But there are a certain number of species which appear to have originated within the area of the European continental platform.

These autochthonous animals, as they have been called, appear to have spread in various directions from certain limited regions, or, it may be said, centres, which have been determined by the present extension and distribution of these species.

Three European areas of dispersion of autochthonous animals seem to have existed. The earliest has been called the Lusitanian region of dispersal, although it is much more extensive than Lusitania or Portugal, since it comprehends the whole of the present Iberian peninsula with the north-west of Africa, and an area that extended westwards into the Atlantic. Another was a south-eastern region, comprising the Balkan peninsula, and a third was the central mountainous area of the Alps and its extensions.

The most important of these was undoubtedly the south-western or Lusitanian region, from which area species migrated northwards, north-eastwards and eastwards. The northward migration was favoured by the Atlantean extension of the continent which gave a direct land communication westwards of the Bay of Biscay for Lusitanian species to reach the South-West of England and Ireland. And thus it is that these areas contain both plants and animals not found in other parts of the British Islands or on the continent of Europe except in the south-west.

Perhaps the most notable animal of these species is the Gasteropod *Geomalacus maculosus* or spotted slug, which is in Kerry and Portugal.* The former direct land connection between Portugal and Ireland is also evidenced by the *Arbutus unedo*, or strawberry tree, and the *Euphorbia hiberna*, or Irish spurge, both species of South-West Europe; but in the north confined, the former to South-West Ireland, and the latter to that area and South-West England.

The mammals of Europe that may be regarded as having a Lusitanian origin are the rabbit (*Lepus cuniculus*), which is in Spain, France and the British Islands, and is fossil in the Pleistocene of Germany, and two moles of the genera *Myogale* and *Talpa*.

Of birds, there is one that is known in the British Islands, but only in the South-East of England, the Dartford warbler (*Melizophilus undatus*), that ranges to the extreme South-West of Europe, and another species of the same genus is in the Mediterranean Islands, and both may be regarded as of Lusitanian origin. Other Lusitanian birds are the pied wagtail, the bearded titmouse and some species of magpie and finch.

Of Reptilia may be noted the snake (*Tropidonotus viperinus*), and two or three species of lizards; while of Amphibia there are several toads, three newts, and the *Salamandra chioglossa*. There are, too, a number of species of terrestrial Mollusca, both of Helix and of slugs, including the before-mentioned *Geomalacus*. No less than ten species of spiders, several butterflies and beetles, and some other small invertebrates, are regarded as being of Lusitanian origin.

The south-east of Europe with its Balkan highlands was a considerable centre of dispersal of land Mollusca. One genus, *Clausilia*, has but a few species in the British Islands, and there is only one *Clausilia* in Spain, while in the south-eastern region there are about one hundred and thirty species.

Although probably the Alpine central region gave to Europe no new genus of Mammalia, there are several species that appear to have been there developed from more ancient stocks.

Of these the most noteworthy are perhaps the chamois (*Rupicapra tragus*) and the steinbock (*Capra ibex*). Both of these characteristic Alpine animals are doubtless species of genera of Asiatic origin which have been subjected to mountain conditions, and so have given the present Alpine forms. So also may be regarded the Alpine marmot (*Arctomys marmotta*),

* For a figure of this animal, see Scharff, *European Animals*, p. 89.

the vole, *Evotomys nageri*, the Alpine shrew (*Sorex alpinus*), and the little dormouse (*Muscardinus avellanarius*), although the last named has spread over a large part of Europe, but not to Ireland.

This, however, can scarcely be said with respect to the genus Salamandra, which appears to be of Alpine origin, for although two species, *S. maculosa* and *S. caucasia*, have a somewhat extended range of habitat, it is centred on the Alpine region, while the third species, *S. atra*, is never found on the lower lands.

Species of land Mollusca of the genera *Helix*, *Pomatias*, *Zonites*, *Acme*, and *Dandibardia* appear to have had an Alpine origin, with some butterflies and grasshoppers.

South-Eastern Immigrants.

The immigration of animals into the European area from Southern and Western Asia was by far the most important contribution to the fauna of Europe.

Europe itself, as has been stated, does not seem to have produced any genus of Mammalia, and the few that have entered Europe from Arctic lands are small and unimportant, though possessing considerable interest for the purposes of this enquiry; while the later immigration from North-Eastern Asia, or Siberia, important as it was undoubtedly, was much less considerable than the migration westwards into our continent of Southern Asiatic animals; for this much earlier faunal movement brought to Europe large quadrupeds and many birds and reptiles.

It was more especially an invasion of Miocene and Pliocene times; but the immigration has continued through the Pleistocene period down to historical times. Many of these Oriental immigrants have become extinct in the European area, but their bones are so abundant and well preserved in Pliocene and Pleistocene deposits that there is no difficulty in giving approximately complete lists of these animals, some of them well known as now living only in Asia and Africa.

The genus Elephas was represented in Europe by four species, while now there are only two species of elephants existing, the *E. indicus* of Asia and the *E. africanus* of Africa. Three of the four species ranged far north-westwards, and with land continuity found such a congenial habitat in what is now Britain that their bones are abundant in English Pleistocene deposits. In this district, the Thames Valley, two species were

so abundant that the teeth of no less than 100 elephants have been taken from the brick-earth of one brickfield at Ilford, Essex. It may also be noted here as interesting to London residents, that the bones of elephants have been found in many places in London itself, notably under Regent Street and Euston Square.

In the same Pleistocene beds are bones of rhinoceros and lion, and, more remarkable still, hippopotamus, which animal is now restricted to tropical African rivers. The excavation of the railway cutting at Kew Bridge revealed the bones of the following eight species of large mammals, all of Asiatic origin: *Bison priscus*, *Bos longifrons*, *Cervus elaphus*, *Cervus tarandus*, *Elephas primigenius*, *Felis spelæa*, *Hippopotamus major* and *Rhinoceros tichorhinus*.

In the deposits forming the floors of caverns, again, there are also the bones of the sabre-toothed tiger, *Machærodus latidens*, bear and, more numerous, hyæna.

The Pikermi deposits of Greece, which have recently been examined, give a remarkable assemblage of bones of animals, most probably of Asiatic and East African origin, amongst which are found the giraffe and antelopes and several species of monkeys.

Though the camel is not generally known as a living European animal, it still exists in one small area in South-West Spain, though probably introduced by man, but the fossil remains of the genus *Camelus* have been found in Roumania and South Russia. Similarly we find in one corner of the Spanish peninsula, Gibraltar, the so-called Barbary ape (*Macaus innus*).

That splendid animal, the Irish elk (*Megaceros hibernica*), which has left its bones and magnificent antlers under the Irish bogs as well as in the Isle of Man, England, Scotland, France, Denmark, Germany, Austria, Italy, and Russia, was probably specifically, as it undoubtedly was generically, Asiatic, though the species may possibly have been developed in Europe.

Of the more commonly known mammalia of Europe which have had a southern or western Asiatic origin may be noted the following: The badger, cat, common hare, fallow deer, goat, horse, pig, red deer, roebuck, and the sheep.

Many of our birds, too, have had a southern Asiatic origin especially those having a more resplendent plumage.

The peacock (*Pavo cristatus*), well known in Judea in Solomon's time, was in Greece after Alexander's Asiatic exploits

This typically Asiatic bird is now largely domesticated, but it is in a semi-wild state still in the South of Spain, where I have seen large numbers together.

The pheasant (*Phasianus colchicus*) another typical Asiatic bird, traditionally said to have been brought from the banks of the River Phasis by the Argonauts, extended its range to England certainly before 1199, for in that year King John mentions it in a licence or charter referring to Devonshire. Unlike the peacock, the genus *Phasianus* has many species and a very wide range in the Palæarctic region.

The common barn-door fowl, as it is called, (*Gallus domesticus*) which is such a friend in giving to us our breakfast eggs, has many strongly marked varieties, but all are from the *Gallus ferrugineus* or *G. bankiva* of India. The genus has been in Europe from at least the times of the ancient Greeks, and was probably introduced into Britain by the Romans. Like domestic fowls, pigeons are very various, and, also like the former, the many varieties of domesticated pigeons are from one species, *Columba livia*, or rock pigeon. The genus Columba is widely dispersed throughout Europe, Asia and Africa, and is evidently of Asiatic origin.

Of smaller birds of Oriental origin, the nightingale (*Daulias luscinia*) is perhaps the most noteworthy. This evening songster and spring visitor to our shores has never been known in either Ireland or Scotland, and even in England its range is limited to the Southern and Midland Counties. Other Eastern birds are the bullfinch (*Pyrrhula vulgaris*), goldfinch (*Carduelis elegans*), dippers (*Cinclus*), fire-crested wren (*Regulus ignicapillus*) and the wagtail (*Motacilla*).

Another curious survival in Spain is that of the flamingo (*Phœnicopterus ruber*), which may be seen in flocks in the great marsh district, Las Marismas, near Seville.

Nearly all European Reptilia and Amphibia are South-Eastern immigrants. The lizards, which are so abundant in South Europe, and the snakes, which have travelled north as far as 72° N. Lat. in Norway, as well as toads and frogs, including the curious tree frog (*Hyla arborea*) of the Mediterranean Islands and the most southern part of continental Europe, and the still more curious chameleon (*Chameleo vulgaris*), are almost all of Oriental origin.

Of the terrestrial Mollusca, but few can be said to be of Asiatic origin, most of the species seeming to be indigenous to Europe. But of insects there are many butterflies, of which there are 20,000 species in the Old and New Worlds, many dragonflies,

and many beetles, of which there are altogether no less than 100,000 species.

The two remarkable species of Orthoptera (*Mantis religiosa*), the Praying Insect, and the Stick Insect (*Bacillus*) must be added. There are also a few spiders and a notable crustacean, the fresh-water crab (*Thelphusa fluviatilis*), which in Europe is quite confined to the south.

Arctic Immigrants.

Although in the early Glacial period much of Northern Europe was submerged below the Glacial sea, yet there seems to have been continuous land extending from the Arctic regions southwards by the Scandinavian highlands to Scotland and England, and so to Central Continental Europe, for the Straits of Dover were not then cut through. By this long and narrow land communication, animals might travel southwards as the rigors of the Glacial period increased in the more northerly lands. At the same time, with the extension of the Arctic land westwards to Greenland and North America, species inhabiting those remote Northern lands could find a way to Europe.

Thus can be accounted for the existence in the British Islands of animals from both Arctic and North American habitats. Some of these doubtless migrated from North America to Greenland and the Faroe Islands in still earlier times, probably later Tertiary, and then afterwards proceeded southwards when glacial conditions impelled a further migration.

Arctic conditions may include a great variation of temperature, one period being much more tolerable for animal life than another. Of this there are abundant evidences not only in the Arctic remains of animals, but much more in the Arctic fossil plants. But however much temperature may have changed, the shortness of winter days and lengthened nights, with short summers without darkness, have been constant accompaniments of Polar regions, and so climatal influences have always played a great part in determining the fauna of far Northern lands. The remarkable prevalence of white as the winter colour of both mammals and birds of Arctic lands is a conspicuous testimony to the powerful effects of the conditions of high latitudes.

As has been pointed out by Dr. Scharff, the large number of Lepidoptera, 243 species, found by Möschler to be common to both North America and Europe, and that twelve species while common to Nearctic and Palæarctic lands are absent from

Asia, is indicative of a former land connection between Northern Europe and Greenland. The evidence afforded by the flora of the Arctic regions of the Old and New Worlds also points in the same direction, and this is all supported by the configuration of the sea-bottom between Norway, Franz-Joseph land, Iceland and Greenland.

One of the most interesting results of the Arctic migration southwards was the presence of reindeer (*Rangifer tarandus*) in Europe as far south as the Pyrenees, and, too, in very large numbers, as is shown by their remains in the South of France. The cave deposits of the department Dordogne contain abundant bones of reindeer of the same type as those now living in the Barren Grounds of North America, which are smaller and have more rounded antlers than the Siberian type. This reindeer, called in America, Caribou, has left its bones in many places in the Pleistocene deposits of the British Islands, including Ireland, and it remained as a living species in Caithness, the most northerly county of Scotland, until the thirteenth century. As additional evidence of now vanished Arctic lands, reindeer are in the islands of Spitzbergen and Novaya Zemlya.

The arctic fox (*Canis lagopus*) is now confined to the mountains of Norway, but its bones attest its former presence in Britain and other European localities. The arctic hare (*Lepus variabilis*) is still in the British Islands, but confined to Ireland and Scotland, though it ranges on the continent of Europe into Scandinavia and Russia in the north, and in the south to the Alps, Pyrenees and the Caucasian mountains. This hare is white in the Arctic regions both summer and winter, in Scandinavia it is white in winter and brown in summer, while in Ireland it is brown all through the year.

Other Arctic immigrants to Europe are the stoat (*Mustela erminæa*), which gives the much valued ermine, and the lemmings, two species of which are fossil in the Pleistocene of this country. The whale and the seal must also be added to the Arctic mammals of Europe.

Of Arctic birds we had in the extreme north of the British Islands until the beginning of the last century the remarkable species called the Great Auk (*Alca impennis*) which was very similar to the penguin now so abundant in the Antarctic regions. The well known Scotch, or red grouse (*Lagopus scoticus*) is an Arctic immigrant, as are also the willow grouse of Norway and the ptarmigan.

As both reptiles and amphibians are unknown in the Arctic regions, we cannot ascribe any European species of these classes

to Arctic migration, but of fishes Dr. Scharff regards the salmon family, the sticklebacks, the perches, many of the cod family, the herrings, and several flat-fish as of Arctic origin.

The North-Eastern Immigrants.

The last great faunal invasion of the European area followed the retreat of the early Glacial sea and the establishment of land conditions extending from the east of Asia to the west of Europe northwards of the Caspian Sea. This has been called the Siberian migration, but as a large portion of Western Siberia had been under water, and the animals were from the more eastern area of central and northern Asia, I prefer to designate them the North-Eastern immigrants.

Impelled probably by search for food, the newly established land communication determined the route of the migrants along a zone due west to Central and Western Europe from the north of the Caspian Sea, to the south of which lay the route of the previous great migration of Asiatic animals which I have called the South-Eastern Immigration. The route of the second Asiatic immigration is very clearly indicated not only by the identity of living species in Eastern, Central and Western Europe with Northern, Central and Eastern Asiatic species, and their absence from the more northern and the more southern parts of our continent, but also by the fossil remains in the Post-Glacial deposits of a long and broad zone stretching westwards from Siberia across Europe midway between north and south.

Some of the immigrants prolonged their journey until they reached as far westwards as what is now England, demonstrating the land connection of this country with the continent then existing, and the more recent cutting through of the Straits of Dover. But these species are not, with one or two exceptions found in Ireland, demonstrating also that although England was joined to continental land, Ireland was then, as now, separated by a sea which prevented the further migration of these eastern animals.

Thus it is found that the very interesting difference between the fauna of Great Britain and that of Ireland produced by earlier migrations was increased and intensified by this later immigration of Northern Asiatic species. By these considerations we have an explanation of the absence from Ireland of many British animals, amongst which may be named the beaver, the dormouse, the common hare, the mole (*Talpa europæa*), the shrew (*Sorex vulgaris*), all lizards, all snakes, all

toads except the natterjack, all frogs except one species, the nightingale, the Roman snail (*Helix pomatia*) and *Cyclostoma elegans*.

Furthermore, it appears that the area of the settlement of the North-Eastern Immigrants was bounded south-westwards by the River Garonne, which does not seem to have been crossed by them, while the far northern lands of Scandinavia and Russia were also unvisited by these Asiatic animals, so that their area of occupation is well defined.

To this immigration Europe is indebted for no less than twenty-eight mammals, of which nine are still, or were recently, living in the British Islands. These are the beaver, the harvest mouse, the pole cat, the common shrew, the stoat, the vole, the water vole, and another species, *Arvicola glarealus*, and the weasel. The remaining eighteen are either now living in parts of the European continent, or, as their bones attest, did so in Quaternary times. These are the Arctic fox, the glutton, the tailless hare, three species of hamster, the jerboa, two species of lemmings and three species of *Arvicola*, the Bobak marmot, and two species of pouched marmots, the moose deer and another species of *Alces*, the musk ox, the Saiga antelope and the Siberian reindeer.

To this immigration we also owe our thrushes, bullfinches and the nuthatch, and from it we have received the sand lizard and two other species of lizards, the viper and the frog, *Rana arvalis*. Of insects, the tiger beetle and several other beetles, and some European butterflies, may be ascribed to the North-Eastern Immigration.

As pointing to, if not proving, the former sea connection between the Arctic Ocean and the Aralo-Caspian region, it may be mentioned here that the *Phoca caspia* of the Caspian Sea is very like the seal of the Sea of Aral and the *Phoca baltica* of the Gulf of Finland, as well as the seals of the Arctic seas. There are also in the Caspian two species of *Mysis*, closely related to the *Mysis oculata* of the Arctic seas, as well as some other crustaceans of an Arctic character.

Some of the migrants from Siberia seem to have advanced westwards into Europe for a certain distance and then to have retreated towards their original homes. Such, for example, is the Saiga antelope, or *Saiga tartarica*, which is now only found in the East of Russia near to the Asiatic border.

The very interesting Cromer Forest Bed, abounding as it does with mammalian remains, has been the subject of considerable discussion as to its geological age. It is usually

regarded as Newer Pliocene, but Dr. Scharff thinks it ought to be considered as of Inter-Glacial age and therefore Quaternary, and that this may have been the period of this North-Eastern Immigration. He contends that comparatively mild climatal conditions may have existed during the Glacial epoch in the North of Europe, very near to the glaciated region, as is now the case in New Zealand and Switzerland where grapes ripen near to the foot of great glaciers, and that these mild conditions would allow of an abundant fauna living then in the southern part of the British Islands.

The history of the spread of the European fauna suggests and opens many highly interesting questions on which much difference of opinion may legitimately arise, but the limits of this paper will not allow of my entering into these discussions. I must be content with having introduced the subject to the notice of the Victoria Institute, indicating its general scope, character and teachings, from which I think it will be seen that it at least offers a good example of the interdependence of different branches of natural knowledge.

Discussion.

The discussion was opened by Sir Henry H. Howorth, F.R.S., who dwelt upon the evidence of the former connection between the Iberian peninsula and the west of Ireland, as shown by the presence of several plant forms, such as the arbutus, two species of heaths of which the "Mediterranean heath" is abundant in Galway, and the *Osmunda regalis*—a magnificent fern which grows luxuriantly both at Killarney and in Donegal.

The Secretary, Professor Hull, F.R.S., after thanking the author for his paper, said,—There is an episode in the remarkable history of the European fauna, to which we have been listening, which I wish to advert to during this discussion. It has been only briefly alluded to by the author, because it is only indirectly connected with his subject; but from its unique character deserves special attention. I refer to the great migration of the Europasian animals into Africa, towards the close of the Pliocene period—resulting in the re-peopling of that vast continent by new races of

animals and the expulsion of the aborigines. The subject has been ably developed by Dr. Alfred Wallace and Dr. Sclater, but newer light has been thrown upon it by observations on the relations of land and sea which brought about (as I believe) the Glacial Epoch.

The Pliocene period, as Professor Lobley has stated, was remarkable for great earth movements, causing elevation of the land and sea bed over the Europasian area, and consequent lowering of the climatic temperature. At the beginning of that period, Africa was isolated from Europe and Western Asia by a broad sheet of sea-water—but as time went on land arose at intervals all along the Mediterranean from the Atlantic westward—and *three causeways* were formed as lines of communications between Southern Europe and Western Asia, converting the Mediterranean into a succession of lakes—unquestionably fresh-water lakes.

Now we have heard how Europe and Asia were inhabited by animals largely representative of those of the present day—namely, huge pachyderms, ruminants, and ferocious felines, such as the lions, leopards and hyænas, which had migrated from the Asiatic region, but their range was bounded by the Atlantic and Mediterranean waters. We have now to enquire, what were the races of animals inhabiting the adjoining continent of Africa at the same period? We have learned from the researches of the authors referred to that the predominant forms were those of the semi-apes, known as the *Lemurs*, which have given the name to a region including Madagascar; but the pachyderms, the felidæ, the ruminants and other forms then flourishing in the Europasian continent were absent from "the dark continent." However, the period and opportunity for a migration southwards into Africa gradually approached and was ultimately reached. Towards the close of the Pliocene period the three great causeways uniting the two continents above referred to arose from the ocean—one at Gibraltar Straits, the second between Sicily and Africa at Algiers, including Malta, and the third across the Isthmus of Suez. Impelled by the increasing cold of the approaching Post-pliocene or Glacial Epoch, those animals unable to endure the rigors of an Arctic climate instinctively bent their steps southwards; they crossed the causeways and entered the warm plains of Africa, driving before them the Lemurs and other humbler forms of animals, until they were exterminated or only found refuge in the Island of Madagascar—now separated by a deep gulf—but one

which owing to the rise of the land had become shallow, or perhaps obliterated.*

Such is, I believe, in brief the account of that great migration of Europasian animals into Africa, the progenitors of those now inhabiting that great continent; a migration of vast importance in the history of races, and recalling to our minds the successive migrations of the Asiatic tribes of men into Southern and Western Europe which are recorded in history, and of which we have heard so much from Mr. Rouse. It may not be considered inappropriate as an appendix to the able paper for which we have to thank Professor Lobley this evening.

Mr. ROUSE.—Upon this instructive and fascinating paper allow me to make two criticisms.

Firstly, the rabbit is not now in Great Britain through having crossed from Portugal or Spain in prehistoric times. We read in Murray's *Historical English Dictionary*, "The rabbit is evidently of late introduction into Britain and Northern Europe; it has no native name in Celtic or Teutonic, and there is no mention of it in England before the Norman period." Its original name in English and its present day name in German, *cony* and *kaninchen*, are both derived, as that work tells us, from the Latin *cuniculus*, which in turn is, "according to ancient authors, of Spanish origin." The earliest quotation that Murray can find for the creature of this name is in 1200, the earliest for *rabbit* in 1440, where in an English-Latin word-list it is interpreted, "yonge conye, *cunicellus*"; while Turberville in his *Venerie* (lxiii, 178) writes, "The Conie beareth her Rabettes xxx dayes." Moreover there was no direct land connection in the Tertiary Æon between Great Britain and Lusitania, but only between our island and North-Western France; beyond that, around the Bay of Biscay, and down the coast of Gallicia and Portugal, there was an extension of the land area about fifty miles out to sea, represented by the present sub-marine plateau; therefore any existing land animals that reached England from Lusitania overland

* Mr. Newton gives the fauna of Madagascar as consisting of 39 species of Lemuridæ, 25 of Chamelionidæ, 260 of birds, the Struthidæ (or great wingless birds) now in a fossil state, also three species of Hippopotamus, swine, and a slender-legged form of Zebu-ox (*Quart. Journ. Geol. Soc.*, Feb., 1895).

must have settled and bred in France on the way; and, if none of their descendants are found in France, they could not have come overland, but must have been imported by ship; as the snake and the slug and the insects referred to might readily have been in the innumerable cargoes of fruit and vegetables, that have in the course of ages sailed from Spain to Britain, and the moles may possibly have been also.

Secondly, there is a confusion in the paper between the migration of fauna in the historic age, or say during the last 4,000 years, and its extension in an earlier age which must have possessed different characteristics, since rhinoceroses, hippopotami and hyenas then abounded in countries where they now cannot live; and since the relics of man associated with their remains show that the human race then possessed much greater strength than in historic times, and, as evidenced in the Old Man of Cromagnon, probably much greater longevity. I speak of course of the Palæolithic Age, which the late Sir William Dawson identified with the Antediluvian. In the later age it was needful that the land animals should all spread from Western Asia; and it is most interesting to hear from the lecturer an account of this spreading. But in the earlier age there was no such necessity; and we should naturally suppose that at their very creation they were dotted at various points over the earth's surface wherever there was the greatest sustenance for them.

The thanks of the meeting having been accorded to the author for his interesting and able paper the meeting separated.