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ORDINARY GENERAL MEETING.*

COLONEL C. E. YATE, C.S.I., C.M.G., IN THE CHAIR.

The Minutes of the previous Meeting were read and confirmed.

The following election was announced :—

LIBRARY ASSOCIATE.—Newcastle-upon-Tyne Public Free Library.

The following paper was then read by the Author, with the assistance of the Chairman :—

ON THE SPREAD OF EXISTING ANIMALS THROUGH EUROPE AND TO THE ISLANDS OF THE ATLANTIC; BASED ON DR. SCHARFF'S RECENT WORK, "EUROPEAN ANIMALS."†

By Professor EDWARD HULL, M.A., LL.D., F.R.S., (Secretary).

PART I.—INTRODUCTORY.

THE origin of the fauna and flora of islands at a great distance from continental coasts is one of the most interesting problems connected with natural history which can engage our attention. Such islands, it has been observed, are peopled by forms of life which are either identical with, or similar to, those inhabiting the adjoining main lands either at the present day, or at recent geological periods not more ancient than early Tertiary ; and if we confine our attention for the moment to those forms common to the islands of the North Atlantic, distant from continental shores and separated by deep ocean waters, the question arises by what means, and under what conditions can the occupation of the islands by the animal inhabitants have taken place.

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* Monday, 2nd March, 1908.

† *European Animals, their Geological History and Geographical Distribution*, by R. F. Scharff, Ph.D., B.Sc. Constable and Co., Ltd. 1907.

Now there are several conceivable means by which this distribution may have been effected; and they may be arranged under the following heads:—

1. By human agency; such as accidental transportation by ships, or direct importation.
2. By the natural agency of winds and currents of the sea.
3. By flotation and swimming; and
4. By land connection at a former period owing to the rise of the sea-bed, by which a land passage was afforded for immigration.

1. On the first of these means there is no necessity to dwell. We all know that animals and plants have from time to time been imported into distant lands by man; as for example the rabbit into Australia, and the sparrow into the United States of America; both turning out to be pests in the countries which have become their homes.

2. On the subject of the natural agency of winds and currents which we may term "meteorological agency," the treatise of Dr. Wallace, one of the founders of zoogeography, takes the first place amongst recent writers,* followed by the work of Dr. Scharff, which has given rise to the present essay, in which I shall have occasion to draw attention to the divergence of views of these writers.

3. The third means of distribution need not detain us, as it is of rare occurrence for distant islands; but the fourth is that which will require our attention as one of great importance.

4. *Range of the Subject.*—The able paper read before the Institute last session by Prof. Logan Lobley† may be considered as introductory to the present subject, in that it dealt with the origin of the European fauna. On this occasion we have to consider the problem, how to account for the existence of some of these forms in the far distant islands of the Atlantic; and to investigate the very divergent views of Wallace and Scharff on this problem. And we shall also endeavour to ascertain how the fact of the great uprise of the lands and bed of the adjoining ocean which has been demonstrated by the formation of the submerged continental platform and the drowned river-valleys, throws light on the presence of these island forms of life.‡

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* *Island Life*, by Dr. A. R. Wallace, 2nd Edit., 1892.

† *Trans. Vict. Inst.*, vol. xxxix, p. 102.

‡ "On the subject of the plant distribution amongst the islands of the ocean." Dr. Guppy's able paper has already been laid before the Institute. See *Trans.*, vol. xxxix, p. 167.

PART II.

Community of forms between the West of Ireland and Portugal.—Before entering directly upon the subject of the fauna of the Atlantic islands, I may here be allowed to interpose a matter indirectly bearing upon it which has impressed itself upon my mind during these investigations. It is a good many years since the late Professor Edward Forbes pointed out the remarkable fact that the fauna and flora of the south-west of Ireland were to some extent identical with those of Spain and Portugal; in other words, that some plants and animals of Kerry and Connemara are peculiar to those parts of Ireland, and do not naturally occur in other parts of the British Islands, but are to be found in the Lusitanian Peninsula. Forbes maintained that it was only by a former land connection that this community of species could be accounted for, and consequently that there must have been, at a very recent period, such a rise in the level of the ocean bed as to form a causeway between the two countries, along which these plants and animals migrated. Amongst the latter are to be found the rare little toad (*Bufo calamita*) known as the "Natterjack," indigenous amongst the mountains of Kerry, and the spotted slug (*Geomalacus maculosus*) which lies concealed under the stones in the same district. But the more characteristic forms are those of the plants such as the *Arbutus*, several species of heath, together with, probably, the *Osmunda regalis*, which grows so luxuriantly by the Lakes of Killarney and western Donegal, also the "filmy fern" (*Trichomanes radicans*), and the "London Pride" (*Saxafraga umbrosa*).

The former land migration of plants and animals appears to have its counterpart in that of the very ancient races of man who settled in Ireland, especially the Milesians, who became settlers in early pagan times. According to Miss Lawless (quoting from authorities, especially *The Annals of the Four Masters**), there were four successive invasions:—1, the

* *Ireland*, by the Hon. Emily Lawless, in *The Story of the Nations* Series. According to Miss Eleanor Hull (*Pagan Ireland*, D. Nutt, 1904) there were five pre-Christian invasions, of which the third was that of the Firblogs, the fourth that of the Tuatha-da-Danaan, the fifth that of the Milesians, the ancestors of the present Irish people, supposed to have come from Scythia, by way of Egypt and Spain, and to have landed on the shore of Ireland at Inisfail, or "The Island of Destiny." Miss Hull regards the Formorians not as settlers, but as sea rovers and pirates, like

Formorians; 2, the Firbolgs; 3, the Tuatha-da-Danaan, and lastly, (4) the Milesian. The remarkable coincidence to which I wish to point is this two-fold migration from the Peninsula to Western Ireland, viz., that of man and of plants and animals, and the question suggests itself whether that of the flora and fauna was precedent to that of early man or contemporaneous with it? Measured by the ages of the Egyptian and Babylonian monarchies, the early settlements may have been several thousands of years before our era—a time, sufficiently distant, when the bed of the ocean may not have settled down to its present level from its high elevation during the glacial epoch, and may thus have presented in its shallower parts a land passage for the Milesians from Spain as well as that for the plants and small animals above enumerated. The land connection with Scotland, on the other hand, is indicated by the Irish hare—not the brown hare of England, but the "blue" or mountain hare of the Scottish Highlands, which is common to both countries.

Part III.

Fauna of the Azores, Madeira, and Canarics.—These islands rise from the Atlantic off the coast of Spain, Portugal, and Africa, and are separated from the mainland by wide and deep water. They contain an ancient endemic fauna originally derived from Europe and North Africa belonging to a period which, according to Scharff, may date as far back as early Tertiary,* together with more recent forms of immigrants, such as goats, rabbits, weasels, rats, mice, and bats. There are also numerous birds, including waders, and insects, and the question arises how have these animals been introduced? Was it by a recent land connection, or by those agencies, either natural or human, to which I have referred above? The former view is supported by Scharff, the latter by Wallace; and we will now consider on which side the probabilities and preponderance of evidence lie.

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the Normans and Danes of a later age. Tradition and invention has had much to do with the history of this age, but there has probably been a basis of reality for the leading events recorded; at any rate the events extended over a very long period.

* According to Wallace, strata belonging to the Upper Miocene epoch are found in one of these islands, pointing to a land or shallow water connection with the mainland at this period.

Let us consider briefly what are Wallace's views as expounded in his important, and largely accepted, work, *Island Life*. He lays down certain propositions which may be accepted by everyone, as, for instance, when he says (p. 71)

"Land mammals cannot pass over very wide oceans."

Again—

"Some animals, as pigs and deer, are very good swimmers, but never voluntarily venture out of sight of land. Small animals, such as squirrels and mice, might be carried on floating trees or 'floating islands,' but it would require a pair of the same species to be prolific—a rare occurrence, and we cannot suppose that such causes have been effective in the dispersal of mammalia as a whole; and whenever we find that a considerable number of the mammals of two countries exhibit distinct marks of relationship we may be sure that an actual land connection, or at all events one within a few miles, has at a former time existed."*

It might be supposed from the above quotations that Wallace believed in the recent connection of the Azores and of Madeira with the mainland, by which the animals I have named above (goats, rabbits, etc.) were introduced; but such is not the case! That these animals have not been introduced by human agency, Scharff has adduced very interesting evidence of an historical kind, derived from the original names given to the islands by their early Genoese discoverers. On Solari's map of the Azores, which dates back to 1385, the names of the islands are indicated as follows:—

Capraria = Goat Island (now St. Michael).
Columbis = Pigeon Island (now Pico).
Li Conigi = Rabbit Island (now Flores).
Corvi marini = Island of sea-crows (Spear-waters ?) now Corvo.

And he adds: "The result of these historical enquiries appears to justify the presumption that mammals, such as the goat and rabbit, are truly indigenous species on the Azores.† This is a view which Wallace does not accept. He considers it improbable that these islands have ever been connected with the mainland, while their wholly volcanic origin is opposed to the view that they formed part of an "Atlantis" including Madeira and the Canaries, though admitting that deposits of

* *Island Life*, p. 72.
† *European Animals*, p. 104.

marine origin referable to the Upper Miocene age occur on the small island called Santa Maria.*

These islands are remarkable for the number and variety of birds and insects. According to Wallace, there are 53 species of birds, a large proportion being aquatic and waders—and he considers that many of the birds were carried by icebergs from Europe during the glacial period. Without denying the possibility of so unusual a mode of bird-migration, it may be doubted whether icebergs from the European area were ever carried into Tropical regions of the Atlantic during the glacial period, or that birds could have survived such a voyage—on such a raft.

As regards the insects, Dr. Wallace considers that the butterflies, moths and hymenoptera—which are all of European species—have been introduced in the same manner as the birds! Beetles are numerous, and out of a total of 212 species, 175 are European, and of these 101 appear to have been introduced by human agency. The remainder are indigenous, and of these 23 species have been introduced from Europe directly by human agency†. As for the rest he accounts for their presence by "gales of wind" or "drifting safely for weeks over the ocean," buried in the stems of plants or "in the solid wood of trees in which many of them undergo transformations."‡ After this where can imagination regarding natural agencies stop?

It is with such reasons as these that Wallace endeavours to satisfy his mind regarding the presence of birds, including waders, in the far-off islands of the Atlantic—the reason being that he is a firm believer in the persistency, or permanence, of the deep oceanic floors, and rather than entertain the view that ocean beds have been elevated and lowered in very recent geological times, he falls back on most improbable phenomena in order to account for recognised facts. It was far otherwise with Lyell, who had no such preconceived ideas, who recognising how,

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* *Island Life*, p. 240. Wallace's statement that there are no terrestrial vertebrata is clearly untenable. Lyell also was under the impression that the only indigenous representatives of the mammalia present in the Atlantic islands were bats, which we know have great powers of flight, for he says, "During this period (Pleistocene or human) no mammalia, not even of small species, excepting bats, have made their appearance, whether in Madeira and Porto Santo, or in the Canarian group." *Antiquity of Man*, p. 497. The names on Solari's map clearly show that the views both of Lyell and Wallace were mistaken.

† *Ibid.*, p. 245.

‡ *Ibid.*, p. 246.

within the Tertiary period, marine formations have been raised high into mountainous land, was quite ready to accept conclusions based on such observations!

No less interesting is the presence of an assemblage of land shells—such as *Helix*, *Pupa*, *Clausilia*, etc.—in Madeira and Porto Santo, both living and fossil—and to some extent local, or proper to each island; only eight of the whole being common. But these genera, shown to be quite indigenous, are those of the adjoining continental regions; and it is inconceivable that they could have been imported into the islands either by human agency, or by those means suggested by Dr. Wallace; thus we are driven back to account for their presence by the hypothesis of an original land connection with Europe or Africa—by which immigration took place.

Dr. R. F. Scharff's views.—We now turn from the above speculations to the more reasonable views of Dr. Scharff, which, as will appear, are in accordance with, and go to confirm the conclusions deducible from recent investigations regarding the features of the bed of the Atlantic ocean. As I have shown in former papers—the rivers descending from the western coasts of Europe and Africa can be traced by means of the soundings on the Admiralty charts—to depths of 1,000 or 1,200 fathoms below the surface—indicating the great uprise of the ocean bed at a very late period.* Such an elevation would produce land connection in the less deep areas existing between the mainland and the far-off islands by which animals may have migrated. Such land emigration is that upon which Scharff founds his views regarding the manner in which the indigenous fauna has established itself far out in the islands of the ocean—and, therefore, corroborates the theory of a former uplift founded on the existence of the submerged river-valleys.

Scharff disagrees entirely with Wallace, when, after discussing the origin of the weasel of the Azores, he says,

"I am, therefore, of opinion, contrary to Dr. Wallace, that the existing mammalian fauna of the Azores supports the view that these islands were formerly connected by land with the mainland."†

It is to be recollected, however, that Scharff recognises an earlier period of land connection than that required for the migration of existing animals, probably in the Miocene period;

* *Trans. Vict. Inst.*, vols. xxx, xxxi, and xxxii.
† *European Animals*, p. 104.

the land connection required in the latter case occurred in the Pliocene and reached its culmination in the Post-Pliocene or Glacial period, and was, as I believe, the immediate cause of the occurrence of glacial conditions in the British Isles and Europe.*

The formation of the river-valleys took place at the close of the Pliocene period, as proved by the late Professor Issel in the case of the submerged river-valleys entering the Mediterranean from Europe; and the subsequent subsidence which approximately brought about the present relations of land and sea took place at the close of the Post-Pliocene stage. Thus we see that physical changes concur with biological conditions in testifying to the great oscillation of level which the bed of the Atlantic and the adjoining lands underwent at the close of the Tertiary period of geological history. To us they seem enormous—amounting, as I have stated, to some thousands of feet—but as compared with the diameter of the earth they are comparatively insignificant, and when we recollect the vast changes of level which can be shown to have taken place in the Alps, the Pyrenees, the Himalayas and other mountainous regions in Tertiary times, they are not unprecedented.

PART IV.

RANGE OF SOME SPECIAL ANIMAL FORMS.

I shall now proceed to give some of the more special examples of animal forms common to the islands, including those of Great Britain, and the adjoining lands drawn from Dr. Scharff's work. Some of these are accompanied by artistic illustrations taken from life, or museum specimens, and by a process of shading, the areas of distribution of the animals are represented on a series of the map of Europe very effectively; I will begin with the Auk.

The Great and Little Auk.—In the picture† we have the Great Auk standing with a whimsical air of dignity over his humble and diminutive companion, who is evidently quite content with the relative positions which nature has assigned to them both. Alas! the larger of these birds has disappeared within the present generation, and is only to be found in our museums and collections. It once existed in vast numbers

* Hull, "Another probable cause of the Glacial period." *Trans. Vict. Inst.*, vol. xxxi.

† *European Animals*, Fig 11, p. 39.

in the regions bordering the Arctic Circle and Southern Scandinavia, the British Isles, Iceland, Greenland, and the North American Continent. Scharff observes that to judge from the fact that its remains have been found in those refuse heaps called "Kitchen Middens" in the north and west of Scotland and Ireland—it was probably used as an article of food by the early races of man in these islands.

2. Our next illustration is that of the noblest of the deer tribe (the *Cervus giganteus*, or *C. megaceros*), whose giant skeletons adorn our museums, and were so abundant in the old lake deposits of Ireland, and especially in those of Co. Limerick —as to have given to them the name of "the Irish Elk"—a mistaken name, as the animal was not an elk but a deer. Though especially numerous in Ireland, its remains have been found in various parts of the British Isles and Northern and Western Europe. It was, in all probability, a contemporary with man, and was probably exterminated by the wild aboriginal hunters of those regions. Scharff gives a restored figure of this noble animal (Fig. 17) after Keller-Andriæ. The enormous size of the antlers must have prevented him from frequenting the forest, and thus rendering him an easy prey to the wolf and to the arrows and spears of the primeval inhabitants.

3. *The Mole* (*Talpa Europæa*).—I have selected as the next illustration this remarkable little animal, so seldom seen, but whose undermining operations are often visible in the little mounds of earth thrown up on the surface of our meadows, because of the extraordinary extent of its range over the Europasian Continent. It is found throughout England, Wales, and Scotland, but is absent from Ireland, and it extends its range through Europe right across Central Asia to the Chinese Sea. Scharff observes, that like the beaver, the mole must have advanced westward from Asia into Europe apparently within recent geological times—on the ground that, had it advanced from Europe into Asia we should have expected to meet it everywhere throughout Western and Southern Europe since it has had ample time to spread. But I do not consider his reasoning on this point quite conclusive—for it would seem that the Alps, the Caucasus, and the Pyrenees have proved effective barriers to its progress into Italy, Greece and Spain, notwithstanding that it has managed to "creep round" the edges of these mountains, to a small extent. The point, however, is immaterial.

4. *The Roedeer* (*Capreolus caprea*).—This graceful little deer has a wide range in the European area—and extends into the

region east and south of the Black Sea including Asia Minor. It is remarkable that while its companion, the red deer, has survived in the mountains of Killarney (owing probably to careful protection) yet the roedeer is absent from Ireland; but with the red deer it ranges through the Highlands of Scotland, and by itself is found amongst the woods and plantations of the lowlands as far as the Scottish borders. I myself have met with a small herd in the woods south of the Clyde—and there are many districts in England where if introduced the roedeer would find excellent cover. The red and fallow varieties appear to be in greater favour with landowners for stocking the parks of England, than is the roe.

The Hippopotamus.—It need not be said, that this huge amphibious mammal is extinct in Europe, although its remains have been found in England, as far north as Yorkshire. The migration of this unwieldy pachyderm, which is so much bound to a semi-aquatic life along the banks of lakes and rivers, is a problem not easy to solve. Assuming its origin to be in Western Asia, and its geological age to be the Miocene, it becomes clear that the physical conditions of the European area must have been widely different from those of the present day in order that the "hippo" might find waterway over this vast extent of country. But we also know that the conditions were very different in the Miocene age—during which mountains such as the Rigi, were lake basins, and extensive lakes existed in Central Europe, while the Mediterranean area in all probability furnished a chain of freshwater lakes, as was certainly the case at a later period. Once he became an inhabitant of a large lake or river the "hippo" would prove difficult to dislodge—and could maintain an equal contest with savage man owing to his skin-armour and his aquatic habits. Scharff in his map (Fig. 26) indicates the presence of remains of the "hippo" in the border of Portugal north of the Tagus, and in Algeria. His figure of the animal standing with open jaws and formidable teeth, is very effective.

The Reindeer (*Tarandus rangifer*).—Nature has destined this animal to a life midst frost and snow, and it is, therefore, no wonder that its picture gives the impression of a cow with antlers—rather than that of a cousin to the noble stag, or the American Woodland Caribou.* Its present range is restricted

* The Caribou of Canada, consisting of two species which never intermingle though inhabiting part of the year the same regions, is classed by Lydekker with the reindeer, genus *Rangiber*. *Nat. Hist.* vol. ii, p. 373.

to Northern Scandinavia, Russia in Europe, Greenland, with Labrador and Canadian Territory in the New World; yet at one time it spread over the greater part of Europe including the British Isles. Its remains are especially abundant in Ireland, and it lived along the northern foot of the Alps and of the Pyrenees. It seems not improbable that its presence so far south was due to the advancing cold of the Glacial period, and that with the return of warmer conditions it followed northwards the retreating ice and snow of a milder climate. The reindeer is the only member of its tribe which is utilized as of service to man for drawing a sleigh or for similar useful purposes.

The Chamois (*Rupicupra tragus*).—We turn with pleasure from considering the case of the obedient and unhappy reindeer to that of the graceful and lively chamois of the Alps, the Pyrenees and the Caucasus. We are all familiar with this inhabitant of mountains from preserved specimens, pictures, or the admirable imitations in wood-carvings by the Swiss craftsmen. But few ever see a chamois alive amongst its native rocks and precipices. It is the shyest of animals, and long before you can get a sight of it the wary chamois has espied you, and is off at full speed out of sight. It was my good fortune when visiting the mountains of Lucerne in 1904 to get a view with my binocular of a group of chamois standing on the edge of a precipice a thousand feet high and quite out of range of a rifle—if I had happened to be a jager, which I was not. I considered myself lucky to get a sight of the animals even at this distance. The occasion reminded me of another, when, some years previously, while ascending the gorge leading to Petra from the Wady el Arabah, on looking up to the crest of the cliff, I beheld three ibexes standing in a row and gazing down on our party, while a bear was scrambling up to the same position of security, a little distance off, and sending the stones, which gave way under its paws, rattling down the cliff. Ultimately bruin succeeded in reaching the same skyline, and turning round, scrutinised our party, wagging its head from side to side as is the manner of bears. The antics of the bear were not, however, observed by the ibexes, as there was a high rock intervening between them, otherwise the ibexes would doubtless have rapidly increased their distance from the bear, and have given bruin a wide berth. I need scarcely say that I allude to the ibex because it is the representative of the chamois, both in its form, and conditions of life, amongst the mountains of Arabia Petræa. In a word, the ibex is first cousin to the chamois, and he is the "wild goat"

of Scripture in the passage, "the high hills are a refuge for the wild goats and the rocks for the conies"*; these I consider to be the jerboas, which I saw on several occasions in the Sinaitic Peninsula, and once on the summit of Mount Sinai itself.

The Lion (*Felis leo*).—"The king of beasts," as the lion has well been called—though by no means the largest or strongest amongst the carnivora—for it is not so powerful as the tiger†—had a very wide range in Post-Pliocene, and recent times over the Europasian Continent, and invaded Africa, its present home, on the approach of the cold of the Glacial epoch. Its remains have been traced from the north of England through the centre and south into Southern Asia, and its form is engraven on the tablets of ancient Babylon. Of its presence in Palestine in Old Testament times we are aware from frequent references in the Bible, but why it should have been so completely exterminated over this vast area remains an unexplained mystery. On consulting Dr. Scharff regarding this question, he writes: "As regards the disappearance of so many large animals, such as the lion, from Europe, it is no doubt largely due to competition with others that had the same tastes. The tiger, as you remark, may have driven the lion out of India, but as the former is not known to have occurred in Europe, some other cause must have induced the lion to leave us."‡ No doubt, also, increase of population and arms of precision have contributed to the same result. But Africa has offered him a spacious and secure retreat, and with the limits of the chase imposed by the British and Foreign Governments upon hunters, this noble animal, which Landseer has so strikingly modelled in bronze at the base of the Nelson monument, will live to roam at large for an unlimited period of time. I may mention here that the lion does not appear to have reached Ireland or Scotland in its migration from Eastern Europe and Asia, and this fact is regarded by Scharff as evidence of its very late arrival in Britain.

The Mammoth (*Elephas primigenius*).—I shall conclude this part of my subject with a short account of this extinct pachyderm, whose history has justly given rise to so much interesting speculation, and whose remains have been discovered over large areas of the Europasian Continent and North

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* Psa. civ, v. 18.

† As proved by actual test in the zoological gardens of the Royal Dublin Society by the late Dr. S. Haughton, F.R.S.

‡ Letter dated May 29th, 1907.

America. In this range* is included Ireland as well as England and the region of Central Europe from the coast of France to the Black Sea north of the Alps. That the mammoth was a contemporary with man in Europe we know from the vigorous and life-like, if rude, sculpturings on the walls of cave dwellings of early man and on bone. Its huge recurved tusks naturally attracted the special attention of the primitive hunter and converted him into an artist! And from the marvellous state of preservation in which its remains have been found in the frozen soil of Siberia, and the abundance of the tusks found in the banks of the Arctic rivers, it is inferred that the mammoth inhabited Northern Asia in great numbers at a time when forests must have provided food for his sustenance. The period and cause of his disappearance in Siberia are involved in mystery. His destruction from the surface of Europe may have been altogether due to the agency of early man. Dr. Scharff thinks that the mammoth may have been the direct ancestor of the Indian elephant, and his woolly covering gave place to that of the present day in India, where the change to a warmer climate enabled the animal to dispense with his warm clothing. On the question of the spread from Asia of the mammoth, Professor Lobley has given very interesting details in his paper already referred to.† The extraordinary extent to which the mammoth, in company with other large mammals, multiplied in the south-east of England of the present day, may be gathered from the fact stated by Professor Lobley that from one brickfield in Essex the teeth of no fewer than 100 elephants have been extracted, and in the excavation for the railway cutting at Kew Bridge the bones of the following extinct animals have been taken, namely, *Bison priscus, Bos longifrons, Cervus elaphus, C. tarandus, Elephas primigenius, Felis spelæa, Hippopotamus major*, and *Rhinoceros tichorinus.*

In a work of great eruditiou, entitled *The Mammoth and the Flood* (1887), Sir Henry H. Howorth has discussed the range of the mammoth and the cause of its extinction in the Arctic regions of Europasia. As a disbeliever in a Glacial period, Howorth refers the disappearance of the mammoth to a vast flood or debacle of waters originating in the polar regions, and giving rise to the wide-spread tradition of "The Flood." The name "Mammoth" appears to have been first used by Cornelius

* Scharff. *Supra cit.* Fig. 55 and map, p. 173.
† *Trans.*, vol. xxxix.

Witzen of Amsterdam in 1694, who described the remains of the animal under the name of "mammoth," afterwards by Arab change of pronunciation, becoming the behemoth of the Book of Job, in the language of the Old Testament. In my reply to Sir Henry Howorth's work, entitled *Ice or Water*, I hope I have succeeded in proving that the Glacial epoch was a reality, and its occurrence may well have contributed to the disappearance of the mammoth from the northern regions.

Part V.

Iceland.—A very interesting part of Dr. Scharff's book is his account of the fauna and flora of Iceland. He strongly maintains that Iceland was connected by land with Scotland by way of the Faröes, Shetland, and Orkney Islands, and that by this causeway the plants and animals migrated from one region to the other. Our late colleague, the Rev. Dr. Walker, who had a very wide acquaintance with the animals, especially the insects, of Iceland, maintained this view; and when engaged in tracing out the iso-bathic contours of this part of the Atlantic, I was able to determine the southern margin of the causeway with approximate accuracy, having been bordered by the Atlantic on the south and the Arctic Ocean on the north. The animals of Iceland include the reindeer, supposed to have been introduced by man, the Arctic fox, and the field mouse, which is one of the most widely spread mammals of Europe and the British Isles. There are twenty-one different kinds of land and fresh-water molluscs, including *Arianta arbustorum*, which ranges over Central Europe, Scandinavia, the British Isles, and Iceland,* but a former connection with Greenland is indicated by several common species, such as *Succinea Groenlandica*, which is common in both countries, yet is unknown in Europe.†

It is remarkable that while there are no fewer than thirty-three species of moths in Iceland there are no butterflies, which may be due to the long absence of sunshine in a country lying along the Arctic circle. The flora of Iceland, though not abundant, supports the view of the former land connection with Europe and Greenland.

Conclusion.—I hope I have now succeeded in showing from the above short references what a large fund of interesting information concerning the dispersal of the animals of Europe

* Scharff: *Ibid.*, p. 65, Fig. 21. † *Ibid.*, p. 66, Fig. 22.

beyond the limits of the European continent is contained in Dr. Scharff's book. The subject forms a fitting sequel to that of Professor Lobley, who has ably dealt with the biological history of European animals in the paper read before the Institute last session.* Both authors recognise the former changes in the level of the European and adjacent sea-beds owing to which lands now separated by ocean waters were connected, and both recognise the spread of type forms from centres and their differentiation due to geographical changes.

Discussion.

Professor G. F. Wright, D.D., LL.D.—The interesting and most significant facts presented by Dr. Hull in explanation of the dispersion of animals on the islands near the western coast of the Eastern Continent have their analogies on both sides of the Western Continent. North America is bordered on both sides by a continental shelf covered with shallow water, which would become a part of the continent on a moderate elevation. Across this shelf there are drowned cañons leading out to the deep sea opposite all the great river systems, notably, the Hudson and the St. Lawrence. An elevation of a few hundred feet would lay bare the whole of Bering Sea, and join Asia to America, and add greatly to the area over which animals might roam and secure abundant forage.

That there was such a connection at the close of the Tertiary period, extending far into the Glacial Epoch, is clear from the dispersion of the Asiatic mammoth over North America. This huge animal, whose remains are so abundant in Northern Siberia, evidently was enticed eastward by the pasture lands now buried in Bering Sea, and covered by the shallow waters bordering Alaska, Vancouver, Washington and Oregon. In northern Alaska his bones are so numerous and the decay of his flesh so recent that the stench evoked at Escholtz Bay by the warm summer's sun is almost unbearable. Over the northern part of the United States the mammoth ranged as far east as New England, and south to Mexico. He was in

* Lobley: "The spread of the European Fauna," *Trans.*, vol. xxxix.

America during the Glacial Epoch, but he was not destroyed by it. Evidently he survived the fierce struggle for existence brought on in the southern United States by the advance of the ice and its contraction of the inhabitable area. The struggle in which he succumbed was that of the milder climate under which the ice front retreated, when other animals throve better than he; for his remains are found in the peat bogs occupying the kettle holes left on the retreat of the ice. Even the Megalonyx wandered during that mild period as far north as Central Ohio, in latitude 40°.

On both continents the study of the distribution of Tertiary animals sheds a flood of light on the changes of land level that occurred at that time, and shows that they were abnormal, and out of all analogy with those now occurring.

Mr. W. WOODS SMYTH, L.R.C.S., writes:—I have read Professor Hull's papers with the greatest interest, and am in entire agreement with the views he has presented to us regarding the fauna of the islands of the Atlantic. I think Wallace's theory untenable. The soundings of the "Challenger" Expedition lend some support to Professor Hull's contention, that at a relatively late age land connecting islands and continents lay where now the Atlantic rolls its mighty waters. It is of interest to remember that, until lately, if not till to-day, traditions remain among the Irish on the shores of the Western Ocean of a land visible from Ireland which contained buildings of a pretentious character. I have in my possession a beautiful poem embodying these traditions. It was to them the Land of the Blest. From the same idea of a pre-existing land came the custom of embarking the dying Norse kings to the happy country in the West; while the migration of the lemming under an impulse which drives them on, on, into the ocean, is a profoundly significant testimony to the fact that the Western seas once held a vanished land. I am grateful to Professor Hull for his interesting paper.

Colonel HENDLEY asked Professor Hull whether any of the fauna of the islands (the Azores, etc.) had been proved to be of American rather than of European character and origin, and whether there was anything in the view that an "Atlantis" accounted for the origin of the fauna of the islands.

In confirmation of the remarks on the mole, he observed that he understood that the animal had been found in India, though it was

extremely rare, and that its presence might possibly be accounted for in the manner suggested for Italy, Greece and Spain. With regard to the lion, it still existed (that is, the maneless variety) in Western India, in the neighbourhood of Simur and parts of Gujarat, but every year it was becoming more rare. He believed that about thirty-five years ago he had seen on Mount Abu the last specimen of what was known locally as the Abu lion. As the Chairman was there about the same time, he might have seen it also, and been responsible for its death!

He stated that he had read in a paper (the *Globe*, of February 28th) that the Russian Academy of Sciences was fitting out an expedition to go to the Yakutsk District to bring back a large mammoth which had recently been discovered, in the intestines of which vegetable remains, hitherto *quite unknown* to botanists, had been found. It seemed possible, therefore, that want of suitable food might help to explain the extinction of the animal. The following is the extract:

"A SIBERIAN MAMMOTH.

"DISCOVERY OF UNKNOWN VEGETABLE MATTER.

"(FROM OUR CORRESPONDENT.)

"St. Petersburg, February 25.

"The Academy of Sciences is fitting out an expedition to go to the Yakutsk District for the purpose of bringing back the huge mammoth that was discovered lately in that desolate region. A remarkable feature of this latest discovery is that vegetable remains, in a perfect state of preservation, and hitherto quite unknown to botanists, have been found in the huge animal's intestines." (See Frontispiece.)*

Dr. WOODWARD, F.R.S., complimented the author on his contributions to our knowledge of the former extension of continental coasts, on the West of Europe and of Africa, towards the Atlantic, by means of the evidence of Admiralty charts and soundings showing the continuations of the courses of old river-channels now submerged. He referred to the evidence of the elements in the fauna and flora of Ireland which have a Lusitanian

* A photograph of this animal taken *in situ* is given in the *Geological Magazine*, August, 1903, p. 361, together with an account of its transfer to the St. Petersburg Museum by Dr. Herz from the banks of the Beresowka.

origin, showing the ancient extent of the old continental shelf—now submerged—which once united the whole of the British Isles with the Continent of Europe. Dr. Woodward referred to the former vastly-extended range of the fauna of Europe, *e.g.*, the *Hippopotamus*, inhabiting the rivers, lakes, and coasts and islands of the Mediterranean seaboard, and the greater part of England up to Leeds in Yorkshire, and the French, Spanish and Italian areas; the British and Italian forms attaining the size of the largest living hippopotamus; while those found in Malta, Sicily, Crete, Samos, etc., were all *pigmy* forms, like the associated pigmy elephants on those islands. The mammoth *Elephas primigenius* occurred abundantly in the British Isles and on the Dogger Bank and the Eastern English Coasts, proving that the vast adjacent area now covered by the North Sea and the Straits of Dover was then a part of the mainland. Thousands of elephant remains had here been obtained during the past hundred years, but many were destroyed by the fishermen because of the damage done to their nets. The reindeer had an equally wide distribution, and was, like the mammoth, common to this country, France and Spain, over which it migrated to and fro. The Great Auk was certainly exterminated by the hand of man; its remains being found in the "refuse heaps" within the prehistoric times, known as "brocks," in Caithness. There seems no justification for the view that the destruction of the mammoth over *three* continents (Europe, Asia and America) was a contemporaneous event, but rather, like many other mammals, it *gradually became extinct* owing to physical and climatal changes (and possibly *partly to man* himself). The vast accumulations of mammoth remains along the Asiatic coasts is readily explained by drownings; owing to *spring floods* on the great Asiatic rivers, which flowing north, by the earlier melting of the snows and by the heavy spring rains in the south, caused great floods over vast areas near their mouths, which, being close to the Arctic Circle, were still full of ice. Hence the accumulations of elephant remains on the New Siberian Islands and the coasts and rivers of Northern Asia and the shores of Alaska.

"The gigantic Irish deer" (*Cervas giganteus*) was first found in a bog on the Isle of Man, and the specimen was presented by the Earl of Derby to the Edinburgh Museum. Another since obtained has been set up in the Castle at Douglas, Isle of Man. This great deer,

whose bones have been so frequently found at the bottom of peat bogs in Ireland, resting on the shell-marl, lived when these bogs were clear water lakes, often connected with rivers. In crossing the ice in winter they may have fallen through and been drowned (as suggested by Professor Hull), and this may also explain their presence in the Isle of Man. Professor Hull may like to know, that more than one hundred *fallow deer* thus perished in Sir Philip Egerton's park at Tarporley, Cheshire, many years ago. Having out of curiosity crossed the lake to an island in the centre, they stayed too long, and a partial thaw caused the ice to break in places, and the deer falling in, could not extricate themselves, and were drowned beneath the ice in crowds.

Mr. J. TOWNSEND TRENCH said.—It may interest some of those who have just listened to observations upon the commonly called "great Irish Elk," but more correctly designated the "Megaceros," if I should briefly relate the circumstances under which, some thirty-five years ago, I discovered and secured the complete skeletons, skulls, and antlers of five of these splendid male animals, and the skull and skeleton of one female.

I was travelling from the Limerick Junction towards Dublin, when, having stopped at a station, the guard looked into the carriage where, amongst other things, I had a stuffed eagle. It had snatched a hen from an old woman's fowl yard; she saw it alighting to devour the hen just at the other side of a loose stone wall, which she stealthily approached, and overthrew with her shoulder upon the eagle, which was killed thereby, and which she subsequently brought to me. The railway guard observed, "I know where there is a stranger animal than that." In reply to my enquiries, he said that at a neighbouring cottage a farmer had an enormous pair of deer's horns, which he had found in a bog.

I at once called for a car and drove off to the farmer's house. It was in a poor district, and near the house was an extensive bog. I told the farmer that I heard he had some horns. He said he had, and showed them to me stowed away in his cow-house, and after a short negotiation, I bought them for a few pounds. I then asked him if he thought there were any more near where he had found that one in the bog. He said he thought not, so I said, "Go and get six men with spades to come and dig for two or three hours, and I will give them each half-a-crown, and if we find any more

horns I will give you two pounds for every one we find." In a short time he reappeared with six men with spades, and he guided us to the part of the bog where he had found the antlers already mentioned.

The men went to work, and one of them soon came upon something hard about 5 feet below the surface. On following up this, and removing the peaty matter, we found not only a handsome pair of antlers in good preservation, but also the skull to which they were attached, and also the complete skeleton of the animal to which these had belonged. They were reposing upon a firm white marl bottom, which consisted of very minute fresh-water shells, which must, many centuries ago, have formed the bottom of a fresh-water lake. Encouraged thus, we resumed our excavations, until we had exhumed the remains of six complete animals as above mentioned, all within a space of twenty or thirty yards square.

Not long afterwards I called upon our friend, Professor Hull, then head of the Geological Department in Ireland, and asked him how it happened that the animals were grouped in such a fashion, and how they came to die there, as there were no marks of wounds on any of their bones, and also how came it that the females were so seldom found? He replied that the herd must have been crossing a frozen lake, and that the ice having given way, they were drowned. As to the females, he said that, having no antlers, they escaped notice often, and when found by the country people are usually neglected, being mistaken for horses' skulls. Thus ended a very curious and very interesting experience. I carried off my prizes, and the farmer carried off his money and the diggers theirs.

Rev. Dr. IRVING writes.—I have read with much interest the proof of your paper on "The Fauna of the Atlantic Islands." In favour of your view as to the *epeirogenic* explanation of the spread of that fauna, I am not quite sure that you may not take a wider time-limit than you seem to do, and extend it backwards to include the *Miocene*, which Zittel years ago worked out as a period of elevation of North-Western Europe on palæontological grounds, giving definite expression to his views by his map of the geography of the *Miocänzeit* in his little work *Ant der Urzeil*, which I have quoted in several recent papers.

There is a point previously raised as to the *Osmunda regalis*. That plant is not at all confined to Ireland. At Wellington

College we were quite familiar with it as indigenous to the old Windsor Forest country, and you may find references to it in the writings of Charles Kingsley.

Sir Joseph Hooker, in the *Students' Flora of the British Islands*, gives it a wide range, so as to include Europe (North and South), as well as tropical Africa, parts of Asia, and tropical America.

Mr. MARTIN L. ROUSE, B.L.—The submarine plateau of Western Africa (which our Secretary has studied to so good account) does indeed overlap nearly the whole of the Canary group of islands, about 150 miles being the limit at which it reaches the 2,000 fathom edge of the abyss; but, even if it has outliers reaching to the bases of the Madeira Islands, it can have none extending to the Azores, which are about 700 miles further off. And, after all, it is only the fauna of the Azores whose origin is in dispute; for the Spaniards and Portuguese found the Guanches to have inhabited the Canary Islands from a remote period before their own arrival. Yet because it is inferred from the names given to three of the Azores by their first Genoese discoverers in A.D. 1385, that they were already inhabited by rabbits, pigeons, and goats respectively, it is further inferred that those creatures could not have been carried thither by the hand of man, but must have arrived there at a time when the islands were connected with the mainland.

Now it would be rather strange if the Phœnicians, who under Pharaoh Necho's orders sailed right round Africa, or their Carthaginian kinsfolk, who, under Hanno, sailed as far as Cape Verd, and were wont to trade with the Fortunate Islands, or Canaries, had never reached the Azores; and, accordingly, I have heard the late Doctor Daniel Wilson, the noted anthropologist (in a public lecture wherein he sought to prove that the Carthaginians were the improvers of the civilization of Mexico) cite as evidence the fact that Carthaginian coins had been discovered on the Azores; which is a proof, not of a mere passing call, but either of a shipwreck or of a settlement by Carthaginian mariners—a settlement brought to an end, no doubt, by some unexpected event. Now, even if a settlement was not intended, but the landing was the result of shipwreck, it is not unlikely that goats had been carried by the Carthaginian ship or fleet, and then landed in the island. In the days when condensed milk was unknown, it was a natural thing to carry goats on board ship; they would stand the rough life where cows would

not, and would yield milk to the crew or to the favoured officers. So too, live rabbits and live pigeons might well have been carried as a store of fresh provision; the idea would naturally occur to Carthaginians as it has to Englishmen and Spaniards in later ages. Still, it is conceivable that pigeons, which apparently can fly for several hundred miles at a stretch, may have flown thither in early ages through being blown out of their course, possibly resting on the rigging of passing ships by the way, as even small land birds have often been seen to do.

Professor LOGAN LOBLEY, F.G.S.—This meeting has been highly interesting, both from the paper and the discussion. The opposed views of Dr. Russell Wallace and Dr. Scharff on the origin of the fauna of the Atlantic islands raises the important question of the permanence of ocean basins, which is affirmed by the former and denied by the latter.

An intermediate view, it seems to me, will meet all scientific requirements. The permanence of ocean basins does not require the permanence of ocean areas, and is quite compatible with great extensions seawards of continental areas by elevations of 2,000 or even 2,500 fathoms. Thus the northern Atlantic islands might with such elevations be united with the neighbouring continents, while the deeper parts of the Atlantic Ocean would remain, though restricted somewhat, still a great oceanic area.

REPLY OF THE AUTHOR.

Rising to reply, the author said, that whatever might be thought of the value of the paper, there could be no second opinion regarding the interest of the discussion. He was exceedingly gratified at the manner in which the paper had been received, and especially in having the support of so distinguished a geologist as Dr. Henry Woodward, for the conclusions he (the author) had arrived at regarding the former extension of the land of Western Europe, and of the river valleys traversing the Continental Platform to great depths below the surface of the ocean. The author could not but regret, on patriotic grounds, that the honour of the discovery of the "gigantic Irish deer" had to be transferred from the bogs of county Limerick to those of the Isle of Man; but no doubt the statement

MAP
to show position of
THE ATLANTIC ISLANDS
SOUNDINGS IN FATHOMS

San Miguel
AZORES
Cape St Vincent
Strait of Gibraltar
1100
Madeira
1177
150
625
1827
1495
1200
822
CANARY ISLANDS
Lanzarote
Palma
Fuerteventura
755
1620
Teneriffe
909
Gran Canaria
1284
100 FATHOM LINE
1691
1289
1797
Cape Blanco
1621
1200
1000
St Antonio
1374
St Nicholas
CAPE VERDE ISLANDS
Bonavista
1380
St Jago
Cape Verde
EUROPEAN CONTINENT
AFRICAN CONTINENT
25°
20°
15°
10°
35°
30°
25°
20°
15°

Stanford's Geog! Estabt, London.

of Dr. Woodward was correct, for patriotism has no place in Science! Certainly the narrative of the death of the fallow deer in Oulton Park helps to explain a great enigma regarding the occurrence of remains of numerous animals under the same peat-bog; but we also know that when deer, like sheep, are frightened they try to herd together, and might thus perish together—for example, on the approach of wolves.

In reply to the question of Colonel Hendley, the author stated that all the animal forms of the Eastern Atlantic Islands were of European genera and species. He was glad to learn from the Chairman and Colonel Hendley that the lion still existed in Western India.

In reply to the suggestion of Dr. Irving—that the age of the great "epeirogenic" uplift might be extended back into Miocene times—he agreed that it may have originated just at the close of that epoch; but Dr. Irving was aware that the Miocene period was characterised by extensive lakes in Central Europe, and the deposits of that age had been elevated to high levels in the Alps during the succeeding Pliocene period—which had left no representations of its own. The late Professor Issel's observations seemed to have settled the question in favour of the Pliocene.

As regards Mr. Rouse's arguments in favour of human agency in the peopling of the Azores, they are worthy of all consideration; but they refer to a period much more recent than that of the possible land connection by means of the uprise of the sea-bed between the islands and the main land.

While these pages are passing through the press I would like to call attention to the remarkable results attained by a party of American explorers under the direction of Professor Osborn, of U.S.A., in the basin of the Fayoum in Egypt, who have apparently discovered the ancestral forms of both the elephant and rhinoceros in the old lacustrine beds of that lake basin. Excellent drawings of these forms are given in the *Illustrated London News* of Saturday, 7th March last. But a more detailed examination had been made by Dr. C. W. Andrews and Mr. J. L. Beadnell, of which an account is given in the *Geological Magazine*, August, 1903.