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A. R. Wallace. Pres. Address
Entom. Soc. of London
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AN

ADDRESS

READ AT THE

ANNIVERSARY MEETING

OF THE

ENTOMOLOGICAL SOCIETY OF LONDON,

ON THE

23rd JANUARY, 1871,

BY

ALFRED R. WALLACE, F.Z.S., F.R.G.S., &c.,

President.

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1871.

AN ADDRESS,

&c.

GENTLEMEN,

On looking over some of the Annual Addresses which have been delivered to you from this chair, as a guide to the proper performance of this portion of my duties as your President, I was much relieved by the discovery that, both as regards matter and arrangement, a wide latitude has been claimed by my predecessors. I may therefore hope that, should I diverge further than usual from the beaten track, you will kindly overlook the fault, and impute it to my old habits of wandering, which, being now debarred from acting on the body, may be supposed to manifest themselves in equally out-of-the-way mental excursions.

To state what losses by death have been suffered by our Society or by our Science during the past year is both a usual and useful portion of the President's Address; and on this occasion it becomes a duty which can on no account be neglected, since we have to regret the irreparable loss of one of the greatest of Entomologists—Lacordaire. It is a proper tribute to his memory to devote a few lines in this place to his life and works.

Jean Théodore Lacordaire was born in 1801 at Recey-sur-Ource, a small town in the department of Côte-d'Or, situate in a hilly country near the sources of the Seine, the Marne, and some of the tributaries of the Rhine. His father was a surgeon, and he was the eldest of four brothers, one of whom became the great Dominican preacher who acquired a world-wide reputation by his eloquence and his liberalism. Our Lacordaire was educated for the bar, but never became an advocate. Circumstances, of which we have no account, led him, at the age of twenty-three, to make a voyage to Buenos Ayres, where he explored the Pampas for four months, and probably acquired or strengthened the

tastes which he thenceforth manifested. After his return he prepared for a longer expedition; and for two years he travelled over La Plata, Uruguay, and the Brazilian Provinces of Rio Janeiro and Minas Geraes. Not yet satisfied with his explorations of this part of South America, he visited it a third time, and traversed the continent, from Santiago, in Chili, to Monte Video. He returned to France in 1830, and published his first scientific essay, "On the habits of the Coleoptera of South America." In the same year he went again to South America, this time to the warmer and more luxuriant regions of Cayenne, where he spent nearly two years. On his return he published his account of the habits of the Diurnal Lepidoptera and Coleoptera of Cayenne, and several descriptive papers in the Revue des Deux Mondes and other periodicals, which is all that he has given the world of his travels and adventures. He appears now to have devoted himself ardently to the systematic study of the insects he had collected, and in 1834 brought out the first volume of his 'Introduction to Entomology.' In 1835 he was made Professor of Zoology at the University of Liège, a position which he occupied for thirty-five years. He was married in 1834, and had four children, two sons and two daughters. He died on July 18th, 1870, at the age of sixty-nine, and was buried at Rosières, in the department of the Somme.

Besides his great work, the 'Genera des Coléoptères,' which occupied the last twenty-two years of his life, and with which his name will be associated as long as Entomology is studied, he published a Monograph of the Erotylidæ, a Revision of the Cicindelidæ, a Monograph of Phytophaga, and the first volume of an Entomological Fauna of the environs of Paris; also several essays,—on Instinct and Intelligence,—on Species, their permanence and variations,—and an inaugural address on Geographical Distribution, besides a few others of less importance.

The unanimous verdict of entomologists has already stamped the 'Genera des Coléoptères' as a work of transcendent merit and usefulness; and when we consider that almost every line of its nine closely-printed volumes embodies the result of numerous observations, careful comparisons, and well-considered judgments upon other men's work, we may form some notion of the mental and physical power required to produce it, volume after volume,

with such an approach to regularity and of such uniform excellence, amid the distractions of professorial duties and other official work. Feeling my own inability to offer any opinion on its various merits or defects, I have thought it well to obtain some estimate of these from my friend and predecessor Mr. Bates, who has, I know, had occasion to examine critically a large portion of Lacordaire's work. He informs me that the distinguishing merits of the 'Genera' are, its completeness (scarcely a single described genus having been overlooked); the justness and accuracy of the characters given, and the clearness of its style and arrangement. In the aptitude and neatness with which the synoptical tables of tribes and genera are constructed, Mr. Bates thinks he has excelled all other entomological writers; and he is also pre-eminent in the instinctive appreciation of genera and groups in those cases where structure is so variable that no logical definition can be found, and in the admirable manner in which he helps the student to find his way amongst them, by means of short general descriptions of facies, colour and other superficial characters. Two defects are indicated by Mr. Bates:—1st, the exclusively systematic point of view from which the subject is treated, no mention being made of the varied functions connected with the characters employed: in consequence of this he sometimes confounds adaptive or analogical characters with those indicating real affinity: 2nd, the absence of groups between the Order and the long series of independent families. The first defect, Mr. Bates himself remarks, would be considered by some entomologists rather as a merit; but is it not more likely that the exigences of space and time compelled Lacordaire, against his will, to restrict himself almost wholly to rigid technical classification? There are, I think, indications of this in his often copious descriptions of the habits and economy, as well as of the structural peculiarities of the families. The second deficiency would probably have been supplied at the end of the work, where, having completed the examination of his materials, he might have given us, as the crowning result, a classification of the families into higher groups.

A few words must be devoted to his character, as painted by his friends and pupils. He was of a gay and joyous disposition, full of spirit, and an excellent speaker, often relieving his lectures by anecdotes of his early wanderings in the forests or the deserts

of the New World. He loved to raise a smile in his pupils' faces, and secured their attention to study by arousing in them a desire for knowledge rather than for academical distinction. He cared little for fame or for honours, but whatever position he undertook he fulfilled its duties with energy. He spent all he could spare upon his library, and delighted in his scientific labours. One of his pupils assures us that he was as much loved as admired by them; that his devotion to his favourite study appeared to increase with his years; and that his last words in public were to the effect—that it is, above all, in her smallest works that the grandeur of Nature overpowers us.

Our own country has also lost an entomologist of the first rank during the past year,—Alexander Henry Haliday, who for more than forty years devoted himself to the study of the Diptera, Chalcididæ, Thysanoptera, and other obscure and difficult groups of insects. He is therefore little known to the majority of entomologists who study Coleoptera or Lepidoptera exclusively, but is highly esteemed by all who are acquainted with his labours. One of his oldest friends, Professor Westwood, has kindly furnished me with the following note on his scientific character:—"He was our *first* entomologist. His ideas of classification and tabulation were so logical, his latinity so classical, and his knowledge of whatever he touched so masterly, that I fear we shall be long before we look upon his like again." Mr. Haliday was a native of Belfast, and passed most of his life in Ireland. During his latter years he lived in Italy on account of ill-health, and died at Lucca on the 12th of last July, at the age of sixty-three.

The only other Members of our Society who have died during the past year are, Mr. T. H. Allis, who had resigned a few months before his death; Mr. A. Haward, who had resigned in 1869; Lieutenant R. C. Beavan, who died on his passage home from India; and H. H. Van de Lier, of Delft. We have also lost our former Member, the Rev. J. F. Dawson, of Bedford, the well-known author of the 'Geodephaga Britannica.'

The annual publication of the Zoological Record renders it unnecessary for me to occupy your time with any detailed account of entomological literature; I shall therefore only refer to a few works which are either of special interest to ourselves, or which treat of subjects of general interest and importance.

In the first class must be reckoned our Transactions, of which four parts have been published in the year, containing twenty-two papers of fully average interest and value, as will be seen by the following classification of them. No less than seventeen consist of descriptions of exotic insects, while only two are devoted to any branch of British Entomology; a proportion which would rather show, that so far from confining ourselves to the restricted field offered by our own country, we have a deficiency of home students, and are hardly doing so much as might be expected in working out the obscurer groups of our native insects, or in studying their habits, structure and physiology. Five very valuable papers are on subjects connected with classification and nomenclature, while only one is devoted to the economy of insects. Looking at them from another point of view, we find that eleven treat of Coleoptera, eight of Lepidoptera, and three of the other insect Orders.

One of the most remarkable and valuable contributions to the volume consists of two papers by Mr. Crotch, on the Genera of Coleoptera studied chronologically. They bring to light an amount of confusion and error in generic nomenclature of which I think few persons were aware, and which will perhaps necessitate some combined action to get out of the difficulty; since entomologists will certainly not agree to the alteration of so many generic names which have become household words, as a strict application of the law of priority would require. Mr. Crotch also makes a suggestion which seems worthy of consideration, namely,—that the best definition of a new genus is not a detailed account of the characters supposed to be essential to it, but the indication of a type species, which is to be the fixed point around which are to be located any other species which sufficiently resemble it. It seems to be undoubtedly the case that the indication of a type is of immense value in permanently determining a genus, which may, with increasing knowledge and materials, be added to or subdivided without affecting the central fixed point which alone is essential to it, and to which the name is attached. It might therefore be a valuable addition to our laws regulating nomenclature, if it were determined, that generic names founded on a recognisable *type* should, in all cases of doubt or where alterations were proposed, have priority over those founded on *characters* only.

The most important systematic paper is Major Parry's revision of the Lucanidæ, which brings up our knowledge of this noble family to the present time, and gives in a compendious form a list of all the species now known, with their respective habitats. The descriptive papers of Mr. Bates on Copridæ and Longicorns; of Mr. Pascoe on Australian Curculionidæ; of Professor Westwood on Pselaphidæ; of Mr. Butler, Mr. Hewitson and Mr. Trimen on Butterflies; and of Messrs. M'Lachlan and Eaton on Neuroptera, will render the volume acceptable to the students of these groups of insects.

The scarcity of papers on British Entomology in our own Transactions is to some extent compensated by the discussion on the economy of Rhipiphorus, which has appeared in the Annals and Magazine of Natural History, and still more by the appearance in the Linnean Transactions of a fourth part of Sir John Lubbock's "Notes on Thysanura." In this valuable series of papers, the author has shown how much is yet to be done in our own country by a close observer of the obscure forms of insect life; for not only are they full of original observations and discoveries in the anatomy, physiology, and affinities of the insects treated of, but a large number of entirely new species have been discovered and described.

It is a satisfaction to me that the year of my presidentship should have been signalised by the issue of the first instalment, although it is but a small one, of the Society's Catalogue of British Insects. The Catalogue of British Neuroptera, by Mr. M'Lachlan, now published, will serve as a specimen of what the work is intended to be; and, looked at merely as a model catalogue in arrangement and typography, it ought to be in the hands of every naturalist. If the whole can be completed in any reasonable time, and of equally good quality, it will form a work of reference useful to general students as well as to entomologists, and a credit to the Society which has produced it.

The Proceedings of the Zoological Society of London are this year deficient in entomological matter, the only papers being, an account of the Spiders of St. Helena, and a Monograph of the genus Idiops, by Mr. Pickard-Cambridge; but the Transactions of the same body contains a valuable illustrated paper by our member, Mr. Charles Horne, on the Habits of the Hymenoptera of North Western India, with descriptions of the new species by

Mr. Frederick Smith. The Proceedings of the Linnean Society, on the contrary, have contained much entomological matter. Mr. Pickard-Cambridge and Mr. Blackwall have papers on the Spiders of Ceylon and Italy; Mr. Pascoe describes a large number of new and remarkable forms of Curculionidæ; while Mr. Kirby's Essay on the Generic Nomenclature of Butterflies exposes a state of confusion in that group similar to that which Mr. Crotch has shown to exist in the Coleoptera, and suggests somewhat similar remedies for them. Mr. Murray's paper, which fills the last zoological part of the Proceedings, will be noticed further on.

The appearance of a general work on Entomology in the English language is so comparatively rare an event, that Dr. Packard's 'Guide to the Study of Insects,' published at Salem, Massachusetts, deserves more than a passing notice. A careful examination of this handsome and profusely illustrated volume shows it to be in many respects so good as to make us sincerely wish it were somewhat better; because, there is hardly demand enough for such works to render it probable that one of the same character will appear for some years to come, and it may therefore indefinitely delay the production of such a complete Introduction to Entomology as we stand greatly in need of. The most radical defect of the work is, perhaps, that it is essentially composed for American readers. Almost all the illustrations are drawn from North American species, whenever such are to be found; while the minor groups and species characteristic of Europe are but seldom mentioned. Now this appears to be bad policy. A work which has involved so much labour, and which is so generally attractive and useful, should be cosmopolitan as regards English-speaking people. It should be illustrated by full reference to all groups of any importance occurring in Europe, North America and Australia, and thus be made equally useful in the three great homes of the English language. The next defect of the work is the very subordinate part assigned to the subject of geographical distribution. The three and a half pages under this heading, in the introductory portion of the work, refer almost entirely to the American continent, while under the separate orders, families, or genera, the subject is hardly touched on. The last defect I shall allude to is in the matter of classification. The orders, or as Dr. Packard terms them the sub-orders of insects, are treated under a

series of families, but these families appear to be formed with little regard to their comparative importance. In the Lepidoptera, for instance, the whole of the diurnal butterflies are included under the family Papilionidæ, which is made to appear as of the same rank as the Sphingidæ, the Ægeriidæ, and the Zygænidæ. In Coleoptera, while adopting almost all the small families of Lacordaire and Le Conte, he makes the Curculionidæ include the Brenthidæ, and altogether omits the Anthribidæ. Again, no reference is made to divisions between the families and genera. The Papilionidæ, including all the diurnal butterflies, and the Cerambycidæ, including all the Longicorns, are illustrated by a series of genera and species without a hint that these enormous groups consist of several well-marked families, subfamilies, or other subdivisions, often characterized by marked differences of structure and economy.

I will now mention what I conceive to be the good points of the work, and these, I am happy to say, are more numerous than the defects. 1. A very clear account is given of the habits and economy of the most interesting groups and species, taken from the best observers, and illustrated by excellent figures. 2. The embryology and development of the chief groups is very fully given, from the most recent researches of Claparède, Weissmann, Huxley, Lubbock and others. 3. The phenomena of Parthenogenesis, Dimorphism and Mimicry are described with tolerable completeness. 4. Various obscure and degraded types have been classed with the allied higher forms, and the evidence for their respective affinities stated. Thus fleas and bee-lice are put under Diptera; Stylops under Coleoptera; Pediculi with Hemiptera; Poduridæ and Lepisma with Neuroptera. Even where the true position of any of these groups is not finally settled, it is, I think, an improvement to treat them in this manner, rather than to give them undue importance by forming additional primary groups for their reception. 5. The chief known fossil insects are introduced into the series, and their affinities pointed out. This is a subject which it is to be hoped will soon become far more important than it has hitherto been, now that leaf and insect beds are being carefully worked. Dr. Packard announces the discovery of a very rich tertiary insect-bed in Colorado, west of the Rocky Mountains. 6. The adoption, in the body of the work, of the simple series of families under each order, is, I think, a

good feature, being far more intelligible to the beginner than the intervention of a variety of named divisions, group under group, which vary in almost every systematic work, while the families themselves are comparatively stable. 7. The full index of names, the clear arrangement and excellent quality of most of the wood-cuts and plates, the good paper and clear type, are to be commended. 8. And lastly, the introduction of the Arachnida and Myriapoda, which ought certainly to form part of every general work on Insects. On the whole then, the book contains a mass of information compactly arranged and clearly conveyed, which is to be found combined in no other English work, and as such it will be a great boon to all who wish to obtain a general knowledge of modern discoveries as to the structure, habits and physiology of insects; while it will prove very unsatisfactory to those who want a guide to their classification and geographical distribution. We must remember, however, that Entomology has become too vast a subject for any one man to master; and to produce such a work as we now require, it would perhaps be necessary for a number of special students to combine, while a skilful editor, with a good general knowledge of the subject, should have unlimited powers to determine the space to be devoted to each subject according to its comparative importance, and to connect the separate portions into a uniform and consistent whole. Let us hope that the appearance of Dr. Packard's work may supply the necessary stimulus for such a combination among British Entomologists.

The very original paper by Mr. Andrew Murray, "On the Geographical Relations of the chief Coleopterous Faunæ," which was read before the Linnean Society in December, 1868, has appeared during the present year in that Society's 'Journal,' where it occupies nearly ninety pages. It contains a variety of curious speculations, supported by a large array of facts; and, as it brings up some of the fundamental questions of geographical distribution as affecting insects, it may be well to consider it at some length.

Mr. Murray first remarks, that of all classes of organized beings, beetles are best adapted to throw light on the past history of the earth by a study of their geographical distribution. This is partly on account of their vast numbers and their universality, but chiefly, he thinks, because they are little liable to be

transported from one country to another by accidental causes, especially in the case of the carnivorous and apterous species. He also believes that beetles (and insects generally) possess a long enduring persistency of form, by which the same type has been preserved through many geological epochs. He then discusses the causes that have led to the distribution of animals, and maintains the view, of which he is now one of the few advocates, that no marked community of forms or species can exist between two countries, without proving that there has been an actual continuity of land between them.

A very prominent feature of Mr. Murray's paper is his division of the Coleoptera of the world into three grand stirpes or races, which he terms the Indo-African, the Brazilian, and the Microtypal stirps. The first comprehends all the characteristic forms of the Eastern tropics, the second all those of tropical America, the third those of the temperate regions of the whole world, not excluding even Australia. He believes that this primary division is to be traced with more or less distinctness in every part of nature, and supports his views by a reference to other groups, and especially by the evidence of Palæontology, which shows that the Eocene Flora of Europe resembled that which now exists in Australia.

The Coleopterous fauna of the Atlantic islands is next discussed at great length, and the facts are held to prove that the whole of these islands from the Azores to the Cape de Verdes, and even to St. Helena, are portions of a vast submerged continent, occupying a large part of the eastern Atlantic, and which was connected with, or formed an extension of, Southern Europe. The chief novelty of this view is the bringing St. Helena into the Atlantic group and its fauna into the microtypal stirps. Certain isolated affinities of African and American groups are believed to prove two distinct land-connections across the Atlantic, one between Brazil and Equatorial Africa, the other between Patagonia and South Africa. The islands of the Pacific, having a microtypal fauna, must have had land-connection with North America or Australia. Australia itself is shown to have affinities with South America, South Africa and Europe, and must therefore at one time or another have had land-connection with all these countries. The *Urania Rhipheus* of Madagascar, with a few beetles and reptiles of American forms, require a direct land-connection with

South America without touching Africa, and this is said to be indicated by an elevated ridge along the sea bottom, from Rio Janeiro round the Cape to Madagascar.

From this short sketch of the paper in question, it will be seen that it discusses many of the most interesting problems connected with the great subject of geographical distribution. The value of the detailed proofs brought forward will in many cases depend upon the degree of affinity indicated by the same generic name being used by different authors, some of whom are not entomologists, and by the manner in which generic groups are limited and doubtful affinities determined. These questions will have to be dealt with by more experienced Coleopterists than myself, but I may take the present opportunity of saying something on the more general questions relating to the geographical distribution of animals.

And first, as to the great value attached to the class Coleoptera in enquiries of this nature, there is something to be said on the other side. Mr. Murray believes that, with the exception of the timber-borers, the presence of the same or closely allied species in discontiguous countries is a proof that there has been a former continuity of soil, because neither their powers of flight nor their vitality are sufficient to carry them over any considerable extent of sea. But in all these respects they must be vastly inferior to mammals, reptiles and land-shells; while their generally small dimensions must offer facilities for distribution in many unexpected ways. Violent gales of wind, for example, will, we know, carry bodies of greater specific gravity than beetles for many miles through the air; and storms and hurricanes are of such frequent occurrence, that they must have played a large part in stocking all uninhabited lands. Again, during great floods, whole forest trees are often carried out to sea, and hundreds of beetles may lurk in the crevices of their bark or even among their foliage, and, under favourable circumstances, be drifted a long way in safety. Even matted rafts covered with soil and bearing living vegetation are occasionally floated out to sea by tropical rivers and may be drifted along for weeks, and ultimately convey scores of insects to far distant lands. A large number of beetles are exceedingly tenacious of life. Immersion in strong spirits for twelve hours will often not kill them, nor will water if many degrees below the boiling point; so that it is not

improbable that some considerable proportion would be found to survive immersion in sea-water for several days. Many facts have not been recorded as to the passage of beetles over wide tracts of ocean, but some of them are sufficiently remarkable. Darwin captured a *Colymbetes* forty-five miles from land north of the Rio de la Plata; and at seventeen miles off Cape Corrientes he caught in a net a number of live beetles of the genera *Colymbetes*, *Hydroporus*, *Hydrobius*, *Notaphus*, *Cynucus*, *Adimonia* and *Scarabæus*. A *Calosoma* also flew on board the Beagle when ten miles from the shore of South America, and the *Calosoma sycophanta* is believed occasionally to cross the English Channel. Sir Charles Lyell also states, that exotic beetles are sometimes thrown on our shores, which revive after being long drenched in salt water. In the case of other insects, we have more positive proof of their passage over wide spaces of ocean. A whole swarm of locusts has been known to pass over Madeira from Africa, a distance of more than 300 miles; while Darwin himself captured a locust at sea 370 miles from land. Two individuals of the *Sphinx atropos* flew on board the Hotspur East Indiaman in 1866, during an easterly gale, at a point 260 miles from the coast of Portugal, and were exhibited at a meeting of the Zoological Society. In his work on the 'Natural History of the Azores,' just published, Mr. Godman relates that a white butterfly flew on board a whaler coming from the south, at about 400 miles from the Azores: it was caught by the captain and placed in a drawer, where it laid several eggs. Such cases as these having been already recorded, we may be sure that migrations to much greater distances are constantly occurring, since we can hardly suppose the extreme cases to be those which have first been observed. We have therefore every reason to believe that, under favourable conditions, almost any winged insect could traverse equal distances. These considerations would lead us to the conclusion that a partial identity of species may exist in the beetles of two countries separated by some hundreds of miles of sea, without in any way necessitating the former existence of a continuity of land between them. In the case of the Atlantic islands, therefore, I see no reason to believe that they owe their Coleoptera to a land-connection with the continent, more especially when there is such strong evidence against that view in the total absence of all mammals and reptiles. Can we believe that the forests of

Madeira would be without a single native rodent, or even a frog, if they owed their rich coleopterous and molluscous faunas to land-connection with Europe?

The exhaustive researches of Mr. Wollaston in these islands will, I believe, furnish, in the single order of Coleoptera, ample materials for the elucidation of this very interesting question. Although the 'Insecta Maderensia' has now been published more than sixteen years, the vast store of facts which it contains bearing on the question of geographical distribution, and especially on that of insular faunas, has never been fully appreciated; and as Mr. Murray has by no means grappled with these facts as a whole, or attempted to show how they are compatible with his theory, I think I cannot better occupy your time than in giving a somewhat detailed analysis of them, and pointing out what I conceive to be their true bearing on the problem of the mode of distribution of beetles, and the origin of insular faunas. My interpretation of the evidence may be erroneous, but the facts themselves must be of value.

I propose to confine myself mainly to evidence furnished by the Coleoptera of the Madeiran group, because, being separated from the mainland by a much wider extent of ocean than either the Canaries or Cape de Verdes, it offers a much more satisfactory test of the opposing theories. It is an advantage also that the materials are, in its case, by far the most complete; and in the 'Insecta Maderensia' Mr. Wollaston has given some details of importance which are wanting in the 'Coleoptera Atlantidum' and in the 'Coleoptera Hesperidum.' The most novel and striking facts brought out by Mr. Wollaston's researches in Madeira are, as is well known,—1st. The affinity with the Mediterranean fauna;—2nd. The total absence of certain large divisions of Coleoptera abundant in that fauna;—3rd. The number of new and peculiar species and of new and anomalous genera;—and 4th. The unexampled preponderance of apterous species. Now accepting, as Mr. Murray does, the theory of slow change of forms by natural causes, we may take the first and third of these facts as proving that the origin of the Madeiran fauna is of a very ancient date. Let us see therefore how the second and the fourth set of facts bear upon the mode of its origin, whether by a land-connection with Europe or by transmission across the sea. It will be convenient to take first the

facts presented by the apterous or winged condition of the species.

This striking peculiarity consists, either in species being apterous in Madeira which are winged elsewhere, or in genera which are usually winged consisting of only apterous species in Madeira, or lastly in the presence of endemic apterous genera, some of which have winged allies while others belong to groups which are wholly apterous. Such phenomena undoubtedly show that there is something in Madeira which tends to abort wings; and Mr. Wollaston was himself the first to suggest that it was connected with exposure to a stormy atmosphere. His further observation, that many of the winged species had wings more developed than usual, enabled Mr. Darwin to hit upon that beautiful explanation of the facts which commends itself to all who believe in the theory of Natural Selection; while Mr. Wollaston himself admits it as fully accounting, teleologically, for the phenomena. That explanation briefly is, that the act of flying exposes insects to be blown out to sea and destroyed; those which flew least therefore lived longest, and by this process the race became apterous. With species to whom flight was a necessity, on the other hand, the strongest winged lived longest, and thus their wings became more and more developed in each succeeding generation.

Now this view of the case enables us at once to explain some of the most striking gaps in the Madeiran coleopterous fauna. The Cicindelidæ, for instance, are entirely absent; and almost all the European species are winged insects of somewhat feeble flight, yet to whom flight is necessary. We can readily understand that such insects would be easily exterminated if they arrived singly or in small numbers; though it is not so easy to understand why, in a forest-clad island, some of the sylvan species should not have found a home had the land ever been connected with a continent where they abound. Their total absence is, therefore, decidedly unfavourable to the theory of a land-connection with Europe. To the Melolonthidæ and Cetoniidæ, as well as the Eumolpidæ and Galerucidæ, which are all wanting, the same argument will apply; and also to the Elateridæ and Buprestidæ, which are represented each by one minute species. But if Madeira is the remains of a continent once continuous with the south of Europe and deriving its fauna from such con-

tinuity, how are we to explain the absence of extensive genera very abundant in South Europe, and, from their being apterous, specially adapted to the peculiarities of Madeira? Such are *Carabus*, *Lampyris*, *Pimelia*, *Akis*, and many others. But these facts are all consistent with the theory of introduction across the sea. Apterous groups, however abundant on the continent, should, as a rule, be absent; and I find that almost all the European apterous genera are wanting, and among the few exceptions there are some whose presence is easily explained and really prove the rule. We must remember, however, that the apterous condition, except in those cases where it is characteristic of an extensive group, is one of little stability or importance. There are species which are sometimes apterous and sometimes winged, and we may therefore be sure, that if any advantage was to be derived by either condition over the other, natural selection would very rapidly render it constant by the repeated survival of the favoured individuals. This is illustrated by the fact that we have winged and apterous species in the same genus, as well as winged and apterous genera in the same family. The Coleopterous Order being essentially winged, and the vast majority of its members being capable of flight, it is a presumption, if not almost a certainty, that all apterous varieties, species, or groups, have been derived from winged ancestors, — comparatively recently in the case of the former, and at a more remote epoch as the character becomes more constant and attached to groups of higher classificational value.

Taking these principles as our guide, let us examine more closely the facts presented by the Madeiran Coleoptera, and their bearing on the rival theories as to their mode of introduction.

There are a large number of European beetles belonging to very varied genera and families which are apterous, and a large proportion of these inhabit the South of Europe and North Africa. Now, on the theory of land-connection, there should be no marked absence of these groups; on the contrary, apterous forms being especially adapted to Madeira, we should expect them to predominate. But, on the opposing theory of transmission across the sea, we should expect them to be wholly absent, or, if there are any exceptions, we should expect to be able to detect some special circumstances which might favour their transmission. A careful examination of Lacordaire's 'Genera,'

and of some works on European Coleoptera, has furnished me with the following list of genera which are wholly apterous, and which abound in South Europe and North Africa.

Carabus, possesses about 80 species in these regions; but is wholly absent from Madeira.

Thorictus, has 10 South European species, and one representative in Madeira, which is an ants'-nest species.

Rhizotrogus (Melolonthidæ), 27 species in Sicily and Algeria, the very countries to which the Madeiran fauna is traced, yet it is wholly absent.

Lampyris, *Drilus* and *Troglops* (Malacoderms), of which the females are apterous, possess 27 South European and North African species; none in Madeira.

Otiorhynchus, *Brachycerus*, and twenty other genera of Curculionidæ, comprising more than 300 South European and North African species, are absent from Madeira, with two exceptions. One is the *Trachyphlœus scaber*, a widely-spread European insect often found in ants' nests; and this, with the case of the *Thorictus*, renders it probable that ants'-nest species have some unusual means of distribution, which are by no means difficult to conceive. The other exception is that of the genus *Acalles*, which has a number of Madeiran species, all peculiar, and is very abundant in all the Atlantic islands. Now we have first to remark that *Acalles* is an isolated form, but is allied to *Cryptorhynchus*, which is often amply winged; so that we may easily suppose that its introduction to Madeira took place before it became completely apterous in Europe. In the second place we have the fact, that many of the species are confined to peculiar herbaceous and shrubby plants, in the stems of which they undergo their transformations, and which habit would afford facilities for their occasional transmission in the egg or pupa state across a considerable width of ocean, while a fragment of dry stem containing egg or larva might possibly be carried some hundred miles or more by a hurricane. Such suppositions would not be admissible to account for numerous cases of transmission, but, as will be seen, this is almost the only example of a genus of large-sized apterous European beetles occurring in Madeira.

Pimelia, *Tentyria*, *Blaps*, and eighteen other genera of Heteromera, comprising about 550 species of South Europe and North Africa, are totally absent from Madeira, with the following

interesting exceptions:—two common species of *Blaps*, which are admitted to have been introduced by human agency, and three species of *Meloe*, two of which are European and one peculiar. The means by which the apterous, sluggish and bulky Meloes were introduced is sufficiently clear, when we remember that the minute active larvæ attach themselves to bees, insects of exceedingly powerful flight, and more likely than perhaps any others to pass safely across 300 miles of ocean. That the solitary exception to the absence of wholly apterous genera of European Heteromera from Madeira should be the genus *Meloe*, is, therefore, one of those critical facts which almost demonstrate that it is not to land-continuity with the continent that the island owes its insect fauna.

Timarcha. This, the only important apterous genus of Chrysomelidæ, is especially abundant in Spain and Algeria, and possesses forty-four South European and North African species; yet it is unknown in Madeira.

The occurrence of two isolated European species of characteristic Atlantic apterous genera—Tarphius and Hegeter—may seem to favour the opposite theory. The *Tarphius gibbulus* occurs in Sicily, and is the only European species of the genus, of which about forty inhabit the Atlantic islands. It is most nearly allied to the smallest of the Madeiran species, *T. Lowei*, which is abundant among lichen on weather-beaten rocks and even ascends in the forest regions to the highest branches of the trees. These habits, with its minute size, are all in favour of this species, or some ancestral allied form, having been carried across by the winds or waves, thus transferring to Europe one of the peculiar types elaborated in the Atlantic isles. The *Hegeter tristis* is an analogous case, this species of an otherwise exclusively Atlantic genus having occurred on the opposite coast of Africa. These instances will furnish a reply to one of Mr. Murray's difficulties,—that all the migration has been in one direction, from Europe to Madeira, never from Madeira to the continent,—a difficulty, it may be remarked, which is wholly founded on an unproved and unprovable assumption; for how can it be determined that, in the case of *Acalles* for example, the genus had not been first developed in the Atlantic islands and then transferred to Europe, instead of the reverse? It is always assumed to have been the other way, but I am not aware that any proof can be obtained that it was so, and it is

inadmissible to take this unproved assumption, and base an argument upon it as if it were an established fact.

We will next consider the facts presented by the distribution of those species of Coleoptera which range from Madeira to Europe, or to any of the other Atlantic islands. If their distribution has been effected by land-continuity, we should expect that the proportion of winged and apterous species that extend their range beyond the island, should not be very strikingly different from the proportion that is found on the island. We do not find, for example, that the proportion of the wingless *Carabi* that have reached our own country from the Continent by former land-connection, is very different from that of the winged *Cicindelæ*.

Now, leaving out altogether those species which have certainly been introduced by man, and grouping the remainder for convenience in six divisions, we find that the Madeiran Coleoptera, which are not peculiar to it, may be classed as follows:—

31 species of Carabidæ, of which 26 are winged, 5 apterous. The whole fauna, however, presents the very different proportion of 38 winged, 43 apterous.

93 species of the families from the Hydradephaga to the Tomicidæ inclusive, of which 90 are winged, 3 apterous. Total fauna; 220 winged, 27 apterous.

28 species of Curculionidæ, of which 26 are winged, 2 apterous. Total fauna; 35 winged, 74 apterous.

15 species of Longicornia and Phytophaga, of which 15 are winged, none apterous. Total fauna; 48 winged, 1 apterous.

20 species of Heteromera, of which 16 are winged, 4 apterous. Total fauna; 28 winged, 27 apterous.

76 species of Staphylinidæ, of which all are winged, none apterous. Total fauna; 109 winged, 6 apterous.

The totals are, for the wide-ranging species, 249 winged, 14 apterous = 263; for the whole fauna, 478 winged, 178 apterous = 656.

It thus appears that, in every case, an immensely smaller proportion of apterous than of winged species are widely distributed. If we take the totals we find that while about two-fifths of the whole number of species range to other countries, only about one-thirteenth of the apterous species do the same, although among the strictly endemic species there are 160

apterous to only 110 winged! We can hardly impute such a constant and overwhelming preponderance to the fact that apterous insects have less facilities for extending their range, when we know that nearly every apterous genus possesses species of almost universal European distribution. I may here recall the fact, that of the above-mentioned 14 apterous species which range out of Madeira, two are Meloes and two ants'-nest beetles, whose presence we have already sufficiently accounted for. It may no doubt be said that much of the difference here shown is due to the fact that the peculiar Madeiran species have had time to become apterous, while the species common to other countries have not yet had time to lose their wings; but this argument, although a valid explanation of some portion of the facts, if we admit that many of the latter have been *recently introduced by natural causes*, cannot be used by those who maintain a former land-connection as the sole origin of the fauna; for on that theory all the species now inhabiting the island (and not introduced by man) must date back to the same remote period, and have had equal time in which to be modified.

Let us now consider what are the special relations of the apterous Madeiran species as throwing light upon their possible or probable mode of introduction.

We have three species which Mr. Wollaston himself states to be usually winged elsewhere, but which are apterous in Madeira. These are *Metabletus obscuroguttatus*, *Calathus fuscus* and *Bradycellus fulvus*. I am inclined to believe that there are a few others which will come under this category, but it is very difficult to get information as to the winged or apterous character of particular species. These insects, however, have evidently become apterous since their introduction into Madeira. We have therefore no difficulty in accounting for their introduction, and, as no other change in their external characters has been effected, we may suppose it to have been comparatively recent.

Next we have those genera which, though apterous in Madeira, are wholly or partially winged elsewhere. These comprise a large number of species, and are twenty-two in number, as follows:— Carabidæ: *Cymindis*, *Dromius*, *Metabletus*, *Scarites*, *Apotomus*, *Loricera*, *Leistus*, *Calathus*, *Olisthopus*, *Argutor*, *Cratognathus*, *Bradycellus*, *Trechus*. Philhydrida: *Hydrobius*. Byrrhidæ: *Syncalypta*. Curculionidæ: *Phlœophagus*, *Tychius*, *Smicronyx*.

Heteromera: *Phaleria, Helops.* Staphylinidæ: *Homalota* (1 sp.), *Othius.* Here we are carried back to a remoter epoch for the introduction of the winged ancestors of the Madeiran species, since not only have the wings become aborted, but the insects themselves have become modified into distinct and often very well-marked species.

The next category consists of apterous genera which are peculiar to Madeira and the other Atlantic islands, but which are allied to winged groups, as follows:—

Elliptosoma.—Closely allied to *Loricera*, winged.

Eurygnathus.—An abnormal form of Licinides, most of which are winged.

Zargus.—An abnormal form of Chlæniides, winged.

Thalassophilus.—Allied to *Trechus*, winged.

Tarphius.—Belonging to the Colydiidæ, most of which, Mr. Pascoe informs me, have wings.

Coptostethus.—Allied to *Cryptohypnus*, winged.

Caulophilus.—Allied to *Phlœophagus*, winged.

Lipommata, Mesoxenus, Caulotrupis.—Anomalous genera of Cossonides, which are often winged.

Acalles, Torneuma.—Aberrant genera of Cryptorhynchides, most of which are winged.

Echinosoma.—Doubtful affinities.

Atlantis, Cyphoscelis, Laparocerus (Laparocerides).—A very isolated group.

Anemophilus, Scoliocerus.—Allied to Trachyphlœides, some of which are winged.

Lichenophagus.—Allied to *Cænopsis* and *Omias*, some of which are winged.

Xenorchestes.—Allied to *Choragus*, winged.

Ellipsodes.—Closely allied to *Crypticus*, some of which are winged.

Hadrus.—Belongs to an apterous group of Opatrides, many of which are winged.

Macrostethus.—Belongs to Cœlometopides, all of which are apterous, but comes next to the "Tenebrionides vrais," of Lacordaire, which are mostly winged.

Xenomma.—Belongs to the Aleocharides, which are winged.

Mecognathus.—Allied to *Sunius*, winged.

Metopsia.—Allied to *Phlœobium*, winged.

Here we have indications of an introduction of forms at a still more remote epoch. In many cases the modifications of structure have been so great as to produce distinct generic forms, while these remain still allied to winged European genera. In other cases, however, the modifications are still greater, and the affinities are with groups which in Europe are wholly apterous. Such cases as *Hadrus* and *Macrostethus*, which belong to small groups of wholly apterous genera, are difficulties on the theory of transmission over the sea. But two considerations render this difficulty less real than apparent. They all carry us back to a very remote epoch; and, knowing what we do of the instability of the apterous condition, we may fairly conclude that the groups in question were, at that time, in a partially winged state. At or near this same remote epoch, the Madeiran group, as indicated by the submarine bank now connecting the several islands, probably formed one more extensive island, and the distance of ocean to be traversed would then have been considerably less than it is now.

If the various groups of facts which I have here set forth, respecting the distribution of apterous and winged species and genera, are fairly considered as a whole, I think they will be seen to be quite inconsistent with the theory of that distribution having been effected by a former land-connection with Europe; and, considering that we are necessarily ignorant of many of the ways by which organisms are transmitted across ocean barriers, such transmission seems to be indicated in the case of the Madeiran Coleoptera, not by means of drift wood and ocean currents, which Mr. Murray thinks must be the most efficient means of transport, but by some mode in which their wings are called into play, which can only be by a passage through the air when assisted by gales and hurricanes.

There is one other group of islands which seems well adapted to offer a crucial test of the correctness of the theory of land-connection. The Azores are more than twice as far from Europe as the Madeiras, and, what is of still more importance, they are cut off from it as well as from the Madeiras by a broad belt of ocean of the enormous depth of nearly 15,000 feet. We may feel pretty confident, therefore, that if both groups have once been united to the continent, the separation of the Azores is by far the more ancient event; and any theory which requires the Azores to be the most recently separated must be strongly supported by

independent evidence to render such an improbable supposition acceptable. If the Azores date the origin of their insect population from a remote epoch when they were connected with Europe, we should expect to find that almost all the species have since become modified, and that these islands would offer us a larger proportion of highly specialized and ultra-indigenous forms than Madeira itself. The exact contrary, however, is the fact, for, out of more than 200 species only about sixteen are peculiar.

Taking the geodephagous group, the species of which, both Mr. Murray and Mr. Wollaston believe, are least liable to be introduced by man, we find that two only are peculiar, while sixteen are European. The Rhynchophora only equal the Geodephaga in number of species, and seven of these are peculiar. Leaving out a large number of species which have, there is little doubt, been introduced through human agency, there remain more than 100 species identical with those of Europe and the Atlantic islands, while only fourteen are peculiar. These facts imply that the insects, as a whole, have been brought to the islands through natural causes, and that the process is probably still going on. On looking to Physical Maps for information, however, a difficulty appears; for the ocean currents, as well as the prevalent regular winds, are all from the westward, while only four of the beetles are American, and these being all wood-borers have no doubt been brought by the Gulf-stream where they have not been introduced by man. Fortunately, however, we have a means of getting over this difficulty; for our member, Mr. F. Du Cane Godman, who has given us the most recent and accurate information on the natural history of these islands, informs us (in his paper on the Birds of the Azores in the 'Ibis' for 1866) that the stormy atmosphere, to which we have seen that Madeira owes so many of its peculiarities, is still more marked a feature of the Azores, where violent storms from *all points of the compass* are frequent, and annually bring to their shores numbers of European birds. As a natural result of this constant influx, the birds of the islands are, all but two, of European species; and, what is very important, they decrease in numbers from the eastern to the western islands of the group. This is just what we should expect if they are stragglers from the eastern continent; but if they are the descendants of those which inhabited the country before its dismemberment, there would be no meaning in such a diminution.

Now we can hardly doubt that these same storms also bring Coleoptera and other insects to the Azores, though it may be more rarely and in smaller numbers than in the case of birds; and the large proportion of European species will then be very intelligible. The same explanation is suggested by the proportions of the most important groups, for while (after deducting all those species believed to have been introduced by man) the Geodephaga and Brachelytra are by far the most numerous, the Rhynchophora and the Heteromera are exceedingly few, a distribution which corresponds with their respective powers of flight. It is also a very important fact that only four non-introduced species can be traced to an American origin, while more than a hundred are European; since it shows of how little importance are ocean currents as a means of conveying insects over a wide extent of sea; whereas the great mass of the non-introduced species have evidently passed through the air, aided by their powers of flight, for a distance of about a thousand miles from Europe. The Azorean Elateridæ form a curious feature of its fauna, considering that the whole family is almost absent from Madeira and the Canaries. Of the six species two are European (one specially Portuguese), so that they may have been introduced with living plants. Two are common South American species, probably introduced in the floating timber, though they may also have come with living plants, which are often brought from Bahia. Two species, however, are peculiar, and one is closely allied to a Brazilian species, so that it must have been introduced by natural agencies before the settlement of the island; the other is of a genus confined to Madagascar.

Now it is a suggestive fact that the Mozambique current, bending round the Cape of Good Hope to the Equator, is one of the sources of the Gulf-stream; so that it is not impossible that a tree, carried down by a flooded river on the west coast of Madagascar, might ultimately reach the Azores. That it should convey living larvæ or pupæ of Elaters may also not be impossible; and if such a log reached the Azores but once in ten thousand years, and but one log in a thousand should convey living Elaters, we should still, if the calculations of geologists have any approximate value whatever, be far within the epoch of existing genera, and even of most existing species. A relation so isolated and extraordinary as that between a single insect of the Azores and those

of Madagascar, may well be due to a concurrence of events as rare and improbable as this seems to be.

The Azores, and in a less degree the Madeiras, appear to me to teach us this important lesson in the laws of distribution of birds and insects,—that it has been determined neither by the direction of ocean currents nor by that of the most prevalent winds, but almost wholly by such more exceptional causes as storms and hurricanes, which still continue to bring immigrants from the nearest lands.

Mr. Murray's argument for a land-connection between the various Atlantic islands, from the Azores to the Cape de Verdes, and even to St. Helena, has perhaps more to be said for it; but I do not think that the facts require anything beyond the extension of each group into a considerable mass of land. Such an extension is indicated by the comparatively elevated submarine bank on which each group stands; and it is evident that more extended land-surfaces would not only bring the groups nearer to each other, but, by offering a much greater length of opposing coasts, would greatly facilitate the migration and accidental transmission of individuals.

The most bold and original, and perhaps the most useful, generalization in Mr. Murray's paper, is his classification of all Coleoptera into three grand stirpes or geographical races—the Indo-African, the Brazilian, and the Microtypal. The difficulty of forming any such broad divisions in so vast and complicated a group is very great, and has never hitherto been attempted; and though it is hardly likely that a true classification should have been hit upon at once, the present one will, I believe, prove very useful as a provisional hypothesis which every student will be able to test in his own special branch of study. Almost every one will admit that the Brazilian or South American division is a natural one; and the Indo-African will also probably be accepted; and these comprise the whole of the intertropical faunas. But the Microtypal, comprising the temperate faunas of the whole world in one group of equal value to each of the others, will be as generally rejected. It is, however, undoubtedly the fact that certain similarities do run through all the temperate faunas, and Mr. Murray has done good service by so energetically calling attention to this fact. The question to be decided is, whether this similarity is fundamental or superficial. Is it the record of

a deep-seated original identity, or merely the effect of a superficial and comparatively recent immigration? Mr. Murray holds the former view; most botanists and almost all zoologists the latter.

Another point of great importance to which attention is called in this essay, is, the long-persisting identity of form which seems to be a characteristic of insects, and which is thought to allow ample time for those revolutions in geography to which Mr. Murray so constantly appeals. But this antiquity and persistence of insect-forms will have allowed equal time for the action of a most powerful agent of distribution, which is too hastily dismissed. I allude to those changes of climate, which within a period so recent as the Miocene, have at one time clothed the now inhospitable regions of North Greenland, Spitzbergen and other Arctic lands, with forests and evergreens and flowering shrubs, and at another have covered the Northern United States and Central Europe with a mantle of ice like that which at present envelopes Greenland. And it is now becoming almost certain that these changes did not occur once only, but were repeated again and again far back into geologic time; and that, in the southern hemisphere, they were equally if not more strongly contrasted, the glaciation of a considerable portion of Brazil seeming to be a well-established fact.* These vast climatic changes must have afforded ample facilities for insect migrations, —between the eastern and western hemispheres when the arctic regions were inhabited by a temperate flora and fauna,—between the northern and the southern, when the animals and plants of either hemisphere were driven towards the equator by the glaciation of their native regions, and when a portion would cross that barrier, either along the elevated lands or by transmission over narrow seas. This cause is admitted by our best botanists to be amply sufficient to account for the presence of European genera and species of plants on the Andes, in Chili, Patagonia and Terra del Fuego, in New Zealand, and in the Australian Alps; and Mr. Murray has hardly attempted to show that it will not also account for the somewhat more remarkable distribution of Microtypal Coleoptera. The relations of South America, Australia, and other southern lands to each other, are still more

* See Review of Hartt's Geology of Brazil in 'Nature,' Oct. 27th, 1870.

marked, and probably more deep-seated, and seem to imply either a greater extension or the existence of intermediate lands at some former period, but not an actual continuity with one another.

The subject of Geographical Distribution is one of such great interest to myself, that I have perhaps been led into more detail and argument than are usual or proper in a Presidential Address. I believe, however, that the curious and suggestive facts which I have disinterred from that bulky and little-read volume, the "Insecta Maderensia," may be of some use, and I beg you to accept them as my small contribution to your volume of Transactions and Proceedings for the year 1870.

I have now, Gentlemen, only to thank you for the attention with which you have listened to me to-night, and for the unvarying kindness with which you have overlooked my very imperfect performance of the duties attached to the honourable position in which you have placed me.

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