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XV.—*On the Diurnal Lepidoptera of the Extra-Tropical Northern Hemisphere.* By W. F. KIRBY, Assistant in the Museum of the Royal Dublin Society.

[Read Nov. 18, 1867.]

AMONG all the subjects embraced in a scientific study of Natural History, the Geographical Distribution of animals and plants is one of the most interesting. I have paid a good deal of attention to it for a considerable period, and now propose to lay before this Society a few remarks on the distribution of butterflies. A few species are almost cosmopolitan; but generally we find a particular insect occurring in a definite locality, or at least in contiguous localities. Some idea may be formed of the influence of locality, from the fact that Corsican and Sardinian butterflies differ so remarkably from those of the mainland, that in many instances they are considered distinct species—even the caterpillars differing; while in Sicily we find some intermediate forms. Sicily appears not to have been isolated long enough to produce the Corsican forms; perhaps, at some future period, they may be evolved. We have not sufficient data at present to be entitled to speak conclusively on the possibility of Mr. Darwin's theory of the Origin of Species; but it seems probable, so far as our present knowledge goes, that it must in a great measure stand or fall by the facts of Geographical Distribution. The facts I have just mentioned with respect to Corsica seem alone sufficient to prove that an isolated race will in time diverge sufficiently from that of the main land to be considered as to all practical purposes a perfectly good and distinct species. The only question remaining is, whether there is any limit to such permanent variation; and to this I must again reply, that at present we have not sufficient data to speak positively. I cannot point to any *genera* peculiar to Corsica, though many species are so. The present remarks are merely intended to point

out the philosophical bearings of the subject-matter of my paper; and perhaps at its conclusion some of the other naturalists present will be able to inform us how far the regions of the distribution of butterflies correspond with those of plants, birds, &c.

Owing to the divergence of the great continents in the South, and their continuity in the North, we find a Fauna tolerably uniform in appearance and character extending over the extra-tropical portions of Asia, Europe, the north coast of Africa, and the northern and western states of North America; while within the tropics, and south of the equator, the divergence is far greater, not only for the reason just mentioned, but also on account of the great natural barriers of mountains, deserts, and, perhaps, rivers. No one who has ever examined collections of Lepidoptera from Europe, Northern or Western Asia, or Northern or Western North America can have failed to notice the great similarity—amounting frequently to absolute identity—of species, and much more of type, in the productions of these widely separated regions. But on comparing collections from Europe, India, Africa south or east of the Sahara, and South America, we perceive at once that they belong to widely different regions, although a few species may be noticed common to two or more Faunas. I may here observe, however, that the Indo-Chinese Fauna, as it may be termed, impinges on the south-east of Europe, while in North China, North Japan, and Amoorland, it completely inosculates with that of Asia-Europe; a few American forms also occur near the north-east coast of Asia, just as we find a few Indian forms in Greece, Italy, and Austria. The insects of the Indian Archipelago and Australia are mainly of the Indian type. The Arabian Fauna is principally African in its character, while that of Persia and Syria is European—of course, with a larger admixture of truly Indian forms. The Fauna of the countries lying between India and Siberia is almost unknown, but appears to be chiefly European, and to abound in peculiar forms. It is remarkable that in many instances Asia-European genera reappear in Chili, while the butterflies of the Cape of Good Hope are, with scarcely an exception, entirely of an African type.

It is now agreed that there are only five great families of butterflies. This arrangement I shall adopt, and also avail myself of the use of sub-families; for though these divisions are mainly artificial, yet they are useful when applied to the productions of a limited district.

The first family, *Papilionidæ*, is subdivided into *Papilioninæ* and *Pierinæ*. The *Papilionidæ* are not numerous in our district; they are more characteristic of the various tropical Faunas. Although exceedingly numerous in species, they have not been satisfactorily divided into genera. The sub-family *Papilioninæ* may be divided into ten genera; but out of 533 species in Felder's Catalogue, 459 belong to the typical genus *Papilio* alone; and *Ornithoptera* and *Parnassius* are the only others that contain more than five species. Of these ten genera, *Papilio* is universally distributed; *Teinopalpus*, *Leptocircus*, *Atropha-*

neura, *Ornithoptera*, *Eurycus*, *Sericinus*, and *Mesapia* belong to the Indo-Chinese Fauna; *Euryades* to the South American Fauna, and the remainder to that of Asia-Europe; *Sericinus*, however, being confined to North China, may almost be considered as belonging to our district. Very few species of *Papilio* occur in the Northern temperate zone. The only British species is *P. Machaon*, principally found in the fens of the south-eastern counties of England. Of this group, two other species occur in Europe, and *P. Machaon* itself occurs throughout Europe, North Africa, the greater portion of Asia, and California. The North American species of *Papilio* which are similar to Old World types, are all related either to this group or that of *P. Podalirius*, a fourth European species. In Amoorland we find *P. Xuthulus*, a species intermediate between *P. Machaon* and *P. Xuthus*, a common Indian and Chinese species, which extends as far north as this district, where we also find two species of the group of *Papilio Paris*, a group exclusively Indian, and which does not occur at all in Western Asia-Europe, Africa, or America.

The small genera *Doritis* and *Thais* belong exclusively to the Mediterranean Fauna. The singular genus *Hypermnestra* appears to be confined to the Steppes of Western Asia, though it is likely that it may also occur within the limits of Europe. When Eastern and Southern Russia, and Turkey and Greece, are properly searched, many of the Western Asiatic and Syrian species will doubtless be added to the European list; and, in all probability, even a few more Indian ones. The genus *Parnassius* is one of those peculiarly characteristic of our district. The species inhabit mountains, and descend gradually to the plains as they advance north. The ascertained limits of the genus are the Sierra Nevada in Spain, the Caucasus, the Himalayas, and California. Its northern range is probably only limited by the Arctic Ocean; but the metropolis of the genus is in the high mountain ranges of Central Asia; and hence most of the species are extremely rare in collections. They are all very similar; white, more or less transparent, generally with black and red spots.

The European species of *Pieris* are divisible into several groups. The group represented by the common European *P. Cratægi* extends to Amoorland, and the Himalayas, and has also a representative in America. *P. Gliciria*, which is really an Indian species, occurs in Greece. A strongly marked variety of the common *P. Brassicæ*, or a closely allied species, is found in the Canaries, and *P. Melete*, a variety (?) of the Himalayan *P. Eruta*, occurs in Amoorland. The European species of *Pieris* are widely distributed throughout Northern Asia (*P. Daplidice* also occurs in India), and several allied species occur in North America. The typical groups of the genus *Anthocharis* are almost confined to our district; the numerous African species belonging to the group *Callosune*. Only two of the European species occur in North-Eastern Asia, and but one, allied to the European *A. tagis*, in India. The North American species mostly belong to a peculiar type, of which a new species from Japan has recently been described by

Mr. Butler, of the British Museum. The genus *Zegris* is confined to South Europe and South-Western Asia; and the few species or varieties of *Leucophasia* are scattered throughout Europe and North Asia without reaching North America. In the tropics the genus *Leucophasia* is replaced by *Pontia*. The genus *Colias* is very characteristic of the North. It is widely distributed, species occurring in South Africa, India, Buenos Ayres, and Chili; but in the tropics it is mostly replaced by *Callidryas*. Some of the species of *Colias* are polar, and it may be well to remark here that polar insects mostly occur all round the pole. A considerable number of species of this interesting but difficult genus occur in Europe, North Asia, and North America.

A few rather closely allied species of *Gonepteryx* occur in our district; and the common *G. Rhamni* is found in California. This insect has recently been taken in Ireland, where it had not been seen for twenty years previously. The genus *Idmais* includes several Indian and African species. One of the former, *I. Fausta*, occurs in Syria, and, not very improbably, also in Europe.

Six sub-families of *Nymphalidæ* occur in the district we are now considering. *Danais Chrysippus*, an abundant species in India and Africa, represents the *Danainæ* in South-Eastern Europe. The genus *Danais* is widely distributed; but its metropolis is certainly in India, China, and the Indian archipelago.

Only two genera of *Argynninæ* occur in Europe, Northern Asia, and Northern America. These are *Melitæa* and *Argynnis*. Both are wanting in Southern Africa, and the former in India. Several *Melitææ* occur in the tropics of the New World, but *Argynnis* is replaced there by *Agraulis* and other allied genera, reappearing however in Chili. The circumpolar species of *Argynnis*, of course, extend to America; and many European species are widely distributed in North Asia, along with species peculiar to that continent. In Amoorland we find, among others, the Chinese species *A. Sagana*, so remarkable for the disparity of the sexes, and *A. Ella*.* All the Indian species of *Argynnis* are confined to North India, except *A. Niphe*, a form not closely allied to any European species.

Of the next sub-family, *Vanessinæ*, we have five genera. The common European *Araschnia Prorsa* extends throughout Northern Asia; and in Amoorland, we find *A. Burejana*, a second species of this interesting genus. Mr. Butler has recently described a third from North Japan. The European species of *Grapta*, *Vanessa*, and *Pyrameis*, are widely distributed, some extending to India, and some to North America, in which countries, however, others are represented by allied species. *Pyrameis Cardui* is in fact almost cosmopolitan. *P. Callirhoe* replaces *P. Atalanta* in the Canaries, India, and Eastern Asia generally; but in Europe, North Africa, and North Ame-

* The male of this species will be found described at the end of this paper. Only the female has been heretofore described.

rica, *P. Atalanta* alone occurs. In Amoorland we find the North American *Grapta Progne*, and the Indian and Chinese *Vanessa Charonia*. In India and Africa the genus *Vanessa* is mostly replaced by *Junonia*.

The next sub-family, *Nymphalinæ*, is very poorly represented in Europe by three genera containing but five species; it is, however, very widely distributed, but belongs, properly speaking, to the Indo-Chinese Fauna; and the great genus *Neptis*, so numerous in Indian species, only sends two stragglers into Eastern Europe. Some of the Syrian species usually placed under *Limenitis* appear to be intermediate between this genus and *Neptis*. The Indian genus *Athyma* is represented by several species in Amoorland, and the genera *Diadema* and *Hestina* are probably represented there also. Several *Limenitis* and *Nymphalis* occur in North America, but in South America, the *Nymphalinæ* are represented by the genus *Heterochroa*. The *Apaturinæ* have only three representatives in Europe. The genus *Apatura* is widely distributed; while *Charaxes* belongs, properly speaking, to the Indian and African Faunas. An insect which Bremer considers an *Apatura*, and Herrich-Schäffer a *Euripus*, but which was originally described by Ménétriés under the name of *Adolias Schrenkii*, occurs in Amoorland. *Adolias* is a large Indo-Chinese genus. The *Satyrinæ* are extremely well represented in Europe, and several genera may be considered as almost confined to the European Fauna. It is owing to the great number of species of *Satyrinæ* and *Lycænidæ* that the European butterfly Fauna is so much richer than the North American and South African. The genera *Melanagria* and *Triphysa* seem to be confined to Europe and Northern and Western Asia; *Lasiommata*, or at least the typical groups, do not occur south of Teneriffe and the Himalayas; of *Hipparchia* and *Epinephile* the same may be said, and the small group of *Epinephile* represented in Britain by *E. Tithonus*, is exclusively confined to the south-west of Europe. The genus *Chionobas* is circumpolar in the northern hemisphere. *Cœnonympha* and *Erebia*, though so numerous in species in Europe and North Asia, are badly represented elsewhere, though widely distributed, species occurring in almost every part of the world. The Indian genus *Yphthima* scarcely extends to Europe, though a few species occur in Northern and Western Asia; a few also in Africa.

The family *Erycinidæ* is very poorly represented in Europe and Northern Asia by a single species in each of two sub-families, *Libytheinæ* and *Erycininæ*. This family preponderates in South America, very few species occurring in any other part of the world.

The larger genera in the remaining sub-families *Lycænidæ* and *Hesperiidæ*, though some are very numerous in European and North Asian species, present little for special remark. The genera *Aurotis* and *Thestor* seem to belong to the Mediterranean Fauna; *Aphnæus* has two representatives in Syria; and the Indian genus *Amblypodia* occurs in Amoorland.

I append a table of the total number of butterflies, known on

satisfactory authority, to occur in the different districts of Europe; but this is, necessarily, in some districts a very imperfect summary.

TABLE I.

Sub-families and Families.	Europe.	Iceland.	Scand.	N. Russ.	S. Russ.	Turkey Greece, & Dalm.
Papilionidæ :—						
Papilioninæ,	12	...	4	4	7	6
Pierinæ,	37	3	11	13	22	16
Nymphalidæ :—						
Danainæ,	1	...	...	...	...	1
Argynninæ,	41	1	23	23	30	13
Vanessinæ,	11	...	7	10	11	5
Nymphalinæ,	5	...	1	8	5	4
Apaturinæ,	8	...	...	2	2	1
Satyrinæ,	100	2	24	20	53	27
Erycinidæ :—						
Libytheinæ,	1	...	...	...	1	1
Erycininæ,	1	...	1	...	...	...
Lycænidæ,	80	...	31	26	57	37
Hesperiidæ,	31	...	11	12	22	12
Total	323	6	113	113	210	123

Sub-families and Families.	Italy.	Corsica and Sardinia	Spain.	France.	Great Britain.	Ireland.	Prussia, Germ., Netherl., & Denm.	Austria and Switzerland.
Papilionidæ :—								
Papilioninæ,	9	4	6	8	1	..	4	7
Pierinæ,	18	10	17	20	10	9	12	18
Nymphalidæ :—								
Danainæ,	1	...	...	...	...	...	...	...
Argynninæ,	28	4	14	24	9	5	27	28
Vanessinæ,	10	7	7	9	7	6	10	11
Nymphalinæ,	4	1	1	3	1	...	3	5
Apaturinæ,	2	...	1	3	1	...	2	2
Satyrinæ,	49	17	27	59	11	9	33	62
Erycinidæ :—								
Libytheinæ,	1	1	1	1	..	...	...	1
Erycininæ,	1	...	...	1	1	1	1	1
Lycænidæ,	52	17	29	4	16	10	41	50
Hesperiidæ,	21	9	19	20	7	4	17	21
Total	196	70	122	202	64	44	150	206

At a rough estimate, we may set down the number of species in Europe and Siberia at 400; in Amoorland at 160; in the northern and western states of North America at 300; in South Africa at 230; in India at 600, and in the Amazon Valley of South America (by far the richest district in the world for butterflies) at 2000.

Various divisions have been mapped out by naturalists who have written on Geographical Distribution; but that ordinarily used in England is that of Dr. Sclater. He divides the world into six provinces, as follows:—1. Neotropical; 2. Nearctic; 3. Palæarctic; 4. Ethiopian; 5. Indian; 6. Australian. In the present paper I have occupied myself with Nos. 2 and 3 only. Dr. Sclater's Palæarctic Region, however, extends as far as Thibet in the south, embracing a portion of the Himalayas, and the greater portion of Northern and Central China. It was unnecessary for my present purpose to include China.

TABLE II.,

Showing the distribution of Northern Genera in Europe, Siberia, and the Mediterranean Basin, Amoorland, and part of Japan, North and West America, South Africa, India, and South America.

Genera.	Northern Faunas.			Southern Faunas.		
	Europe, &c.	Amoor-land, &c.	N. & W. America	South America	South Africa.	India.
Papilio:—						
Machaon Group,	*	*	*	..	..	*
Podalirius Group,	*	..	*	*	..	..
Paris Group,	..	*	..	..	..	*
Other Groups,	..	..	*	*	*	*
Thais,	*	..	..	..	..	..
Doritis,	*	..	..	..	..	..
Hypermnestra,	*	..	..	..	..	..
Parnassius,	*	*	*	..	..	*
Leucophasia,	*	*	..	..	..	..
Terias,	..	..	*	*	*	*
Pieris:—						
Cratægi Group,	*	*	*	*	..	*
Brassicæ Group,	*	*	*	?	..	*
Mesentina Group,	*	..	..	?	*	*
Other Groups,	*	*	*	*	*	*
Zegris,	*	..	..	..	..	..
Anthocharis:—						
Genutia Group,	..	*	*	..	..	..
Other Groups,	*	*	*	*	..	*
Nathalis,	..	..	*	*	..	..
Colias,	*	*	*	*	*	*
Idmais,	*	..	..	..	*	*
Gonepteryx,	*	*	*	..	..	*
Callidryas,	..	..	*	*	*	*
Danais,	*	..	*	*	*	*
Melitæa,	*	*	*	*	..	..

Genera.	Northern Faunas.			Southern Faunas.		
	Europe, &c.	Amoor-land, &c	N. & W. America.	South America.	South Africa.	India.
Argynnis :—						
Selene Group,	*	*	*	*	..	..
Other Groups,	*	*	*	..	..	*
Araschnia,	*	*	..	..	..	..
Grapta,	*	*	*	?	..	*
Vanessa,	*	*	*	..	..	*
Pyrameis,	*	*	*	*	*	*
Neptis,	*	*	..	..	*	*
Athyma,	..	*	..	..	*	*
Limenitis,	*	*	..	..	..	*
Diadema,	..	?	..	..	*	*
Hestina,	..	?	..	..	..	*
Euripus,	..	?	..	..	..	*
Adolias,	..	?	..	..	..	*
Apatura,	*	*	*	*	..	*
Charaxes,	*	..	..	..	*	*
Melanagria,	*	*	..	..	..	..
Lasiommata,	*	*	..	..	..	*
Hipparchia,	*	*	*	*	..	*
Epinephile,	*	*	*	*	..	*
Triphysa,	*	*	..	..	..	..
Cœnonympha,	*	*	*	..	..	..
Yphthima,	*	*	..	..	*	*
Chionobas,	*	*	*	*	..	..
Erebia,	*	*	*	?	*	*
Euptychia,	..	..	*	*	..	..
Pronophila,	..	?	..	*	..	*
Debis,	..	*	*	..	*	*
Neope,	..	*	..	..	..	*
Libythea,	*	..	..	..	?	..
Nemeobius,	*	..	..	..	..	*
Amblypodia,	..	*	..	..	*	*
Dipsas,	*	*	..	..	..	*
Thecla,	*	*	*	*	..	..
Aurotis,	*	..	..	..	..	..
Thestor,	*	..	..	..	..	*
Aphnæus,	*	..	..	..	*	*
Chrysophanus,	*	*	*	..	*	*
Lycæna,	*	*	*	*	*	*
Pyrgus,	*	*	*	*	*	*
Nisoniades,	*	*	*	..	*	*
Pamphila,	*	*	*	..	*	*
Cyclopides,	*	*	*	..	*	..
Goniuris,	..	*	*	*	..	..
Gontloba,	..	..	*	*	..	*

It must be remembered that though most of the European genera (with many others) occur in India, very few species are common to both countries.

ARGYNNIS ELLA, BREMER.

This species was described and figured in Bremer's "Lepidopteren Ost-Sibiriens," p. 94, n. 11, pl. 8, f. 1, from a unique female example taken near Port Mai. The Society possesses a pair of this species from Japan, presented by Captain Boxer, and I therefore give here Bremer's diagnosis, and a translation of his description, and remarks on the species, appending thereto a relative description of the male, taken from the example in the Society's Museum.

Alæ anticæ sinuatæ, posticæ dentatæ, omnes fulvæ nigro-maculatæ, anticæ macula triangulari, apicem versus, ad marginem anteriorem.

"*Alæ anticæ subtus pallide fulvæ maculis ordinariis cellulæ medianæ maculisque 9 nigris; apice viridi-micanti, albido-irrorato, maculam albam paginæ superioris includente—alæ posticæ viridescenti-micantæ seriebus tribus macularum obscuriorum; maculis seriei internæ albo-pupillatis, seriei submarginalis rotundatis serieique marginalis lunulatis; macula ad marginem anteriorem alba.* 79 m.

"Larger than any European species of *Argynnis*. Fore-wings with the hind margin very strongly indented. Upperside of the wings spotted as in *Laodice*, with a white spot near the tip of the fore-wings, as in the female of *Laodice*.* Underside paler; the usual markings in the middle of the cells, as in *Paphia;* on the outside of these cells are two black blotches in cells 2 and 5, followed by a row of black blotches in cells, 1, 2, 3, 4, 5, 6, and 9. This row of blotches makes a right angle in cell 3, and the spots become smaller as they approach the costa. The tips of the wings are varied with greenish, dusted with whitish atoms slightly inclining to reddish, and with the triangular white spot of the fore-wings indicated.

"[Underside of] hind-wings varied with unicolorous pale green, a white crescent-shaped mark on the costa, followed by a row of rather darker rounder and greener spots with white pupils; beyond this is a similar row without white pupils; a third row of crescent-shaped spots scarcely defined from the ground colour precedes the hind-margin.

"Only the upper side of our species resembles *Laodice* in the position of the markings; the lower side of the wings, independently of their contour, is remarkably dissimilar in colour and pattern; probably the fore-wings of the male, which is at present unknown, may be still more strongly curved. Only one female specimen taken at Port Mai on the 26th of August."

I will add here that our specimen of the female is duller coloured, and more suffused with greenish brown towards the tips of the fore-wings above than represented in Bremer's figure; the spots are also larger, and generally rounder. Our specimen of the male differs from the female in being slightly more rounded at the tips of the fore-wings.

* Traces of this spot may also be observed on the underside of the fore-wing of the female of *A. Paphia*.—W. F. K.

The emargination is hardly more noticeable in one sex than in the other. Contrary to Bremer's expectation, the emargination is, if anything, less conspicuous in the male. This sex has no trace of the white spot, or of the dark apical shading. The tint and markings of the fore-wings of the male, (the veins of which are not incrassated) are almost identical with those of the Indian *A. Niphe* male, except that the double row of marginal spots runs nearly straight from the inner margin to the costa, and these spots decrease uniformly in size from the spot second from the inner margin, to the costa. The black spot between the second row of marginal spots and the angulated branch is also wanting in *A. Ella*. The spots nearer the base are also larger than in *A. Niphe* male. The hind wings in *A. Ella* are nearly similar in both sexes; there are 3 marginal rows of black spots; and the cell is surrounded with five other spots, and contains a sixth. But the costal spot of the second marginal row is only present in the male. The underside of the fore-wings in the male is unicolorous pale fulvous, very slightly greenish towards the tip; in our example of the female, the apical greenish portion of the wing is much more extended than in Bremer's figure, and the white spot is surrounded with a slight whitish violet tint, and there is a rather large irregular square blotch of a similar colour between this and the tip. The hind-wings beneath do not differ from his figure except in being much less distinctly spotted. The under side of the hind-wings in the male are of a much more brassy green than in the female, and the markings are still more indistinct. The most conspicuous markings on the underside of the hind-wings in both sexes are a silvery streak along the costa (narrower in our specimens than in Bremer's figure), which meets a triangular silvery spot, at about the same point as the commencement of the chief silvery band in *A. Paphia*.

XVI.—*On the Culture of the Japanese Oak-feeding Silkworm, Bombyx Yama-maï.* By HERMANN ROBERT DE RICCI, M. D.

[Read Monday November 18, 1867.]

I WISH to lay before the Royal Dublin Society the results of an attempt made during the past summer to introduce into Ireland the culture of the Japanese silkworm, *Bombyx Yama-maï*. It is impossible to infer from one small experiment whether the culture of this silkworm will succeed as a practical undertaking in this island; but from the results obtained, and from the similarity of the Irish climate to the Japanese, I am inclined to believe that this silkworm will be easily acclimatized in this country, and that within a comparatively short period of time the culture of the oak-feeding silkworms will be added to the already existing industries of this country.

It had been known to naturalists ever since the return to Europe, at the end of the last century, of the celebrated physician, Thunberg,