

geometrical contact. No trace of the planet's periphery could be seen when it left the solar disc, although it was carefully looked for.

The Government Astronomer at Sydney, Mr. H. C. Russell, states that fifteen photographs were taken of the transit of Mercury. He reports that as the planet crossed the sun it presented the appearance of a round and intensely black disc without any fringe such as has been noticed in former transits, and owing to the unsteady state of the air towards the close of contact, the "black drop" phenomenon took place, preventing clear definition.

AN IMPORTANT ASTEROID.—The minor planet BE 1894 proves to be a very important member of the community to which it belongs. M. Tisserand remarks, in *Comptes rendus* for December 26, that, of all the asteroids, it has the smallest perihelion distance, leaving out of count Brucia (963), of which the elements are very uncertain. When BE is at its descending node, its distance from the orbit of the earth is only 0.67 the radius of this orbit. On account of this circumstance, the asteroid is most favourably situated for the determination of the solar parallax. The elements given by M. Tisserand are as follows:—

		1894 November 4.7 Paris Mean Time.		
<i>m</i>	...	23	18	38.5
$\pi$	...	357	25	53.5
$\Omega$	...	212	36	51.4
<i>i</i>	...	23	5	5.7
$\phi$	...	18	4	8.1
$\mu$	...	1002"	151	
log <i>a</i>	...	0.366049		

} Mean Eq. 1894.

PROF. ADAMS' COLLECTED MEMOIRS.—A note in the *Observatory* informs us that Prof. R. A. Sampson, formerly Isaac Newton Student at Cambridge, is gradually reducing to order the large quantity of MSS. left by Prof. Adams. The memoirs relating to lunar theory have been completely separated and arranged, and the lectures on Jupiter's satellites are also well advanced. Memoirs on the solution of the infinite determinant, and others on some small matters, have been separated from incidental and preparatory work; but a considerable quantity of matter is still outstanding, so it may be one or two years more before the examination can be completed, and the collected works be ready for publication.

### THE BIRD-WINGED BUTTERFLIES OF THE EAST.

IN the days of Curtis and Stephens, the late Mr. W. C. Hewitson was a diligent collector and observer of British insects of all orders, and likewise an ornithologist, who published several editions of a well-known work on British birds' eggs. But the day came when he was to discover, as he says in one of his own publications, that a butterfly might be beautiful, though it was not a British species; and he became thoroughly infatuated with these beautiful things, to the study and illustration of which he devoted the remainder of his life. And this is how it came about, as he used to relate to those who had the privilege of the acquaintance of a kind old enthusiast, whose work was of immense value to the progress of entomology in its day, though he was unable to sympathise with or to appreciate the vast revolution in modern biology which many men with whom he was intimate—and men, too, not much younger than himself, with Darwin, Wallace, and Bates at their head—succeeded in effecting in a comparatively short time.

One day of the days, as it says in the "Thousand and One Nights," he happened to be at Stevens's Auction Rooms, when a lot was put up containing several species of the well-known genus *Adelpha*, Hübner, or *Heterochroa*, Boisduval, as it was then called, which replaces our European White Admirals in South America. The butterflies attracted his attention, for at that time it was a novelty to him to see a number of butterflies so closely resembling each other, and yet quite distinct; and he bought the lot. He turned round, and saw Prof. Westwood, who said to him, "What, are you buying butterflies?" "Yes, I am," he answered; and thus he commenced the formation of his great collection of butterflies, now in the British Museum, which was fed by the cream of the expeditions of Wallace and

Bates, and remained unrivalled up to the day of his death, in 1878, though there are now several collections in England, France, and Germany which surpass it.

The exact date when this epoch-making event in the history of the study of butterflies occurred, we do not know. It is true that the first paper published by Hewitson on exotic butterflies related to the genus *Heterochroa*, and was published in the *Annals and Magazine of Natural History* in 1847; but in the previous year, Edward Doubleday had commenced his great work on the "Genera of Diurnal Lepidoptera," the letter-press of which was completed after his death by Westwood; and Hewitson executed all the plates, as joint author. It is, therefore, probable that Hewitson had already commenced the formation of his collection before that time, especially as his own great work on exotic butterflies was commenced before the actual completion of the "Genera."

Yet, since the death of Hewitson, new countries have been opened up, and wonderful butterflies have reached Europe, never dreamed of by Hewitson, or which remained unattainable objects of his desire, to the last. Chief among these may be mentioned the butterflies of Central Asia, a *terra incognita* except for Eversmann's and Nordmann's papers, in Hewitson's time; and the butterflies of the Eastern Archipelago, for the older naturalists, and even Wallace and Lorquin, much as they were able to accomplish, only succeeded in sampling some few islands, and many others now known to produce some of the strangest and grandest butterflies in existence, remained unvisited and unexplored.

Chief among the butterflies of these islands are the grand species to which Boisduval applied the generic name of *Ornithoptera*, or bird-winged butterflies, of which only a few, and those not the most remarkable, are found on the mainland of India, the Malay Peninsula, and South China. Many of the species are very closely allied, but others are so different that they can hardly be regarded as congeneric; and it will be well to discuss them by groups.

First of all, we may divide them into the black and yellow species, and those with black and green, orange, or blue males; and each of these two main groups includes a variety of species, which are hardly all congeneric.

Two species only, *O. Priamus* and *O. Helena*, were known to Linné. Several more were figured and described before the end of the last century; but only eight species were described as late as 1836, and though several others were afterwards described, Hewitson's collection only included eighteen, counting several forms which he treated as varieties. Now, however, Mr. Rippon's large work, "Icones Ornithopterorum," at present in course of publication, is intended to extend to eighty folio plates. But there is always some difficulty in determining the exact number of species, for these butterflies are variable, and in the numerous islands of the East there are a great number of closely allied local races, and we are hardly in a position at present to determine whether it is best to treat them all as distinct species, or as different forms of two or three, and especially is this the case with the group of *Ornithoptera Priamus*.

It will be best to commence with the black and yellow species, which are found on the Asiatic Continent, and the Malay Islands, and therefore in nearer and more accessible localities than any of the green species, except *O. Brookeana*. They are also found in the Moluccas, &c., but less numerous, being more abundant in the Malay Islands.

Of this group, *Ornithoptera Pompeus*, Cramer, from Java, may be regarded as typical. The males of this and the allied species are of a velvety black, with the nervures more or less bordered with grey, and the spaces between the ends of the veins on the hind margin, bordered with white. The hind wings are of a beautiful golden yellow, intersected with the black veins, and bordered with black along the hind and inner margins. The inner margin forms a fold which conceals the brown scent-bearing scales, and is fringed with long hairs.<sup>1</sup> On the inner margin, the black border projects into the wing in a series of long cones between the nervures. The females are similar, but the grey markings of the fore wings are more extended, and on the hind wings the scent-organs are wanting, and there is a row of black spots opposite the cones of the border, which are often connected into a continuous series, as

<sup>1</sup> See, for a fuller description of the scent-organs in *Ornithoptera*, Haase, "Correspondenzblatt des entomologischen Vereins, Iris zu Dresden," 1. pp. 93-94.

well as with the cones themselves. The fore wings are long and narrow, measuring about five or six inches from tip to tip, and the hind margin is very oblique. The hind wings are rounded and dentated, but form almost a right angle at the anal angle of the hind wings. Behind the head, we often find a red collar in one or both sexes. We have not thought it necessary to figure a species of this group, representatives of which may be seen in almost every collection of butterflies from India and the adjacent islands; but we have given figures of the larva and pupa of *O. pompeus* (Figs. 1, 2). The transformations of all the species of *Ornithoptera* are very similar, as far as they are at present known; and the larvæ are rather short and thick, with rows of long fleshy spines, and with the retractile scent-producing and defensive bifid horn on the head, common to all the true *Papilionida*. In the yellow group, these larvæ are generally brown, with a broad pale oblique band about the middle.

The amount of yellow on the hind wings of the butterflies of the *Pompeus* group differs very much. Sometimes we find only a narrow black border, sometimes a very broad one, and sometimes the base is also black, the yellow colouring being restricted to a broad band, or even to a large spot in the centre. Two or three yellow species, found in Malacca, Borneo, &c., of

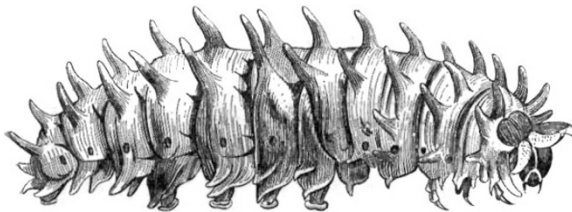


FIG. 1.—Larva of *Ornithoptera Pompeus*, Craw.

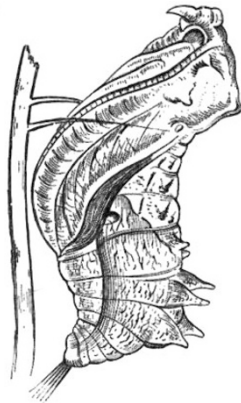


FIG. 2.—Pupa of *Ornithoptera Pompeus*, Craw.

which *O. Amphrysus*, Cramer, is the commonest, are distinguished from the others by having radiating yellow instead of grey lines on the fore wings of the males. Occasionally specimens of the yellow group are met with, with the yellow replaced by deep golden-red; but it is not certainly known whether this peculiarity is accidental or specific.

The grandest of all the yellow species, however, is *O. Magellanus*, Felder, a native of the Philippine Islands. If the butterfly is held towards the light, there is nothing to distinguish it from any other yellow *Ornithoptera*; but if you turn your back to the light, and hold the drawer on a level with your eye, you will see a marvellous iridescence of the most delicate pale silvery blue and green glancing over the whole of the hind wings of the insect. There is nothing to compare with it in any other butterfly, not even in *Morpho Sulkovskyi*; the nearest approach to it is in the iridescence over the red spots in some South American *Papilios* (which, though much smaller, are considered to be closely related to *Ornithoptera*), and in the iridescence over the yellow on the wings of some South American butterflies belonging to the genus *Euselasia*, Hübner. But these latter belong to a different family (*Lemoniidae*), and are small butterflies, not exceeding an inch and a half in expanse, whereas *O. Magellanus* is a grand black and golden-yellow

butterfly, measuring six inches across the fore wings. It is closely allied to several common Indian species, though none of these show more than the very faintest traces of iridescence. But in order to obtain the full effect, it is necessary that *O. Magellanus* should be set flat. If the wings are set sloping, according to the old English method, now being rapidly superseded by the flat setting which has always been in use on the continent, the effect of the iridescence is almost entirely lost. *O. Magellanus* is still a scarce insect in collections.

Among the more abnormally coloured species of this group we may mention *O. Plateni*, Staudinger, from the Island of Palawan, in which the male has two broad golden-yellow blotches on the centre of the hind wings, separated by the upper branch of the subcostal nervure; on the underside, and in the female, this colour fills up a large part of the centre of the hind wings. A still more remarkable species was lately discovered by Mr. Doherty in the Island of Salibobo, or Lirung, one of the Talautse Islands, and was described and figured by Mr. Rippon under the name of *O. Dohertyi*. The male is of an intense silky black above, with a slight greenish glow in certain lights; on the underside is a yellow band, parallel to the hind margin, and ceasing before the inner margin. The female has brown fore wings, with the usual grey markings inclining to reddish; the hind wings are darker, with a small irregular buff patch in the centre, divided by the nervures; on the underside this patch is larger, and the ends of the nervures are bordered with the same colour. These butterflies measure about six inches across the wings.

Next to the golden yellow group of *Ornithoptera*, we may place the splendid *O. Hippolytus*, Cramer, the female of which sometimes measures nearly eight inches across the wings.

It is not very closely allied to any other species. The fore wings resemble those of the last group, but the hind wings in the male are dark smoky brown, with a row of large yellow spots extending all round the wings, except on the side next the body; these are bordered, both outside and inside, by a row of nearly connected large black spots. In the female the yellow markings are more extended, and the base of the wings is black; the lower part is bluish-grey; and over the yellow and grey part of the wing runs a marginal row of large white spots. The fold on the hind wings is filled with long fluffy white hair. This insect is met with in Amboina, and Piepers, the Dutch entomologist, records his having seen a specimen mobbed and driven away by small butterflies, just as small birds will mob and drive away a hawk in Europe.

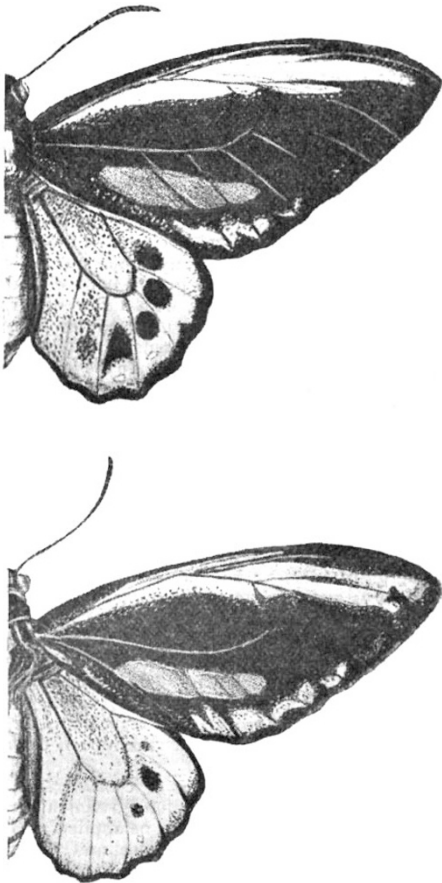
Mr. Rippon has proposed the name *Pompeoptera* for the foregoing series of species; but the types of *Ornithoptera* are *Papilio Priamus* and *Helena* of Linné, and as the former is fixed as the type of *Troides*, Hübner, by Hübner's inclusion of it in the second volume of his "Sammlung exotischer Schmetterlinge," *Helena* remains as the true type of the genus *Ornithoptera*, as correctly given by Mr. Moore in his "Lepidoptera of Ceylon," though Dr. Scudder, having overlooked both this point and the impropriety of regarding *Helena* as the type of *Troides*, specifies *Priamus* as the type of *Ornithoptera*, and *Helena* as the type of *Troides*.

Next to the golden-yellow species of *Ornithoptera*, we come to the green, blue, and orange section, to which the name of *Troides* should, as we have just seen, be applied, and of which *Papilio Priamus*, Linné, from Amboina and Ceram, is the type. To *O. Priamus* and its allies Mr. Rippon restricts the name of *Ornithoptera*.

The species of *Troides* are all very similar except in size and colour, and we have copied Mr. Rippon's figures of the smallest species, *T. Richmondia*, from Australia (Figs. 3, 4, ♂; Fig. 5, ♀). This insect varies in size from 4½ to nearly 6 inches in expanse, the female being always the largest; but in most of the other species in the group, the wings expand 6, 7, or even 8 inches in some of the females. The males of this section have velvety black fore wings, with a wide green bar parallel to the costa, and another, more or less extended, at the hinder angle of the wing, running along the inner margin towards the base, and curving upwards along the hind margin. The hind wings are green, with a row of black spots (sometimes reduced to one or two) along the hind margin. There is a long brown patch of raised scales towards the hind margin of the fore wings in the male, which is quite absent in the yellow group (*Ornithoptera*, true). The females are brown butterflies, with two irregular rows of white spots on the fore wings, the innermost very large (though obsolete in some

species), and with the hind wings pale beyond the middle, and crossed by a row of black spots; the pale part of the wing is whitish within them, and brownish, or yellow, beyond. The sides of the thorax are generally bright scarlet under the wings, and the abdomen is generally yellow in the males, and brown in the females. These green species are not found in the Malay islands, but throughout all the Moluccan and Papuan islands, as far as Australia; though many of the most remarkable are very restricted in their range, being confined to one or two small islands.

Sometimes, as in the male of *T. arruana*, Felder, a narrow green stripe runs along the median nervure and its branches, in the male. In certain lights the green of the fore wings exhibits very remarkable changes of colour to yellow, coppery-red, or blue; the copper-red is most conspicuous in *T. Pegasus*, Felder, from New Guinea, and the blue in *T. Eumeus*, Rippon, from the Aru Islands.



FIGS. 3, 4.—*Trooides Richmondia* (male, two varieties).

*T. Eumeus* leads us on to *T. Urvillianus*, Guérin-Ménéville, from New Ireland, from whence several specimens were obtained during the voyages of the *Coquille* and the *Astrolabe* between 1820 and 1830; but no more were brought to Europe for fifty years. They were named after the famous French Admiral, Dumont d'Urville, a worthy successor of our own Captain Cook; and who subsequently perished, with his wife and only son, in the great accident on the Versailles Railway, on May 8, 1842, one of the most terrible and fatal of all on record.

In the male of *T. Urvillianus*, all the portions of the wings which are green in other species, are of a deep blue; but with an iridescence or opalescence in various lights, showing green or coppery. *T. Urvillianus* has lately been found in New Guinea, New Ireland, Duke of York Island, and the Solomon Islands. The butterfly does not appear to be difficult to capture, as Mr. Gervase F. Mathew, R.N., frequently found them descend to

low bushes; and he also obtained the larva, which is black, with carmine tentacles, and fleshy spines, the latter tipped with black; about the middle of the body is an oblique white stripe. It feeds on a species of *Aristolochia*, sometimes quite close to the ground.

From *T. Urvillianus*, we may pass on to other remarkable species. One is *T. Cræsus*, Wallace, from the island of Batchian in the Moluccas. Here the green or blue of the species we have already mentioned is replaced by a brilliant golden orange, shading into green in certain lights. Mr. Rippon treats *T. Cræsus* and *Urvillianus* as a separate section (*Prismoptera*) of *Ornithoptera* (which name he retains for the *Priamus*-group); but they can hardly be considered sufficiently distinct from the others to rank as a separate genus, as he himself admits.

After *T. Cræsus* we may place *T. Lydius*, Felder, which replaces that species in the island of Gilolo or Halmahera, one of the Northern Moluccas, not far from Batchian. Here the subcostal band on the wings of the male is of a very deep coppery-red; but both in this species and in *T. Cræsus*, the only other mark on the fore wings, except a short dash at the base of the inner margin, is the very large oval brown sexual blotch. The hind wings are of a rather paler colour than the band of the fore wings, and varied with yellow. The female of *T. Cræsus* does not differ much from the ordinary females of the *Priamus*-group, but that of *T. Lydius* is black, with the cell, and two



FIG. 5.—*Trooides Richmondia* (female).

complete rows of long spots, concave at the extremity, and the inner row very large, between the nervures beyond the cell. The hind wings are of a yellowish-brown, with the base, nervures, a submarginal row of mostly connected spots, and another on the hind margin, black.

From the genus *Trooides*, we pass on to another splendid group, *Etheoptera* (Rippon), in which the male has apparently no masses of raised scent-producing scales on the wings, and the hind wings are very long. Intermediate between *Trooides Cræsus* and *Etheoptera Victoria*, the type of *Etheoptera*, stands *Æ. (?) Tithonus* (De Haan), from New Guinea, a butterfly which remained unique in the Leyden Museum for fifty years. The fore wings of the male, which are seven inches in expanse, are black, with three changing green and yellow bands, two united at the base, the first running narrowly along the subcostal nervure, and much widened before reaching the apex of the wing; the second, broader at the base, extending along the lower part of the cell, and growing broader beyond as it curves towards the hind margin; the third runs along the inner margin, nearly to the hinder angle of the wing. The hind wings are varied with green and golden-yellow, and are narrowly bordered with black. There are three black spots on the hind wings on the upper side, and more beneath, as well as on the hinder part of the fore wings; the abdomen is yellow, with some black spots above on the sides, towards the extremity.

The female is not certainly known, for it is doubtful whether the insect which has been regarded as such may not be that of another species.

*Eitheoptera Victoria* (Gray), the type of its genus, is likewise a species of which little was known for many years. A single female, damaged by shot, was brought back by Macgillivray from the voyage of the *Herald*, and remained unique in the collection of the British Museum for more than thirty years, when several specimens were obtained by Mr. C. M. Woodford in the Solomon Islands. The true *Æ. Victoria* proves to come from the island of Guadalcanar, and the male measures six inches across the fore wings, which are long, narrow, and rather pointed. It is black, with a wide green and yellow space for one-third of the distance from the base, and another blotch of the same colour near the costa before the apex, divided by the veins. The hind wings are very concave at the anal angle, and are green, bordered outside by a yellow band, on which stand three orange spots (also visible below, where they have black spots between and beyond them), and beyond this is a narrow

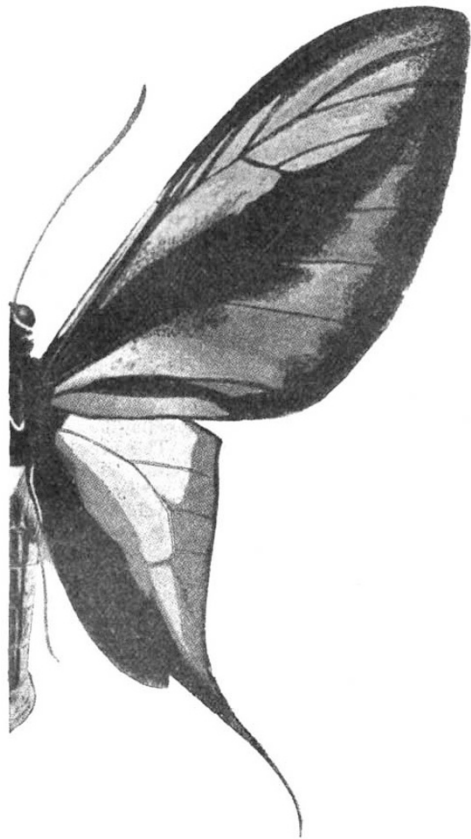


FIG. 6.—*Schoenbergia Paradisea*, Staudinger (male).

black border. The female is a black butterfly, with much broader wings, seven inches in expanse. There is a row of large white spots, and another of submarginal spots on all the wings; on the fore wings a yellow band, white at the extremity, runs along the cell, and another along the inner margin; on the costa of the hind wings is a yellow band. The larva is dark brown, with long carmine fleshy spines; the retractile fork is yellow.

In the island of Malayta is found the closely-allied *O. Regina*, Salvin, a larger insect, the male of which has more black on the hind wings, and three orange spots surrounded with green on the orange part of the wing, instead of the yellow band.

These butterflies, as well as *Troides Urvillianus*, frequent the sweet-smelling white flowers of *Cerbera Odollam*, a plant allied to the Oleander, which is common throughout the East Indies and Polynesia.

The next genus, *Schoenbergia*, Pagenstecher, is in some respects the most remarkable of all, as it is the only one allied to

*Ornithoptera* which is tailed. The only species, *S. Paradisea*, Staudinger, was captured by natives in the Finisterre Mountains in New Guinea, at a height of 500 metres. The male (Fig. 6) measures five inches across the fore wings, which are black, with two broad green bands glossed with golden yellow, one below the costa, and the other between the cell and the submedian nervure, and curved upwards, opposite the hinder angle of the wing, to beyond the middle of the hind margin. The hind wings are remarkably short, not more than three-fifths of the length of the inner margin of the fore wings, but they are very long and narrow, with the hind margin almost straight, and a tail quite as long as the wing is broad, at the outer angle; the inner margin is lobate. The hind wings are green, more suffused with orange-yellow than the fore wings, and narrowly bordered outside with black, but with the base and inner margin very broadly black.

The females are larger, and exhibit nothing unusual in form or colouring, being black, with two more or less developed rows of white spots on the fore wings, large towards the costa, and diminishing towards the hinder angle, where they converge; on the hind wings is a pale submarginal band, extending over the lower half of the wing, but much narrowed towards the costa; the outer part is yellow, shading within to bluish-grey and whitish; across it runs a row of black spots.

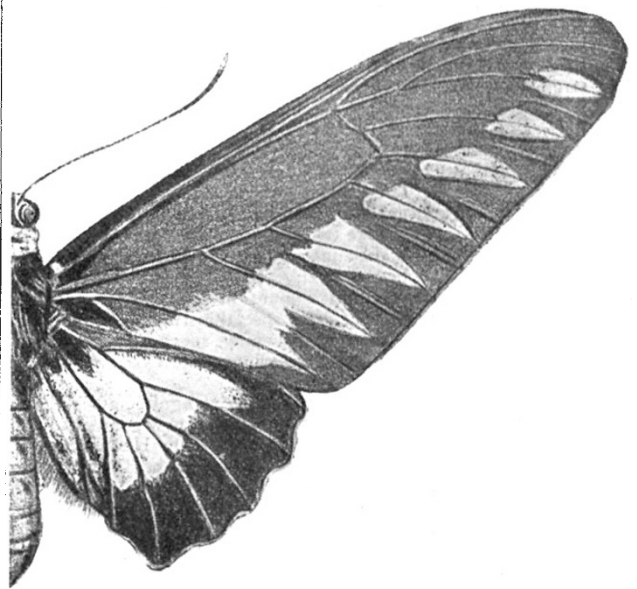


FIG. 7.—*Trogonoptera Brookeana*, Wallace (male).

This is the only known species of the group with tails on the hind wings; but this seems to be a tendency in some Papuan *Lepidoptera*. Thus the true Atlas Moths belonging to the East Indian and South American genus *Attacus*, Linné, are all tailless; but there is a closely-allied genus (*Coscinoceva*, Butler) found in New Ireland and at Cape York, which has very long tails; in fact, these moths are probably the largest tailed *Lepidoptera* known.

We have one more Eastern genus to mention, which we have left till last because it occupies a rather isolated position, and would have interrupted the sequence of our genera. This is *Trogonoptera*, Rippon, the type of which is *T. Brookeana*, Wallace, which was discovered in Sarawak, Borneo, by Dr. A. R. Wallace, and named after Rajah Brooke (Fig. 7). It is the only green *Ornithoptera* which inhabits the mainland of Asia (the Malay Peninsula) and the adjacent islands of Sumatra and Borneo. It measures from six to eight inches across the wings, which are black, the fore wings very long, with the hind margin very oblique, and the hind wings short, rounded, and dentated. The front of the thorax and the sides below the wings are crimson. The fore wings have a row of large green submarginal triangles, with the pointed ends resting on the hind margin, and each triangle intersected by a nervure; on the hind wings the whole centre is green. In the female, the green is much more glossed with brassy, and is bordered within with blue,

which is rarely the case in the male, and the green markings which disappear towards the costa in the male, are there in the female replaced by long bifid grey streaks between the nervures. An interesting account of the habits of this species, as noticed by various observers, is given by Mr. Rippon in his "Icones Orthopterorum."

One other species of this genus is known: *T. Trojana*, Staudinger, from Palawan, an island about a hundred miles from the north coast of Borneo. Here the brassy-green spots of the fore wings of the male are shorter and more subconical, instead of forming long isosceles triangles, and there is only a row of connected green spots across the hind wings, bordered within with blue; the base of the wings is also marked with rich blue across the nervures, and along the edge of the fold of the hind wings.

Some idea of the market value of conspicuous insects, before they are sent over in numbers, may be gathered from the circumstance that a specimen of this butterfly recently sold for £15 at Stevens's auction rooms.

This is the last genus included in *Ornithoptera* which is met with in the East, but the two largest West African butterflies are likewise considered to belong to this group, and may receive a passing notice here. One of these is the famous *Drurya Antimachus*, which was brought by Smeathman from Sierra Leone, and figured by Drury in 1782, and, afterwards, by Donovan in his "Naturalists' Repository," but of which no second specimen was seen in Europe till 1864. It is an insect with very long and narrow wings, from seven to nearly nine inches in expanse, and much resembles some gigantic species of the very characteristic African genus *Acraea*. It is black, with large tawny spots and markings towards the base of the fore wings, the greater part of the hind wings is tawny, with a row of black submarginal spots. It has been suggested that this insect possibly mimics an extinct *Acraea*, for the largest known species of that genus are not much more than half the size of *D. Antimachus*. The female is considerably smaller than the male (a rather unusual character in butterflies), and has much shorter wings. There are two specimens in the Hewitson Collection in the British Museum, and it was one of these that Mr. Hewitson used to say cost him £500. The real explanation is probably that he spent that amount in sending out agents to collect butterflies in Africa, with special instructions to look for *D. Antimachus*. Of late years, many specimens have been brought to Europe, and the butterfly can now be bought at a comparatively reasonable price.

The other West African butterfly now recognised as belonging to the *Ornithoptera* group, but for which a new genus will probably be created before long, was described by Hewitson under the name of *Papilio Zalmoxis*. It measures about seven inches across the wings, which are broader and more rounded than in the typical Eastern butterflies of this group. The male is of a rather pale blue, with black borders, slightly spotted with blue on the hind wings, and with black marginal lines between the nervures, and a black costa on the fore wings. The male is fairly common in collections, but the female, which is of a dull yellowish grey instead of blue, is still very rare.

It is curious that, like the gorilla and chimpanzee, the nearest relatives of these two great West-African butterflies (if we except *Papilio Ridleyanus*, White, a West African butterfly which has some resemblance to *D. Antimachus*, though it is much smaller and redder), are to be looked for in the islands of the Eastern Archipelago.

W. F. KIRBY.

#### A NEW ELEMENT IN THE NITROGEN GROUP.

A NEW element appears to have been discovered by Dr. Bayer in the residual liquors derived from the older process for the extraction of aluminium from red bauxite, and an account of it is communicated to the current issue of the *Bulletin de la Société Chimique*. The liquors in question consist chiefly of sulphate and carbonate of sodium, but there are also present considerable quantities of chromic and vanadic acids, and smaller quantities of molybdic, silicic, arsenic, phosphoric, and tungstic acids, together with alumina, magnesia, and lime, and an acid of the new element. In order to isolate the latter, the vanadium and chromium are first removed, the former as the difficultly soluble ammonium vanadate, and the latter as hydrated sesquioxide. The filtered liquid is then saturated with sulphuretted hydrogen, and the sulphides, all of

which are soluble in the alkaline liquid, are precipitated by hydrochloric acid. This precipitate exhibits a deep brown colour, due to the new element. When dried it presents a brown earthy appearance, and burns readily with evolution of sulphur dioxide and formation of a bright brown powder. Concentrated nitric acid instantly causes ignition, and formation of a deep brown solution, from which a small quantity of a yellow precipitate of a compound of molybdic and arsenic acids is deposited. The brown liquid contains no tin, antimony, or tellurium, but still retains traces of vanadium, molybdenum, and selenium. These elements are best removed by calcination of the sulphides immediately after their precipitation with hydrochloric acid when selenium is volatilised, treatment of the residue with ammonia and ammonium nitrate, which precipitate the last traces of vanadium as ammonium vanadate, and concentration of the filtered liquid which causes deposition of ammonium molybdate. During the concentration two distinct crops of different crystals are obtained, the first and most sparingly soluble being cubic crystals of an olive-brown colour, and the second the much more soluble ammonium molybdate. The olive-brown cubic crystals contain the new element, together with a little molybdenum. The latter is readily removed by dissolving the crystals in dilute hydrochloric acid, and passing a current of sulphuretted hydrogen through the liquid heated to about 70°. The new element is not precipitated by sulphuretted hydrogen in an acid solution. The filtered liquid is then allowed to evaporate in the air. At first it is bluish-violet in colour, and contains the new element in a low state of oxidation; subsequently it becomes oxidised, and the colour changes to lemon yellow. The oxide in the latter stage possesses marked acid proclivities, and probably corresponds to the formula  $R_2O_5$ . The acid itself is soluble in water, from which it is deposited in yellow crystals, which at a red heat fuse to a brownish yellow mass. Ammonia transforms the acid into a crystalline powder of olive colour, presumably an ammonium salt, which readily dissolves in hot water and crystallises from the solution in cubes on cooling. The solution is olive green and is precipitated by strong ammonia. The solution of the acid after reduction with sulphuretted hydrogen in presence of hydrochloric acid yields with ammonia a voluminous deep violet-brown precipitate, which rapidly becomes crystalline. The precipitation is not complete, hence the supernatant liquid is coloured violet. Caustic soda and sodium carbonate likewise incompletely precipitate it, owing to solubility of the precipitate in excess of the reagent with formation of a soluble salt. Chlorides of barium and calcium produce greyish-violet precipitates of the salts of those metals.

An especially interesting reaction is that with ammonium sulphide, with which the highly oxidised yellow solution of the acid yields a deep cherry-red colouration, due to a sulpho-salt. Acids precipitate from this solution a sulphide of the colour of iron rust. Silver nitrate produces a green precipitate of the silver salt, soluble both in nitric acid and in ammonia, and if the solution in the latter solvent is effected at a moderately elevated temperature the silver salt is deposited in crystals upon cooling. Magnesia mixture gives after standing a few minutes a green precipitate analogous to ammonium magnesium phosphate, and owing to the slowness of the precipitation the latter occurs in the form of relatively large crystals; moreover, the precipitation is complete after a short time, for the liquid which at first is green becomes colourless. A yellow precipitate is likewise afforded with a nitric acid solution of ammonium molybdate, as in the case of phosphoric acid. The chlorides of the new element appear to be volatile, for very considerable loss occurs on attempting to remove by ignition any admixed ammonium salts, for instance from the solution obtained after removal of the vanadium as previously described. A yellow sublimate is produced having all the characters of a chloride of the new element, and which is readily soluble in water.

A sufficient quantity of the new element in the form of any of its compounds has not yet been accumulated to enable exact quantitative analyses to be carried out, but Dr. Bayer hopes shortly to have obtained the amount requisite for this purpose and for the determination of the atomic weight of the element. There appears to be little room for doubt that it will prove to be one of the missing elements predicted by Prof. Mendeléeff in the nitrogen-phosphorus group. It exhibits characteristic spectroscopic lines in the green, blue, and violet.

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