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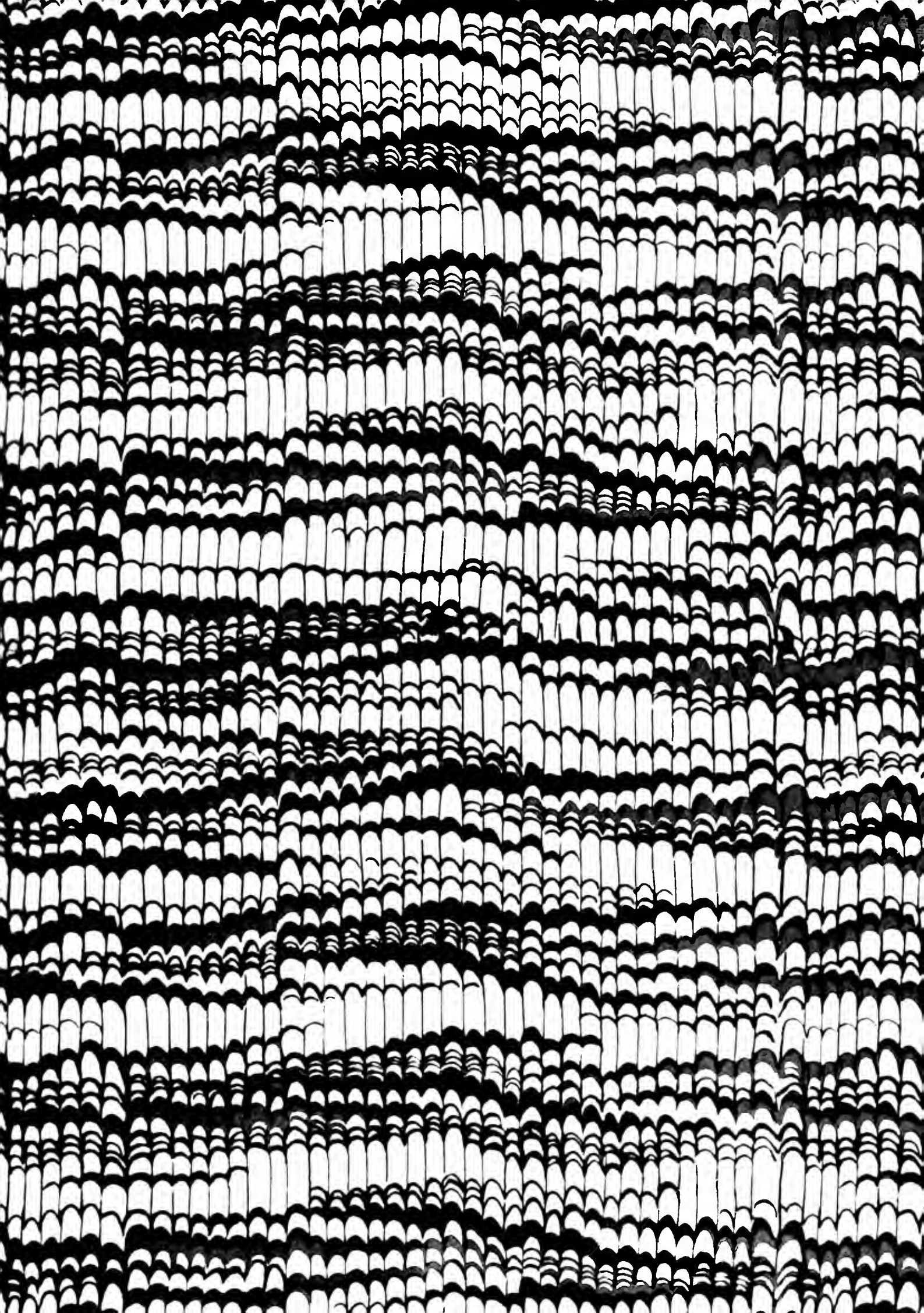

PIERIDAE

BY

M. C. PIEPERS AND P. C. T. SNELLEN

WITH THE COLLABORATION OF H. FRUHSTORFER

WITH 4 COLOURED PLATES

THE HAGUE
MARTINUS NIJHOFF
1909

LONDON
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THE RHOPALOCERA OF JAVA

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INTRODUCTION.

For about 28 years I lived in the Malay archipelago; nine months in Sumatra, five years in the south-western peninsula of Celebes and the rest of the time in Java: from January 1863 till August of the same year, from May 1864 till May 1869, from May 1879 till July 1888 and from January 1889 till June 1894. Most of the time that I passed in Java I lived at Batavia, but during the last two years and a half of my stay in that island also partly at Buitenzorg, both places situated in West-Java; some time also at Semarang, at Touban and at Bojonegoro in Central-Java, as well as at Kediri in East-Java, while I also visited for a shorter time other parts of the island, as the mountains of East-Java and frequently the mountains of West-Java. As far as my extensive official duties allowed me, I occupied myself all that time with the study of the fauna of the Lepidoptera in those places; hunting for, as much as possible myself, and breeding these insects on a large scale where I had settled down, while I sent out people to hunt for butterflies and caterpillars, augmenting my material for study with what they had caught as well as with that which others had the kindness to send me or with what I could obtain by purchase from other collectors of insects.

Those that I collected in Celebes have since been made known in volumes XXI—XXVIII of the *Tijdschrift voor Entomologie;* in the same journal several publications about the Java Heterocera have appeared in volumes XLIII, XLIV, XLV and XLVII. Since a long time, however, I have also intended to work out my notes about the Java Rhopalocera; an extensive material, as well as hundreds of figures of early stages made in Java, most of which are still entirely unknown, and thousands of notes about the biology of these animals, are at my disposal for the purpose.

But the great expense of such a publication has kept me back till now. Even if I confine myself to those figures which cannot be omitted,

because they are still quite unknown or for other reasons, I shall have to give a great many plates in quarto which, though the figures have been made already, will amount to a pretty large sum of money and there are still the printing-and publishing costs of the text, and the inevitable translation-fees. And who can guarantee that the produce of such a work will even slightly lessen the expenses?

Therefore I have resolved to try it by publishing the said fauna of the Rhopalocera in separate monographies according to families instead of the whole work at once. To the first monography, which will serve at the same time as a proof, I intend to add, according to the amount of financial support given in this way to the publication, a subscription list for the next, in order to be able to judge of the possibility of continuing it. As the first family to be treated of in this way, I have chosen that of the Pieridæ. This one seemed most suitable to my purpose. Firstly, because it is not very numerous in species living in Java, while at the same time there already exist good figures of many of them, so that a relatively small number of plates will suffice. Secondly because the said family especially offers the occasion to speak about some lepidopterological views which I profess, contradictory to the prevailing opinions in this respect, and thus enables me to explain these views in examples, from the beginning. For this reason my work has a peculiar character, especially with respect to the evolutionary nature of the morphogeny of the Lepidoptera. Therefore, to my mind, in that regard it is also scientifically further advanced than previous works which treat of the lepidopterological fauna of any other region. In order to be able to judge correctly of my work, it is, however, necessary to understand my said scientific views clearly from the beginning.

These views concern:

I. My absolute rejection of the minicry theory and of all that is connected with it.

II. The importance of the fact, hitherto biologically neglected, of the phenomenon of evolutionary atrophy to which the Lepidoptera are subject.

III. The revelation of this fact by the phenomenon which I have called that of the colour-evolution.

IV. My appreciation of the differences of colour among tropical butterflies, founded on this phenomenon, which are generally thought to be forms of the dry and of the rainy season.

V. The process of the phenomenon, referred to under II, in the gradual disappearance of the hind-wings.

I have already published several essays on these subjects. The principal are the following:

Ueber die Farbe und den Polyphorphismus der Sphingiden-Raupen (Tijdschrift voor Entomologie XL, 1897).

Die Farbenevolution (Phylogenie der Farben) bei den Pieriden. (Tijdschrift der Ned. Dierk. Vereeniging, 1898).

Mimicry, Selektion, Darwinismus. Leiden, 1903.

Noch einmal: Mimicry, Selektion, Darwinismus. Leiden, 1907.

Ueber die sogenannten "Schwänze der Lepidopteren." (Deutsche Entomologische Zeitschrift Iris, 1903).

All those who wish to get acquainted with my opinions in this respect and with the scientific reasons on which they are founded, I must refer to these studies; two of them, which have been published separately, are rather voluminous. Though the first two have been inserted in Dutch periodicals and the next two have been published in Holland, they have all been written in German. My preference for the English language for this work has its reason in the circumstance that almost all the strictly faunistic works about the Indo-Australian Rhopalocera — *Rhopalocera Malayana* by DISTANT, *The Lepidoptera of Ceylon* by MOORE, *Lepidoptera Indica* by MOORE, *The Fauna of British India including Ceylon and Burma, Butterflies* by C. T. BINGHAM, *A list of the Butterflies of Sumatra with especial reference to the Species occuring in the north-east of the Island* by LIONEL DE NICÉVILLE and DR. L. MARTIN. (*Journal of the Asiatic Society of Bengal, Vol. LXIV. Part II No.* 3. 1895), besides many other books referring to the same fauna, as those by HORSFIELD and MOORE or by WALLACE and others, have also been written in English. In order to facilitate the general comparative study of the Indo-Australian Rhopalocera and in order to ensure in such a study as much attention as possible to my book, it seems preferable to me to make use of the English language. But as in that language nothing but a short communication "*On the Evolution of Colour in Lepidoptera*" in the *Proceedings* of the *Fourth International Congress of Zoology*, held at Cambridge in 1898, and an essay "*The Evolution of Colour in Lepidoptera*" in the *Notes from the Leyden Museum* Vol XXII, has as yet been published about the said point of view, I think it is necessary for clearness' sake, to shortly explain here once more my ideas on the subject.

This, however, seems unnecessary to me with regard to the subject of mimicry, and protective resemblance, about the protecting or warning colours and suchlike things; in one word with regard to the modern zoological romanticism, which especially in the sphere of lepidopterology has indulged in real orgies and has not shrunk from any excesses. For, to be sure, the fact of the existence of resemblances between different species of animals, or between animals and plants or lifeless objects, which resemblance often deceives the

human eye, cannot be denied. And the possibility must also be acknowledged that this resemblance may sometimes protect such an animal, though in this respect people are apt to forget that it is the human eye only which serves them as standard. For this, in the first place, it is not developed sharply enough, secondly it is not practised enough and lastly it is not seconded so much by other organs, especially by scent, as is the case with several animals. But it is not this fact only, which is called *mimicry* in biological science, but the theory based on it. This theory I consider an error. It is however impossible to refute briefly these erroneons ideas; too many explanations are needed for that; the *pro*-literature is so very extensive that the discussions *contra* would have to count with this and for this reason could not be short. Moreover, I do not think this at all necessary. To be sure these errors still count many upholders, but nevertheless they have already several times been controverted in a scientific and most satisfactory way, whereas their advocates have never been able to refute, even for a part, the numerous and very serious objections against them. They never adduced new grounds for their assertions; they always confined themselves to enumerating new examples, the conception and explanation of which, however, were always founded on the same reasons which have already been proved not to be able to bear a serious examination. Only recently there appeared in the well-known periodical *Nature, Oct.* 31, 1907, under the title of: "*Recent Developments in the Theory of Mimicry*" an "*Evening Discourse Delivered at the Leicester Meeting of the British Association, on August* 5 *by* Dr. F. A. Dixey." "Recent" it is called in the title, but the essay contains nothing but the old assertions; and there is no question in it of the least contradiction or of any scientific battling with the foresaid objections; it seems as if this entomologist is entirely ignorant of this or wants to be so. Upon such a work serious science does not set any value. If the said theory has already found from the very beginning, many adversaries among really serious zoologists, after the attacks against it of late years, their number has greatly increased, especially in Germany. I myself have already treated this subject extensively in the two ample, above-mentioned books; and several other authors have also moved in the same direction. Only a short time ago (1908) a very interesting and extensive study by Prof. Géza Entz sen. entitled: "*Die Farben der Tiere und die Mimicry*" was published at Leipzig in the: "*Mathematische und Naturwissenschaftliche Berichte Aus Ungarn, 75er Band, Ies Heft.*" Others too, who are not energetic enough to abandon this theory entirely, have all the same, been obliged to reject so much of it, that we are quite in considering it an erroneous idea which is dying out and which will gradually disappear. I think that I may therefore abstain from discussing it here in a general sense,

I shall confine myself to mentioning my contrary opinion when treating of those butterflies in which other entomologists have adopted the existence of mimicry or suchlike phenomena, and to giving, in some well-known cases—as for instance in that of the genus KALLIMA—the special reasons on which my contradiction is founded.

There is only the following point that I should like further to mention here in this respect. With many Pieridae the under-side of the hind-wings, as also that part of the fore-wings, which in rest does not remain hidden under the former, is strongly coloured. Sometimes the colour is of such nature as to give rise to the supposition that in rest the butterfly thereby becomes only slightly visible and that it must be looked upon as a protective colouring. But often, especially in the PIERIS and TYCA genera, in those places such conspicuous colours are, however, seen, as to render this view untenable. There would thus only remain the case of so-called warning-colours, and it would then have to be presumed that butterflies in which this occured, are uneatable; there is, however, nothing that bears this out, and it certainly becomes but very slightly probable, if it be considered that there are also several species belonging to the same genera, whose under-side is not so glaringly coloured. Could these, on the contrary, be eatable? Such a great difference between animals so closely related, is not so lightly to be presumed. With the PIERIS PANDIONE Hb. the said system of colouring is even met with only in the case of part of the specimens, in the LEPTIS race it is not found. Can it then be that that race alone is not in need of such protection? If so, then why? There is, forsooth, nothing to show that this race, no more than such species in which the same is the case, would in the least degree be injured in regard to their chance of life; they are frequently very common and therefore numerous in individuals.

With this it is only a matter of phantasies. The origin of these colours, as we shall see further on, is very sufficiently to be explained as a result of the process of colour-evolution; nor can it therefore, as has also lightly asserted, be a result of the influence of light. This process does often seem to run its course more slowly on the under-side than on the upper-side without one knowing the reason of it; as far as this is concerned, we might, perhaps, ascribe it to some influence of the light, to which the under-side is more exposed than the upper one, or, maybe, to atmospherical influences, with which the same is the case. For secondarily—as we shall see further on CUNNINGHAM rightly conceives it—suchlike influences may make themselves felt and also influence the course of the process referred to; of this, forsooth, other examples are known which I have discussed in my afore-mentioned

works. Scientific certainty in respect to this has, however, not been attained.

Very important on the contrary is, I think, a fuller explanation of my ideas about the phenomena treated of in the works mentioned above under 2, 5, 4 and 5, though this explanation can only be shortly resumed here; for an ampler treatment of them I must refer to those books themselves. For in this respect my views greatly differ from those adopted by most entomologists. -Moreover, some discussion about these subjects must be considered of great consequence in order to show clearly the great importance of the study of the evolutional changes in the Lepidoptera and to fully understand the character of this evolution, namely the basis of the whole biological science. In no other order of animals can this be so easily studied; therefore a far greater estimation is due to lepidopterology than is given as a rule by zoologists. It is but few who recognize the truth of what Prof. WEISMANN observed more than twenty-five years ago, that difference of colour is nothing but a difference of form in a peculiar manner; therefore they do not understand either that the difference of colour also changes evolutionally or that the study of these changes for this reason also includes that of the charader of the evolutional changes of the form.

All living animals owe their present form to such changes and in the same way as this has sprung from forms which existed formerly, it will pass again into new ones. This evolutionary process is general, all beings are subject to it; but it often seems that there is a cessation of change either in species or in races, or even only in either the one or the other sex, sometimes even in some individual beings, which cessation probably is only of a temporary character, but may last, however, a considerable time and even continue so long that the species becomes extinct altogether for some reason or other. Moreover the evolutional impulse usually does not entirely alter a form; but, as a rule only affects some organs or other physiological unities and causes them to vary, either by developing them differently in a special direction or by making them disappear by means of weakening and lessening them. Sometimes, however, a change takes place at the same time in several similar, physiological unities and then, of course, the form is so much altered that it really ceases to exist. The process of change here mentioned may be best observed, when for some generally very uncertain reason, organs disappear in this evolutionary way. The caterpillars of the Sphingidae, for instance, are characterized by a so-called caudal horn, the shape of which differs, however, considerably in the different species. Only in one species DEILEPHILA VESPERTILIO Esp. as far as we know at present, it seems that nothing has remained of that horn but a crooked colour-mark which may perhaps be called a remnant of it. In DEILEPHILA OENOTHERAE Esp. the horn has also disappeared, but at the same place we

still see a horny spot, round which an ocellar marking has been formed, which in this way shows the place where formerly there was a horn. Many caterpillars of this family, however, have a generally crooked, hard horn, the length and shape of which differ according to different species and which kan sometimes be moved at will and sometimes not. Occasionally we find instead of the horn only an appendix of the skin, which can also be moved. In some cases the horn has remained particularly long. From the ontogeny of these caterpillars, as divided into succeeding periods by its moults, it its apparent that the said organ occurs in these periods in all kinds of different stadia of atrophy and that this process increases according as the caterpillar approaches the stage in which it is full-grown nowadays, and in which, as has been already said, the horn has already entirely disappeared in a few species. If we apply these results of ontogenesis according to HAECKEL's well-known biogenetical law, we find that probably all these species must originally have possessed a long horn, armed with long spines (poisonous?), which could be moved at will and has probably been a defensive weapon; this organ however, probably because it was no longer necessary to the organism, has since begun to atrophy more and more and thus disappear gradually. The process in which this change reveals itself, goes on little by little, as is generally the case in evolutional changes, but in one species quicker than in another and, moreover, very irregularly; a process which can easily be observed in the different stages of development of the caterpillars, either in the form or in the flexibility of the remnant of the horn, and which also makes it easy to understand the variety of this organ in the full-grown caterpillars. This only shows how far the atrophy in each species has already advanced. For, though no species possesses the horn anymore in its original state, the progress of this process among the species differs greatly and in the end, the total disappearance of the horn has only been reached by a single one, as has been already said, and even then not without leaving distinct marks. This process which thus annihilates a single organ, may be studied particularly well in these caterpillars. Those who want more detailed information on this point, I must refer to my essay: "*Ueber das Horn der Sphingiden-Raupen*" *in Vol. XL of the* "*Tijdschrift voor Entomologie*" published in 1897.

There are, however, several other suchlike processes that are not so easily observable, and among those also some to which the Rhopalocera are subject, which annihilate in the same way important organs of these insects, thus altering the corporal form. A similar process has already formerly destroyed the prothoracic wings,—it is true that this has not happened among the Lepidoptera, which did not yet exist, but in a high degree among the Pseudoneu-

roptera, from which the Lepidoptera have sprung. Each of the three thoracic segments of these insects was originally provided with one pair of legs and one pair of wings; in their descendants living nowadays the wings of the prothoracic segment fail entirely and in many families the legs have also partly been annihilated. Some few remains had already made anatomists suppose the former existence of these wings; later on this supposition has been entirely confirmed by the finding of fossil remains of Pseudoneuroptera of the Devonian and the carboniferous age. Among these remnants of the said wings were clearly obvious. It was also evident that even in those ancient times the process of atrophy must have been going on for a long time, as it had already far advanced in those species whose remains had been preserved; the difference in size of those remnants also clearly shows that a gradually proceeding extinction must have taken place. This evolutionary change has come to an end now. But with another one, which at present is taking place among the Lepidoptera, this is not at all the case. This process aims at making the prothoracic legs of the Rhopalocera disappear gradually; there is also much difference in its appearance. In some families it already appears distinctly in both sexes, but among the Libytheidae, the Erycinidae and the Lycaenidae it is only developed in the male sex, whereas in the other sex it only begins to appear. And in some families it seems to have not yet begun. Such a gradual difference in its appearance, however, makes it easy for the biologist te recognize it as an evolutional process of change. But little as this process may have advanced, it is already of old date, for, as SCUDDER has shown concerning the Tertiary Nymphalidae and Libytheidae, the present difference in this respect existed already in these families during the Tertiary age.

In the same way as I have explained in the above-mentioned essay, I think I may deduce a third similar process to which the Rhopalocera are subject, from the state in which nowadays the hind-wings of many species happen to be. Not only that the appendages of those wings which occur in different ways and are of no use and which therefore can evidently be considered as remnants, are very numerous, but the wings often become narrower, one thing and another altogether more and more reducing the size and with that also the use of those organs, in such a degree that in two species of the genus DIPTILON nothing but an insignificant remnant has remained. Here also the great variety in which this change occurs and the gradual extinction of the said wings, which is common to it, indicates to the biologist the gradual progress of a process which is also annihilating in this way these subthoracic wings, as formerly happened with the prothoracic ones. At the same time it seems that, probably by correlative influence, the size of the thoracic wings, and

with it the whole corporal size of the Rhopalocera is strongly diminishing.

Lastly there exists a fourth analogous process, namely the one which I have treated of in detail in the essays mentioned before in the 2nd, 3rd and 4th place and which I have indicated with the name of evolution of colour. It is that of the gradual destruction of the pigments to which the Lepidoptera owe their pigmental colours and the disappearance of the scales which contain them, beginning with a chemical process which causes the paling of the original red pigment from blood-red into various shades of a paler red, after that into orange, then into yellow and afterwards into white, while at last the pigment entirely disappears and the scales become transparent; finally they fall off as useless remnants. This may be observed f. i. among the Sesiidae, which in emerging from the pupa, have still such remnants of scales on the wings, fastened so loosely, however, that they fall off as soon as the butterflies begin to fly. The last period but one is certainly that in which the scales either partly disappear or still exist, but colourless; which is probably the case with the somewhat transparent spots which are fond on the wings of the ♀ of the European APORIA CRATAEGI L. In 1898 already I have mentioned this as a supposition. Now it has been confirmed by the observations published by B. SLEVOGT in n° 29 of the *Entomologisches Wochenblatt*, 1907 and in n° 14, 1908. We are informed that in 1907 in Courland and in the Caucasus many specimens of APORIA CRATAEGI L. have been caught which had lost, in a still much stronger degree, the scales either on the fore-wings or on all the wings. It is just this irregularity which is of such a great importance, as from it follows, that here the different stages of development exist, which characterize every evolutional process, and that therefore an evolutional change is taking place.

During this process there often appears another similar phenomenon, the cause and the course of which, though the fact itself is very distinctly visible, are still very little known, viz., a strong increase of the black colour, so that scales which seem to contain a black pigment cover more or less the brighter coloured ones, but only to eventually disappear again, showing once more the brighter scales underneath, though in that case generally much paler, as their evolution in the meantime has not stood still. The real nature of this phenomenon of growing darker which is quite independent of the former, the getting paler, though it often takes place at the same time on the same sides of the wings, requires closer research. Is it that new scales are formed which contain a black pigment or does the pigment in some scales turn into black, or does still some other process take place? This has not yet been investigated; the fact, however, that the black colour on the wings increases in the said manner and disappears

again during the evolutionary change—perhaps even after hundreds of years—in the existence of the same species or of the same genus, is undeniably evident from the comparison of the different stadia of development. It sometimes proceeds in a very peculiar manner, showing clearly that it advances according to certain rules. Sometimes we only see a lot of black scales spread in such a way among the light coloured ones that f. i. the yellow of some species of COLIAS and of the well-known marblings on the under-side of the hind-wings of EUCHLOE (ANTOCHARIS) CARDAMINES L. which have been taken for mimicry, look like green. Another time such black scales cover more or less closely the lighter ones and cause what is called an irroration of black scales. But not seldom also does the black entirely cover the other colours on smaller or larger parts of the wings or even their whole surface. And in that case also we see the black spread so much in the same manner or in the same direction, that this may only be explained by the circumstance that this process does not take place by occasional influences, but is the outcome of fixed factors, which govern the evolutionary change, though they are not always the same in all the species.

From the study of a polymorphic species this process may readily be known. Especially in the African PAP. DARDANUS Brown [1]) the different stadia of the evolutional increase of the black on the fore-wings are very obvious, provided that one has the disposal of a sufficient material for study to compare its numerous evolutional forms. In the ♂ form of this species which is distinguished as ANTINORII Ch. Oberth., there is nothing of it to be seen yet; in other ♂ forms as TIBULLUS Kirby and HUMBLOTI Ch. Oberth., a black stripe which stretches itself on the upper-side from the basis of the fore-wings along the costal margin, may distinctly be discerned; in the ♀ of the form HUMBLOTI Ch. Oberth., this stripe is still stronger developed, and in the ♀ of the form MERIONES Felder as well as in that ♀ form of ANTINORII Ch. Oberth., which resembles the ♂ form, this stripe is bent on the middle of the wing into a broad hook which, growing broader and broader, extends all across the wing in the ♀ forms HIPPOCOON F., TROPHONIUS Westw. and NIOBE Aur., till at last in the ♀ forms CENEA Stoll and ECHERIOIDES Trim., the black covers the entire wing with the exception of a few small spots. So, notwithstanding the variation occurring in each form, we see the black gradually extend itself across the wing in such

[1]) It has been tried to explain several forms of this butterfly by mimicry; in this way, most forms, however, remain unexplained. I consider the mimicry theory a mistake, but to those who still attach value to it, I must recommend the perusal of a study by GUY A. K. MARSHALL, F. Z. S., a convinced partisan of this theory, which is to be found on page 121 of Part I of the *Transactions of the Entom. Soc. of London*, 1908.

a way as shows unmistakably the progress of an evolutionary process of alteration and which makes it impossible to attribute it to accident or to external influences. And therefore when we meet that black in other butterflies in a way which completely gives back one of those stadia of colour-evolution, occuring in the numerous forms of P. DARDANUS Brown, we are without doubt justified in explaining it in the same manner. Such is the case f. i. in the South American species PAPILIO DEILEON Felder and the African PIERIS CALYPSO Drury, which both show the peculiar black hooked stripe of the above mentioned form MERIONES Felder ♀ and which therefore undoubtedly happen to be in the same stage of colour-evolution. This same stripe is also met with in several of the Java Pieridæ mentioned hereafter; it is, however, not always so coherent, nor does it always form such a rectangular hook, but sometimes it is more or less rounded; it is, nevertheless, always to be unmistakably recognized as the same phenomenon of evolution. So we sometimes also see a peculiar black little stripe on the upperside of the fore-wing in the interspace between two of the veins near the terminal margin as a beginning of the accretion of the black; this is the case f. i. in the ♀ of PIERIS NERO F., but also in other species as in some specimens of PIERIS NERISSA F. (See the figure by CRAMER, pl. XLIV, fig. a). It is true that the stripes do not always occur between the same veins nor have they always the same shape, but they always show so much in the same manner and all of a sudden, as it were, that it is evident that they arise from the same cause. When this process proceeds further, there arise more of those stripes at the same place in the interspaces between other veins, which afterwards unite into a band; suchlike facts, incorrectly generalised, have probably led EIMER to his well-known theory about spots and stripes. There where this hooked stripe has been developed, it also happens that the black begins to form a projection from exactly the opposite side of the wing, namely from the terminal margin, which gradually unites with the black of the hook and in this way shuts off the apical part of the wing, till the black spreads everywhere and fills this part. Another time the increase of the black takes place more regularly from the apex towards the basis of the fore-wing, or sometimes along the margins. Among the Java Pieridae the black is generally much more developed in the ♀ than in the ♂, and often in such a way that the sexes can easily be recognized, as f. i. either by the black on the upper-side of the fore-wings, as in T. BELISAMA Cram., C. SCYLLA L., C. CHRYSEIS Drury, and others, or by this colour as a border on the upper-side of the hind-wings as in T. HECABE L. and T. SARI Horsf. So there is no question of a secondary sexual characteristic, but only of a dissimilarity in colour-evolution, and probably in this way that the ♂ are further advanced; as the black in these species, most times at

least, does not seem to be any more in a period of increase, but of decrease. The increase of the black always takes place in such a manner, that though among the specimens of the same species all kinds of variations occur according to their more or less advanced stage in this evolutionary change, this process always follows the same course among the individual insects of the same species or even among a whole genus. This also proves without any doubt that a certain evolutional process which proceeds in a fixed direction, must be the cause. How strongly this may be the case in such alterations, unmistakably proving that there can be no question of external influences, but that the cause must be of an evolutionary nature by which a fixed direction in this change arises which answers to it, also became obvious to me by examining the extremely important collection of Lycaenidae of Prof. Dr. L. G. COURVOISIER at Basle; the spots on the under-side of these butterflies also show in their so-called varieties, everywhere the same fixed way of changing. Therefore we often see among polymorphic butterflies the same forms in many islands of the Indian archipelago, because the same direction or several such directions are working in the evolutional process of alteration which causes those forms and make it take the same course, though, as sometimes happens, local influences may affect and hinder it at the same time. For there are also local influences which affect the colour and the form of the Lepidoptera; whenever this is the case, I shall mention it.

All those who have in this way got acquainted with the phenomenon of the colour-evolution, especially with regard to the black, will understand that the explanation given by Dr. FREDERICK A. DIXEY in his essay: *On the Phylogeny of the Pierinae, as illustrated by their Wing-markings and Geographical Distribution (Trans of Ent. Soc. of London* 1894), of some colour-phenomena caused by it among the Pieridae, cannot be scientifically accepted, just as little as his Phylogenesis of this family which is concluded from what, in reality, is only a supposition.

The colour-evolution reveals itself in changes of physiological nature which, if possible, follow the same direction, but which also follow different directions, if such be required by the circumstances; consequently sometimes showing a great difference, though always tending to the same end. Evidently these changes are governed by the same leading element of evolution, but the nature of this element is entirely unknown to us. As it only attains its end sometimes after many thousands of years and as during all that time the existence of the being which is subject to it remains uninjured, we cannot think of any necessity for this existence and therefore neither of reasons of utility or fitness. So we can only see in it a phenomenon of that motivity which characterizes

life and shows itself to us as evolution, but the origin and nature of which are still unknown to us.

This matter is a phenomenon of great biological importance, the study of which, however, has been neglected until now. Nearest to a just understanding in this respect comes, as far as I know, J. T. CUNNINGHAM M. A. in his important work "*Sexual dimorphism in the Animal Kingdom*", published in 1900. At page 243 we read: "It must be remembered that, according to the views I am maintaining, external influences only excite variation and determine its direction; the result of the variation, the coloration and marking produced, may depend very largely on the physiological processes of grohwt and the development of tissues". The author certainly shows himself far above the prevailing ideas; it is, indeed, a matter of an internal factor, but he did not solve the question which one, as he was not acquainted with the phenomenon of colour-evolution. As to the knowledge of the coloration of the Lepidoptera and probably of animals in general, the study of this phenomenon is even of such direct importance that I fully maintain what I have said about this subject in my last work, that nowadays no actual scientific significance should be attributed to any considerations about animal coloration in which the phenomenon of colour-evolution is not taken into account. The alteration of the coloration, here mentioned, is, as Prof. WEISMANN already observed long ago, an alteration of the bodily form as to its coloration and, therefore, its importance also includes every evolutional corporal alteration. It extends thus to the signification of the real nature of evolutional processes in general. Since DARWIN the word evolution may be met with everywhere, but a right understanding of the nature of the organic change that is meant by it, is not at all common. Especially to the totally independent evolutional change of separate organs or physiological units of any being, without these changes seeming to be in its general interest, no due attention has heen paid.

Like all evolutionary changes the two mentioned here also advance unequally, occurring irregularly according to species, races, sexes and even sometimes in individuals, revealing itself now on one, then on another part of the wings; in every stage of evolution also occurs every now and then the cessation of development, already mentioned, by which the colour of some part of the wing, or of the whole wing, remains unchanged during many generations, while in the first mentioned case the alteration goes on in the meantime on the other parts of the wings. Herewith appear also the structural colours, and by these different things, arise those numerous varieties in colour and pattern which render the Lepidoptera such a beautiful group of animals.

The afore-said change of the pigmental colours I first of all observed and

studied in the caterpillars of the Sphingidae; after which I published it in the first of the above-mentioned works. Several years ago the matter had already been noticed by Prof. WEISMANN, who considered it, however, as a phenomenon of mimicry. Later on I think I have been able to establish the colour-evolution not only among many other orders of insects, but also among birds and mammals and even in respect to man. But its full significance as a gradually advancing process of atrophy I have only learned to understand in the study of the imagines of the Lepidoptera; the course of this process I can only show distinctly as far these imagines are concerned.

In this way an entirely different insight may be obtained into the Lepidoptera in general as well as into the Rhopalocera in particular, than is the case when such knowledge fails. Many so-called facts of mimicry are in the first place explained by it in a natural way. Also the fact that the colour of both sexes in a species of butterflies may strongly differ, which is incorrectly and without any foundation taken for a secondary sexual phenomenon, though it is simply the result of the circumstance that the process of the colour-evolution does not advance equally in both sexes and that, therefore, one sex proceeding further, has changed more than the other. Further the astonishment with which a few years ago Dr. OUDEMANS stated that the castration of ♂ caterpillars of OCNERIA DISPAR L. has no influence at all on the colour of the butterflies emerging from them. Just so many phenomena that are at present simply attributed without foundation to heat, cold, dryness, dampness and all other kinds of climatical causes, these influences not being explained in a comprehensible manner. Indeed such influences exist, but nothing gives us a right to attribute such a great significance to them; because the real cause is not known, words are used which only represent hollow meanings. So it is for a great part with the so-called local forms and especially with the conception which has been emphasized these latter years about forms of the dry and of the rainy season in the tropical countries, a conception which is understood with European weakness of comprehension according to the nature of the differences between winter and summer in Europe, so that even in collections they are indicated as summer and winter forms. A terrible exaggeration in this respect nowadays prevails among Lepidopterologists.

The difference between the dry and the rainy season of the tropics must not at all be considered in the same way and so strongly separated as winter and summer in the temperate zones. Though it is said that Dr. BRANDES was the first to mention this fact, it is DE NICÉVILLE, without doubt, who has most of all drawn the attention of entomologists to the differences, which were said to arise from these causes among butterflies; it is certain at least that

the conception of the existence of such a strongly separated horodimorphism has become his hobby; continually at it, involving others in it and being backed up by the dealers in insects to whom this is profitable. Now I certainly do not dispute the possibility that in a continental climate like that of British India such differences perhaps appear more strongly than in the climate of the islands of the Indian archipelago, but it is certain that in those islands they are not so distinct and cannot be so either. In the first place there are sometimes regions where the seasonal rain falls and those where this is not the case at the same time close to each other. In the south-western peninsula of Celebes the mountains seem to form the boundary. While south-east of them the seasonal rain falls, the dry season prevails west of them, and the reverse; near Bantaëng (Bonthain) these two regions are contiguous to each other.

Probably the same phenomenon occurs in West-Java with regard to the northern and the southern part, which are also separated by a high mountain-range. More than once I saw collections of Lepidoptera which were clearly characterized by their richness of species and strong development of the individuals, as being collected in the rainy season, from the regions on the south-coast near Pelabouan Ratou (Wijnkoopsbay), where they had been caught in July and August, when North Java is in the middle of the dry season. To distinguish those forms, it is therefore necessary to know exactly when and where each of them was caught in some island, and when the dry and the wet season prevail in the different districts of this island. Besides those seasons are very irregular. This is the same case with the seasons in a coast-land like Holland, where very warm summers and very cold winters are rare, where a great part of the winter is temperate and a great part of the summer bleak. So also in Java f. i., especially in West-Java very dry or very wet seasons are an exception. Often there are many dry days during the rainy season and rain falls every now and then during the dry season. It also seems that in some parts, as in N. E. Sumatra, it rains all the year round every now and then. Where a rainy season exists, it is certain that the humidity is greater, and this causes a more abundant flora and in connection with this also a more abundant fauna of butterflies. The more humidity there is, the stronger the plant and its different parts and consequently each leaf independently develops itself; so it is very probable that also the nutritive power will increase; the caterpillars which are caught in a strong rainy season make the impression of being extremely well fed and therefore big and strong specimens. We must not forget, moreover, that in the dense woods of the high mountains which are always the greater part of the day enveloped in clouds, the whole flora is always in a very damp state.

Though sometimes a period of cessation may occur, all animal forms, and consequently also the butterflies, are subject to evolutional alteration and therefore it is obvious that when such a process is taking place, every influence that is particularly favourable to the bodily development in general, will hasten the progress of this evolutional process; indeed this is very obvious in the process which I indicate as that of the colour-evolution.

In the second of the works above-mentioned, I have made known in this respect the results of a comparison of 97 specimens of CYLLO LEDA L., caught in Java at different times, and such especially with a view to the ringled spots on the underside of the wings. These spots are or different size and development, but the proportion between them in this respect is constant; the same spot is always in every individual insect the largest or the smallest; a proof that their development is not capricious, but is regulated by a general cause. In the appearance of those spots in the different, individual insects there is on the contrary, a considerable difference and such of a gradual nature. In some butterflies all those spots have been reduced to tiny dots; in others this is only the case with the smaller spots while the larger ones have remained ringled spots; at last in the most advanced insects all those dots have become ocellar spots, of which some are very strongly developed and in this way have become black eye-spots, white centred and set in a clear tawny ring, which is again surrounded by a thin black line. A gradually advancing process of evolutional alteration shows itself unmistakably, but has proceeded in one individual more than in another. It is obvious that the progress of this process is connected with the greater or lesser humidity which prevailed during the time that the caterpillar lived and thus with the greater or smaller nutritiveness of the plant which served it as food. Therefore the most developed ocellar spots are found on butterflies of the rainy season and specimens with only dots by preference in the driest season. But between those there are various transition forms. These are partly caused by the fact already mentioned that the showers are not always equally heavy or equally long, as well as by the showers during the dry season; I possess such butterflies with rather well-developed ocellar spots, the caterpillars of which must, however, have lived in the dry season. But this does not explain how also in the middle of the season of the heaviest rains, in which so many individuals with particularly well-developed ocellar spots occur, there are also found some that have only dots, so that the form which most strongly marks the dry season is found at the same time and at the same place as the one which most clearly shows the type of the rainy season. The reason of this may easily be understood, however, when we know that it is caused by a process of evolutional change and not directly

by climatical influences. Even if such an evolution is brought about by external influences or exciting causes—as in the case in question by the quantity or the nutritiveness of the food—this can only happen when the susceptibility also exists. Yet, this is, not always the case among the caterpillars that are irritated. If not, such an individual insect retains notwithstanding that irritation, the older form which has not proceeded further. Besides, some species, races, sexes or even individual insects happen to be in the above-mentioned period of cessation of development *(epistasy)* when no irritation makes them change.

Already in 1895 did Dr. L. MARTIN declare in his above-cited description of the Rhopalocera of Sumatra, in consequence of the thirteen years he lived in that island, that at least in the north-eastern part which was known to him, there did not exist a strongly separated dry and wet season, there being no month in the year when it does not rain; indeed it is rare for a week to pass without a shower, consequently there are no dry-season forms of butterflies to be found in Sumatra. Except—he remarkably adds—the dry season form of MELANITIS ISMENE Cram. which, as also in Java, is found all the year round equally common with the wet season ocellated form M. DETERMINATA Butler. The said butterfly happens to be the same as the form CYLLO LEDA L. just mentioned, whose pretended season forms do indeed not show that character, as has been said already and therefore do not make an exception, but on the contrary are quite compatible with MARTIN's observations. Dr. MARTIN's just insight, founded on his 13 years' experience, could, however, not prevent his collaborator DE NICÉVILLE, though the latter had not that experience about Sumatra, from expatiating in the same chapter in a very superficial manner on his hobby of the dry and the wet season forms.

Observations which answer to the results of my researches in this respect and thus also confirm Dr. MARTIN's views, have been made known more than once. In the *Proceedings of the Ent. Soc. of London, Febr.* 5 1879, SWINHOE already informed us that both forms of the said butterfly occur all the year round at Bombay, therefore in continental India. A good deal about it is still to be found in the *Transactions of the same Society* of the years 1903, 1904 and 1905. At Aden, in a district where occasional showers are very rare and where, therefore, a very dry season is the rule, YERBURY found the so-called dry and wet season forms as well as intermediate forms at the same time. MARSHALL observed the same in Mashona land. Dr. DIXEY mentions butterflies collected in the dry season near the White Nile, several of which had characteristics peculiar to those of the wet season. LONGSTAFF had the same experience in British India and Major NEVILLE MANDERS mentions of Ceylon that there the so-called dry and wet season forms of CALLIDRYAS

Chrvseis Drury (Pyranthe L.) occur all the year round. And recently the journey of Major Powell-Cotton in the large African tropical virgin forest of Itury informed us that there the seasons are not sharply separated; generally it rains there four or five days a week; seven successive days without a thunderstorm was the longest period observed by this traveller. But it seems that not much attention is paid to these observations that are contrary to the prevailing notions. Bingham, however, also remarks that the so-called wet and dry seasonal varieties are often captured together. A short time ago dr. Martin also showed me in his collection specimens of Thyca Rosenbergii Voll. bred at Macassar in all the months of the year and in which no differences are to be seen.

Lastly I received by the kindness of Mr. Edward Jacobson at Batavia in the year 1908, about 5000 Rhopalocera, all caught in the latter half of December and the first half of January 1907, that is, in the wet season, among which are many specimens of Pieridae common there. And later on, in 1909, I got another thousand caught in the same localities in the months of August and September 1908, that is in the very heart of the dry season, among which also several Pieridae, which furnished me an excellent material for comparison. Among these last thousand were many specimens of Callidryas Pomoma F., two of Callidryas Scylla L. ♂; the both sexes of Iphias Glaucippe L., the ♀ of which quite fresh; 3 ♂ and 3 ♀ of Thyca Belisama Cram.; 3 ♂ of Pieris Java L. Sparrm.; one pair of Thyca Egialea Cram., and several of Thyca Hyparete L. and of Thyca Peribaea Godt., as well as of Terias Hecabe L. and Terias Sari Horsf. Of all the above named species there were also many specimens in the wet season collection. There were further 7 specimens of Pieris Nerissa F., all of the form Corva Wall., but the 5 ♂ absolutely identical to those from the wet season, the two ♀ being far more light coloured, showing as much white on the upper-side as the ♂, though, as they were caught at the same time and in the same place as the 5 ♂ this fact may not be an inducement to conclude thereby that any difference of form should exist during the dry or the wet season. Only among the many specimens of Callidryas Pomona F. was a slight difference to be stated, in as much as among the wet season individuals the ♀ form, indicated by me as *f*, was found almost exclusively, and the other forms only in a few specimens, while among those from the dry season, there were, besides the same ♀ of the *f* form, at least just as many of the *ζ* form, though only such, of which the upper-side has become just as pale as that of te *f* form ones, but on the under-side still showing many remains of the red pigment, which are no more to be found in the *f* form. That

is, such as in regard to colour-evolution stand, so to say, on the very line of demarcation between both forms, or, the degree of development of which in this respect is but little behind that of the ♀ form. Now this, since these specimens are found as well at the same time as some ♀ form ones in the dry season, is the very thing I stated about the ocellar spots of CYLLO LEDA L. and mentioned on page XVI. So that, in fact, what this comparative study has taught me, did fully confirm the afore-said, namely: that no peculiar wet and dry season forms may be admitted, though butterflies of the same species found in those different periods, may mutually differ a little in degree of evolutional alteration.

It has also to be noticed here that in Java it often happens that dwarfish Pieridae and also other Rhopalocera are caught which entirely correspond with such as can be artificially bred by insufficient feeding of the caterpillar. It is, however, to be doubted whether this dwarfish development is excited by the same cause, as I have also caught such specimens in the middle of the rainy season.

So we see that we must be very careful in admitting these season forms and that the wild exaggeration of nowadays in this respect—much of which is due to the pursuit of gain by the dealers in insects—can not be called scientific. An equalization with what happens in Europe in this respect by the great difference between summer and winter, is altogether wrong. We must not forget that in many tropical butterflies as f. i. in those of CYLLO LEDA L. already mentioned, the generations succeed each other uninterruptedly, also during the dry season; though probably during that time the progress is slower in the wet season when among some butterflies a generation from egg to egg comes to an end within a month, which does not prevent, however, the time necessary for the development of the insects from sometimes varying a good deal. From larvae, pupated at the same time one part will sometimes give the butterflies after one week, the other part only after months, even after eleven months. And such under evidently the same circumstances; here also the individual susceptibility plays its part. The European colour-dimorphism of ARASCHNIA LEVANA L. with the form PRORSA L. is nothing but a phenomenon of colour-evolution in which, however, not the lesser value of the food, but the cold prevents its further development of colour as happens in the said case with the ocellar spots of CYLLO LEDA L.

Best of all may the process of colour-evolution among the butterflies be studied in the genus IPHIAS Bsd. (HEBOMOIA Hb.). Because the numerous species or races of this genus really only differ in colour, so that it is doubtful whether it is here a question of species or only of races; at all events, if we

have to accept several species, the transition from race into species can only date from rather recent times. For this reason the wings of this genus show a pattern-book of the gradual, but always very irregular progress of this evolution, as is not so characteristic elsewhere. But also in many species belonging to other genera this process is very obvious, especially so in the family of the Pieridae. And this study is indispensable for the knowledge of the morphology, especially among the Lepidoptera. Studies concerning these insects, when we are ignorant of the said phenomenon or if we do not take it into consideration, do not answer any more to the requirements that are expected of scientifical labour.

Many species of Rhopalocera only occur at certain altitudes above the sea, others show at different altitudes variations in form and colour which are also often due to the greater humidity in the mountains or to some other suchlike influence which affects their early stages. Sometimes also separate races have been formed in certain regions; then it also happens that afterwards such a race is again dispersed over a district where the not yet changed form still exists, or that on the contrary this latter one spreads where a new race has sprung up, and then the two forms occur there beside each other, at least till gradually by mixing together and by the progress of the evolutional change the two have again become the same. The altitude at which the butterflies have been found is, therefore, as far as I knew it, always mentioned by me in metres, by a figure in brackets.

In ignorance of the fact that the ever varying manner in which the pigmental coloration occurs among the Lepidoptera, is mainly the effect of an evolutional process connected with it, and consequently in the erroneous idea that only external influences govern it, endeavours have been made by numerous experimental researchers to confirm this meaning, especially the supposition that heat and cold cause such variations. Moving entirely in the narrow-minded sphere sprung from the generally exclusive knowledge of the European fauna, people quite forget that if the great change of heat and cold in Europe may be of significant influence, this cannot very well be the case in the tropics and that if therefore—as indeed occurs—tropical butterflies normally show exactly the same changes of colour as the European ones, the cause of this must probably in the latter not be attributed to these influences either. Neither do these variations depend on the pretended differences of the dry and the wet season, which have been represented in an exaggerated manner.

Some acceleration or delay in this process has been brought about along an experinental way in butterflies from the temperate zone, whose progress in their evolutional change under normal conditions is more or less connected with

higher or lower temperature. The same fact occurs also sometimes during particular conditions of the temperature in nature. Thus in these proofs it has always been a matter of abnormal phenomena, which for this reason showed an absolutely morbid character when they were brought about artificially in a higher degree than ever happens in nature, and which lead to the remarkable result that both, by strong heat or severe cold, the same changes are caused. A clear proof, indeed, that it is not any longer the specific character of the artificial influence—in this case cold or heat—which causes the effect, but only the fact of the irritation exercises this influence, and that as soon as this has passed certain limits, it simply causes a morbid disturbance. Though thus the said climatical influences may, to a certain degree, affect the progress of an existing process of evolutional change, the alterations which are brought about by that progress are, not directly, however, caused by those influences. The later researches by PICTET showed, moreover, that even such an influence, which can really cause some alteration of colour, particularly certain food of the caterpillars, cannot take an active part in it for more than a few generations; after that time it seems that the insects have so much adapted themselves to the new food that this can no longer affect their colour, and that they again take their origanal tint. Here also the external, or rather the direct influence only causes an abnormal, if not a morbid condition, which can only exist temporarily and so can never be the cause of normal and therefore lasting differences of colour.

Among caterpillars also the phenomenon of colour-evolution occurs. I observed it first among the larvae of Sphingidae and since then I have witnessed the same dimorphism in which this phenomenon reveals itself in those caterpillars, also among other larvae, between which there was a great difference, as well in caterpillars of Java, Satyridae f. i., as with those of EUPITHECIA. Evidently the evolutional change only takes place in respect to the ground colour and with regard to the increase of the black, which occurs among the Pieridae in the caterpillars of CALLIDRYAS POMONA F. So it is obvious that just as the butterflies have pigmental as well as structural colours, of which only the former are subject to the colour-evolution, those same two kinds of colour also exist in the caterpillars, and that the ground colour must be considered the pigmental one. But as regards this, it seems that only very little has been investigated as yet, and, therefore, there is not much to be said about the said phenomenon in caterpillars. Where, however, a case of this character occurs, I shall draw attention to it.

As to the chrysalids, I think we must also admit the existence of colour-evolution. Very important researches, especially those by POULTON, have proved,

it is true, that certain influences of light can modify the colour of many pupas; but the different species are not equally susceptible to it and sometimes not at all. So it is probable that the normal coloration which always exists, cannot take its origin from this cause; also in cases where the said influence cannot very well exist, the pupas are coloured. In some chrysalides, as in those of the European PAPILIO MACHAON L. there exists colour-dimorphism and this indicates perhaps a stage of transition, in which the original colour changes into another, and thus a process of colour-evolution. Not long ago CECIL FLOERSHEIM published in *Ent Rec. XVII: „Some notes on the earlier stages of* PAPILIO MACHAON, *particularly with regard to the colour-dimorphism in its pupa.*" The observations which it contains are very important, so far as they also again show that mimicry does not act a part in it; as the author, however, is ignorant of the phenomenon of colour-evolution, he does not know how to explain the colour-dimorphism of those pupas and confines himself to the supposition that it must be of a mechanical nature. The treatment of the Papilionidae and Danaidae, families, in which this colour-dimorphism of the pupas especially occurs, will give me the opportunity to discuss this matter. As to the Pieridae this phenomenon only reveals itself in the unequal increase of the black spots on some pupas.

Every time the opportunity occurs, I intend, when speaking of the Rhopalocera of Java, to indicate how, in my opinion, the form or the colour of a species may be explained, and to make this clear by the necessary figures. As to the so-called influences of mimicry and the process of atrophy of the hind-wings, the treatise concerning the Papilionidae will principally give me the opportunity to do so, as to the colour-evolution, that of the Pieridae. The great number of figures and descriptions of the early stages, which for the greater part have arisen from researches, first made by me, will also be of great use.

He, who is acquainted with the biological phenomenon of the colour-evolution and who, therefore, understands the nature of the colour-difference in apparently closely related Lepidoptera, can, of course, not agree with the mania of to-day to form new species only because of such differences of colour. There where indeed distinctly separated races or so called subspecies [1]) exist, a trinominal

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[1]) The term *subspecies* has been very much used of late years, I cannot agree with this use because this word intimates a sub-division of the species, which however, is not the case, as is it meant to distinguish different forms only in which the same species occurs. When these progenerate separated from each other, they form races. It is also objectionable to indicate them as geographical or local races, because the separation is often geographical, but not always so; and also because this name gives too much the impression as if various local influences are the cause of the difference of forms, for—though such influences are, indeed, sometimes met

nomenclature can be of some use; but with much more moderation than is the custom nowadays, if we do not want to exceed the limits of a really scientifical study. In this way there never ought to be given a separate name to such forms as only indicate evolutional changes of colour and no races; in this case they always ought to be distinctly indicated as forms, and it seems preferable to me to distinguish them by numbers or Greek characters only, as I have done with regard to CALLIDRYAS POMONA F.

The following remarks are still necessary.

The systematic part of this work has been arranged by the well-known Dutch lepidopterologist P. T. C. SNELLEN, who has indeed helped me greatly with the rest also, by his knowledge of the Indo-Australian Lepidoptera, and under whose supervision and for whose account a great part of the imagines has been figured. I have only had part of them made, especially those which must serve to make clear the process of the colour-evolution and also all the numerous figures of the early stages which have been made in Java. European, Eurasian, Javanese and Chinese draughtsman, the one more, the other less capable, have been working at it under my supervision as the oppertunity presented itself; those figures have always been compared by me with the living animal. As to the imagines, these have been figured from dried specimens, whose thorax and abdomen had often suffered by drying. This is an evil still common to all figures of Lepidoptera and which I have not been able to avoid.

The biological part is by me. Many important observations in this respect have, however, kindly been given to me by Mr. FRUHSTORFER, at present living at Geneva, who certainly is one of the best connoisseurs of the Indo-Australian Rhopalocera-fauna and who has also collected butterflies himself in Java. Dr. VAN DER WEELE, conservator at Leyden Museum was also so kind as several times to assist me in some investigations.

The scientific names of the plants which I got to know as the food of caterpillars, I owe, so far as they are well-known plants or that I could lay hold of the flowers, principally to the kind assistance of the well-known botanist Prof. Dr. TREUB, who during the time I resided in Java, was Director of the Government Botanical Gardens at Buitenzorg; while also other botanists there have sometimes been so kind as to determine the plants for me. For

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with—the difference is generally not excited by them, but by a dissimilarity in the process of evolutional development caused by the separation, which is also why that difference is not constant either, but the insects continue incessantly their evolutional change, as far, at least, as they do not happen to be in a state of temporary *epistasy*. It is especially the phenomenon of the colour-evolution which makes this clear to us.

the rest I have tried as much as was possible to find out the names in different botanical works on the flora of Java. The native names of the plants I have noted down as they were given to me by the natives. Not always, however, can we trust these names; rather than acknowledge that he does not know the name of a plant when we ask him, the native of Java often mentions a name of his own fancy. Well acquainted with the character of the natives and knowing many names of plants in the Malay and the Sundanese languages, I generally noticed when this was the case, but the reverse may also have occurred.

And lastly, wherever I speak of Java in my work, the Isle of Madoura is included, which being of the same formation and only separated from it by a narrow strait which has been formed later, is really only a part of Java. Not so, however, the more remote Isle of Bawean, though this one belongs to the ressort of the Javanese province of Sourabaya. Neither the Kangean islands, which are situated at a small distance east of Madura, and which lepidopterologically differ distinctly from Java.

With W. J. I have indicated West Java, Central Java as C. J. and East Java as E. J. As this island has a very oblong shape from East to West, the butterfly-fauna has not everywhere the same character; the dry season f. i. lasts also much longer in the western part than in the eastern one. Therefore it is necessary to mention it with every butterfly.

I not only write the generical names in capital letters, but also those of the species and of all forms, even when these, like in words as *flavus*, *alba* and such like are not real proper names. For where they are used as names they obtain, in my opinion, just as well the character of proper names, as in the case of human family names as, for instance: *Taylor*, *Blacksmith*, *Green* and many more others.

Besides the English works already mentioned above, I have also often cited:

P. Cramer, *Papillons exotiques des trois parties du monde. Avec supplément par* C. Stoll. *Amsterdam* 1779—91.

S. C. Snellen van Vollenhoven, *Essai d'une faune entomologique de l'Archipel Indo-Neerlandais; Famille des Pierides. La Haye* 1865.

Dr. O. Staudinger, *Exotische Tagfalter in systematischer Reihenfolge mit Berücksichtigung neuer Arten. Fürth* 1888.

M. C. Piepers.

PIERIDAE. [1])

J. W. TUT *(a Natural History of the British Lepidoptera)* maintains that the Pieridae are nearer related to the Nymphalidae than the Papilionidae. This is, however, biologically unacceptable. Their ontogenesis indicates undeniably a far closer relationship with the last mentioned family. Such a great difference in the manner of development as is shown among those Rhopalocera, which for that reason have already been distinguished by BOISDUVAL as *succincti* and *suspensi*, renders it certainly very acceptable that the families, belonging to each of those groups are more closely related to each other than to the families of

[1]) Besides the species of Pieridae which are treated of here, there are still some forms mentioned as met with in Java, which, however, seems to me too uncertain to justify me in giving them a place in the Javanese fauna. They are the following:

a. PIERIS ZELMIRA Cram.. A specimen of this species is found in the PAGENSTECHER collection at Wiesbaden and is said to have been sent from E. J. No other from Java is known, and in my opinion the information about this specimen being found there, is not sufficiently reliable.

b. PIERIS RACHEL Bsd.. BOISDUVAL alone mentions this species from Java without further explanation. SNELLEN VAN VOLLENHOVEN already considered this a mistake, as this butterfly is probably only a form of P. PITYS Godt. which lives in the Moluccas. FRUHSTORFER, however, possesses the latter species also of Bawean and of the Kangean Islands, situated in the neighbourhood of Madoura. In KIRBY'S catalogue the species is not given as belonging to Java.

c. ELODINA EGNATIA Godt. Both sexes of this species, which is only known from the eastern part of the Malay archipelago, are in the museum at Tübingen, and are said to have been received there from the province of Japara in C. J.

d. In the *Berliner Entom. Zeitung 1896* H. FRUHSTORFER published a list of Javanese Rhopalocera and in it he also mentioned PRIONERIS VOLLENHOVII Wall.. This certainly is erroneous and in a following essay, entitled *Studies on Pierids*, in the year 1899 of the same periodical, the author himself doubts its correctness.

e. DERCAS GOBRIAS Hew.. DISTANT mentions this species from Java in his *Rhopalocera Malayana* without further explanation. In no collection whatever have I ever seen a Java specimen of this butterfly. BINGHAM also knows this genus as belonging to Sumatra and Borneo, but not to Java.

the other group, even if there is sometimes a great resemblance between the families of different groups in regard to the development of a single organ as f. i. that of the veins in the wings. Moreover, the study of the early stages of the Nymphalidae clearly shows that this family must have sprung from that of the Satyridae.

The Pieridae are an old family of Rhopalocera. Of the Miocene age a Pierid has been preserved, which, generically, does not seem to differ from the butterflies of this family that now exist.

The caterpillars of the Java Pieridae give no occasion for considerations of a general character, but the pupas do.

Among the Rhopalocera an evolutional process unmistakably reveals itself, the nature of which is to reduce more and more the use of their spinning-power. By some seemingly old forms of Papilionidae, as f. i. in the genus PARNASSIUS, much spinning-thread is still used for pupating; by the Hesperidae also pretty much, but in the genus PAPILIO, and further also in several families, to which belongs also that of the Pieridae, the spinning-instinct has been reduced to that which forms the fastening of the tail-part of the pupa as well as the silken girth. Therefore these pupas have been called *succinctae*, and in those of several other families, among which f. i. the Danaidae and the Nymphalidae, this silken girth has also disappeared, for which reason those pupas have been called *suspensae*. Now in some pupas of Java Pieridae, viz. *suspensae*, we may distinctly observe a tendency to turn into *succinctae* and this seems important enough, as a confirmation of that evolutional character for me to draw attention to it. Indeed, until now, I have never found this mentioned.

The pupae of the genus PIERIS, like those of the Papilio's are fastened as a rule perpendicularly against some vertical object. This is also the case in the genus THYCA, though these, being fastened on the upper-side of leaves which do not always hang, but often lie more or less flat, also lie on them horizontally, when this is the case. But it is not right to say, as BINGHAM does, that this perpendicular position is taken by all the Pierid pupae. In several Papilionidae pupae the head is distinctly seen to diverge from the vertical direction, and this is also sometimes particularly the case in the pupa of EUCHLOE (ANTOCHARIS) CARDAMINES L., as is shown by a figure in the well-known work by RÖSEL VON ROSENHOFF. Among the Java Pieridae, the pupae are often fastened to the under-side of stems and branches that grow in a very slanting direction, and they are often of a strongly bent shape, with the result that the head hangs downwards, prevented by the silken girth only from resembling the *suspensae*. The pupa could, indeed, do without this silken girth and this has probably led to the arising of the *suspensae*, to which the said pupae form a transition.

This is especially the case with the strongly bent pupae of IPHIAS Bsd., but also in the genera CALLIDRYAS Bsd. and TERIAS Swains.

Genus PONTIA Bsd.

I XIPHIA F.

FABRICIUS, *Spec. Ins. II p.* 43, *N.* 180 (1781). . .	Pap. Xiphia.
CRAMER, *IV. p.* 175 *pl.* 379 *A* (1782)	„ Alcesta.
HÜBNER, *Zuträge fig.* 47, 48 (1818)	Leptosia Chlorographa.
BOISDUVAL, *Spéc. Gén. I p.* 431 *N.* 2 (1836) . . .	Pontia Nina.
SNELL. v. VOLL., *Mon. d. Piér. p.* 3 (1865) . . .	„ „
DISTANT, *Rhop. Mal. p.* 288 *pl.* 26 *fig.* 8 (1882—86).	Leptosia Xiphia.
SEMPER, *Schm. d. Phil. I p.* 251 *pl.* 42 *fig.* 1, 2 (1886—92)	„ „
BINGHAM, *Fauna of Br. India II p.* 138 *fig.* 36 (1907).	„ „

This small butterfly, whose eyes, when alive, are of a greenish yellow colour, flies, hovering slowly, near the ground and seems to be spread all over Java, but especially in more or less woody regions, where perhaps its foodplant grows.

W. J. Common in the forest of Pademangan in the lowest part of the vicinity of Batavia; much less common in the higher parts there (3—14). Also from the neighbourhood of the Tjiletou or Sandbay on the south-coast.

C. J. At Touban on the north-coast and at Bojonegoro (258).

E. J. I found many of them in coffee-plantations (500) on mount Semarou. So this butterfly is by no means an especially low country species in Java, as MOORE mentions of Ceylon, on MACKWOOD's responsibility, but is found at different altitudes. Its early stages are unknown to me. But according to BINGHAM the caterpillar and pupa have a strong resemblance to those of TERIAS HECABE L., the former green and thinly pilose, the latter sometimes green, but more commonly pale pink. According to DE NICÉVILLE (*The Food-plants of the butterflies of the Kanara District; Journal of the Asiatic Society of Bengal, Vol. LXIX.* 1000) the food of the caterpillar consists of CRATAEVA RELIGIOSA Forst. and some kinds of CAPPARIS.

Genus PIERIS Schrank.

1 JAVA SPARRM. L.

LINN., *Amoen. Acad. VII p.* 504 (1767)	Pap.	Java.
CRAMER, *I p.* 106 *pl.* 68 *B, C.* (1779).	„	Coronea.
BOISDUVAL, *Spéc. Gén. I p.* 474 *N.* 52 (1836)	Pieris	„
SNELL. v. VOLL., *Mon. d. Piér. p.* 29 (1865).	„	„
HERR.—SCHÄFF., *Stett. Ent. Zeit.* 1869 *p.* 76 *pl.* 1 *fig.* 3. .	„	„
STAUD., *Exot. Schm. p.* 32 *pl.* 18 (1884—88).	„	„
RÖBER, *Tijdschr. v. Ent.* 34 *p.* 280 (1891).	„	„

The eyes of this species during life are of a very pale grey. In many specimens there is no black to be seen on the upper-side, but dark brown; this is, however, perhaps caused by the circumstance that such specimens are not quite fresh any more. Many very fresh butterflies of this species, recently received by me from Batavia are all dark-black without exception, also those caught in the middle of the dry season. SNELLEN VAN VOLLENHOVEN mentions a specimen from Semarang with white marginal spots on the upper-side of all the wings.

W. J. Always common in the forest of Pademangan and other low-lying localities in the neighboorhood of Batavia. In higher districts (3—14) not so common, except in some years, as in 1867, when it frequently appeared. Further more in the vicinity of Pelabouan Ratou (Wijnkoopsbay) (150) in the south of the province of Prajangan.

C. J. Semarang (4). I received also specimens from the province of Madioun.

E. J. Very common in 1877—1878 at Kediri (64). In the Leyden museum there are also specimens from mount Arjouno and from Malang (445). At Kediri I found in December the very gluttonous, and for that reason, very quickly full-grown caterpillars on a kind of CAPPARIS, which is called there in Javanese *wanouwannan* and at Batavia *dawon* or *kajou toujoh*.

They show the ordinary PIERIS form. Except the sides, which are covered with short white hairs, they are smooth. The back is of a metallic hue and dark lead-coloured, regularly spotted with larger and smaller gold-coloured dots. Lengthwise, on the middle of the back and along each side, there is a dark stripe. The chrysalis has also the common PIERIS form. The head ends in a long snout. It is white, or pale yellow, with black spots and dots, the number and size of which differ a great deal, so that some pupas show only black dots, whereas others are almost quite black. On the 6th or 7th day after pupating, the imago appeared. This irregularity in the increase of the

black on these pupas, which also occurs in other species, is probably also a phenomenon of an evolutional nature which shows that the phenomenon of colour-evolution is also to be observed among pupae.

In the *Trans. of the Ent. Soc. of London.* 1888. G. D. F. MATTHEW gives the life-history of P. TEUTONIA F. from Australia, New Guinea and some other Polynesian islands. According to W. J. RAINBOW this P. TEUTONIA F. is the same species as P. JAVA SPARRM. L.; the specimens of TEUTONIA, however, which I have seen, differ so much from JAVA, that they undoubtedly belong to another race. According to the above mentioned entomologist, TEUTONIA occurs in Australia much more abundantly one year than another, and is also said to appear in great flights every now and then, as f. i. in 1903, which never is the case in Java. This butterfly is said to be known there under the name of the *Cape-White* and to have a spring and a summer brood; both sexes are also said to show more black than JAVA and in some ♀ the hind-wings are almost quite black. In Australia also, the caterpillar is said to live on CAPPARIS.

2. JUDITH F. [Pl. I, fig. 1].

FABRICIUS, *Mant. Ins. II p.* 22 *N.* 230 (1787)	Pap.	Judith.
DONOVAN, *Ins. of India pl.* 27 *fig.* 2 (1800)	„	„
HÜBNER, *Zuträge fig.* 669, 670 (1832)	Acrea	„
BOISDUVAL, *Spéc. Gén. I p.* 468 *N.* 44 (1836).	Pieris	„
SNELL. v. VOLL,, *Mon. d. Piér. p.* 21 (1865)	„	„

Occurs all over Java and is not rare; but I never found this butterfly so common as HORSFIELD states it to be. In many parts it is entirely wanting. The upper-side of the ♀ has much more black than that of the ♂; but in some specimens, this is stronger than in others.

W. J. As to the vicinity of Batavia exclusively in the lowest localities, viz. in the forest of Pademangan. Furthermore at Tjampea (160), also in the Megamendoung, Salak, and Wajang mountains (1000—1500), at Soukapoura in the province of Prajangan and on mount Tjerimai in the province of Tjirebon.

C. J. At Touban (2) on the north-coast and at Dander (± 30) in the provinces of Madioun and Tegal.

E. J. At Loumajang (45), Besouki and Banjouwangi, and in the Arjouno, Semarou (1500) and Tengger mountains. Larvae and pupae are still unknown.

3. TAMAR Wall. (Pl. I, fig. 2).

WALLACE, *Trans. Ent. Soc. of London Ser.* 3 *vol.* 4 *p.* 337 *pl.* 6 *fig.* 2 (1867)	Pieris Tamar.

In 1879 I twice caught this species at the watering-place Bekti near Touban, situated on the north-coast of C. J., and in the collection of the Zool. Institute at Tübingen I found 4 specimens, which are said to have been caught in Japara, also in the north of C. J.

4. NERISSA F. (Pl. I, fig. 3 *a*, *b*, *c*, *d*, *e*).

FABRICIUS *Syst. Ent. p.* 471 *N.* 123 (1775)	Pap. Nerissa.
CRAMER, *I p.* 69 *pl.* 44 *B. C.* (1779).	„ Coronis.
„ *III p.* 47 *pl.* 221 *F, G.* (1782).	„ „
„ *IV p.* 141 *pl.* 362 *E, F.* (1782)	„ Evagete.
HORSFIELD, *Cat. Lep. E. I. C. p.* 144 *pl.* 4 *fig.* 9 *a—f* (1828).	Pontia Coronis.
BOISDUVAL, *Spéc. Gén. I p.* 471 *N.* 49 (1836)	Pieris „
SNELL. v. VOLL., *Mon. d. Piér. p.* 26 (1865)	„ „
BINGHAM, *Fauna of Br. India p.* 183, 184, *fig.* 49*a* ♀ (1907).	Huphrina Nerissa.

I found this butterfly whose eyes during life, are pale-grey, common only in the lower countries, where it flies at a moderate height, especially in gardens near hedges and brushwood. But it occurs also in the mountains and according to Dr. HAGEN (*Iris* 1894) it is in Sumatra even a mountain-butterfly. MOORE's HUPHRINA PHRYNE of Ceylon probably belongs to the same species. In Java the form CORVA Wall. is the common form which closely approaches the form LICHENOSA Moore, figured by BINGHAM; and which is particularly characterized by a strong increase of the black, especially in the ♀.

Also the specimens of Bali are conform to these. FRUHSTORFER, however, did find much lighter-coloured specimens of both sexes of this butterfly, in which the upper-side of the ♀ shows just as much white as that of the ♂, and the black pigment on the upper-side of the ♀ like that on the under-side of both sexes has changed to a sometimes rather yellowish lightbrown. He found these in the mountains near Malang (445) and Lawang (500) in E. J., but only here and there and in a few specimens. One caught by him at Soukaboumi in W. J. is obviously a transition to the dark form. In the Leyden museum there are also several such specimens from the same localities in E. J. And in the collection named on page XXVIII, gathered in the heart of the dry season at Batavia, I received also two such ♀, but at the same time with 5 ♂ belonging altogether to the dark form, and quite conform to those from the wet season.

I give a figure of the under-side of the hind-wing of such a specimen, but it must be borne in mind that some of them are a little more blackish; that in others the general yellowish shade is much paler, and that in a few, the yellow quite turns into white, while also the dark yellow spot near the base

of the wing becomes very insignificant and even almost disappears. In the above mentioned museum there are also still four old specimens whose undersides show a much brighter and darker yellow, as occurs also in this species in other islands, and which bear the label of Java: as I do not know anything about where they have been found and as they differ strongly from all the above mentioned Java specimens, I dare not yet class them as such. The specimens figured by CRAMER, are none of them from Java.

Indeed the CORVA form must point out a stadium of the evolutional increase of the black pigment in the same manner as this shows out in the form LICHENOSA MOORE from continental India, being in Java the most commonly met with condition of this species, for though there were found individuals of the same colour in which that black is less extended and less intense of colour, yet they must be reckoned among the CORVA forms; there are also, as the above named specimen of Soukaboumi shows, transitions between the one and the other. So one stands here before the ever embarrassing question: are those light-coloured specimens to be considered as individuals in which the evolutional increase of the black pigment has not yet appeared, or as such in which it has already stopped and is followed again by a diminishing of colour. For this last supposition might plead the fact that also with those individuals with which the increase of the black seems to be strongest, the upper-side of the ♂ is much whiter than that of the ♀, which agrees with what is found in other PIERIDAE, such as for instance THYCA HYPARETE L. and T. PERIBAEA GODT., where this doubtlessly points to a condition in which the black pigment is vanishing and wherein the ♂ is more advanced than the ♀. And also, that in the light-coloured ♀ specimens the peculiar deep yellow relict-spot on the underside at the base of the hind-wings, is already quite gone, though that still shows out very strongly in the ♀ in which a strong extension of the black is present; for this does point, indeed, to the fact that in the firstnamed a process of etiolation has operated vigorously. But, after all, this is not of great significance, as both evolutional processes, the one that makes the yellow vanish, and the other the black pigment increase and diminish, proceed each independently. On the other hand the fact that the light specimens are only met with here and there, just the same thing, indeed, as is going on with THYCA BELISAMA regarding the form BELISAR, and in CALLIDRYAS POMONA F. regarding the form CATILLA Cram., is a strong inducement to make one think of remains from an older evolutional form in those light individuals too. This supposition seems to be confirmed also by the circumstance that both the light specimens caught at Batavia were got there in the dry season, just as in the case with individuals less advanced in colour-

evolution of CALLIDRYAS POMONA F. and often too of CYLLO LEDA L. That is why I think it most likely that those light specimens still represent an older form, wherein the increase of black pigment, now characteristic of CORVA, is not yet effectuated.

A very superficial contention about a case of mimicry, which is said to take place with this butterfly has rightly been contradicted even by an ardent partisan of the mimicry theory, GUY A. R. MARSHALL F. Z. S., page 118 and following ones of Part I of the *Transactions of the Ent. Soc. of London* 1908.

W. J. Batavia (3—14), Dèpok (95), Soukaboumi, the vicinity of Pelabouan Ratou (FRUHSTORFER).

C. J. Touban (2) on the north-coast and Bojonegoro (258), both in the province of Rembang. Also in the province of Japara in the north.

E. J. Kediri (64) and also in the Tengger mountains at Pouspa (630), Malang (445) and Lawang (500) (FRUHSTORFER).

The caterpillar, at Batavia as well as at Kediri, on the same kind of CAPPARIS, on which feeds also that of P. JAVA Sparrm. L. MOORE mentions the same food of Ceylon and DE NICÉVILLE of India. It has the common form of PIERIS; the colour is green, the head concolorous with the body; the back, however, is darker than the sides which are somewhat whitish. Each segment shows some transverse, parallel wrinkles. When magnified on the body numerous white dots are seen and on the sides short, white hairs, though, for the rest, the caterpillar is smooth. The pupa also shows the common PIERIS form, green with white lines on the abdomen; the head has a light-brown head-process, while on the edge between thorax and abdomen there is a double pointed transverse dorsal ridge of the same brown colour. On the 7th day the imago emerged from the chrysalis.

My figures of the larva and the pupa are much more accurate than those given of Java ones by HORSFIELD (P. CORONIS) and of Ceylon ones by MOORE (H. PHRYNE).

5. AMASENE Cram.

CRAMER, *I p.* 68 *pl.* 44 *A* ♂ (1779)	Pap. Amasene.
HÜBNER, *Zuträge fig.* 771, 772 ♀ (1832).	Catophaga Leis.
BOISDUVAL, *Spéc. Gén. I p.* 535 ♂ (1836)	Pieris Amasene.
„ „ „ „ „ 538 ♀ (1836)	„ Paulina.
SNELL. v. VOLL., *Mon. d. Piér. p.* 35 ♀ (1865).	„ Amasene.
„ „ „ „ „ „ „ 37, *pl.* 4 *fig.* 5 ♂ (1865).	„ Zoe.
DISTANT, *Rhop. Mal. p.* 313 *pl.* 25 *fig.* 6, 7, 10 (1882—86).	Appias Leis.

The eyes, during life, are pale-grey, somewhat greenish. The species is spread all over Java, but nowhere abundantly.

W. J. Batavia (3—14), Dèpok (95), Tjampea (160) and the neighbourhood of the Tjiletou or Sandbay on the south-coast.

C. J. Dander (± 30) in the province of Rembang and from the mountains near Ambarawa (500), situated in the province of Semarang.

E. J. Pouspa (630) in the Tengger mountains.

One day I received a caterpillar, which reminded me more of a CYLLO than of a PIERIS larva, it was said to have lived on INOCARPUS EDULIS L. The head was of a reddish yellow colour, covered with many very small black spines. The under-side yellowish green, somewhat transparent and separated from the back by a dark-yellow stripe. On the very pale grey back, there was at each segment a transverse row of black spines, which were much thicker at the bottom; on the thoracic segments there were six, on most of the abdominal segments four, but on the last, one more; between those rows I also saw some such small spines. The caterpillar had in general a more transparent appearance than other PIERIS larvae. The chrysalis was of the common PIERIS form, but particularly oblong. On the under-side of the thorax there were on each side two projections and on the head a long snout, the abdomen grew thinner, ending in two flattened points. The colour was a dead-yellow with black; the latter colour forming especially two subdorsal rows of large, round spots and still some smaller ones. Also the long snout on the head was black. As the silken girth was wrongly, placed, the imago could not emerge from the chrysalis; as far as I could judge, it seemed, however, to belong to this species.

6. PANDIONE HB. (Pl. I, fig. 4 *a*, *b*, *c*).

HÜBNER, *Zuträge fig.* 651, 652 (1832)	Hyposcritia Pandione.
BOISDUVAL, *Spéc. Gén. I p.* 527 (1836)	Pieris „
„ „ „ „ „ 538 „	„ Paulina.
LUCAS, *Revue Zoologique, 2e série IV p.* 235 (SNELL. v. VOLL., *Mon. d. Piér. p.* 34	„ Ida.
SNELL. v. VOLL., *Mon. d. Piér. p.* 33 *var.* ♂ . . .	„ „
FELDER, *Novara, Lep. p.* 163 (1867)	„ Leptis.
WALLACE, *Trans. Ent. Soc. of Lond. ser.* 3 *vol.* 4, *p.* 381 (1867)	„ Lucasii.
DISTANT, *Rhop. Mal. p.* 314 *pl.* 25 *fig.* 9 (1882—86).	Appias Leptis.
„ „ „ „ 467 „ 41 „ 11 „	„ Lagela.

I take this butterfly for the same species as the HIPOCRITIA NARENDRA Moore, described by this entomologist from the mountains of Ceylon. The eyes of the living insect are pale-grey. It occurs in Java in three forms. The type is characterized by the black hooked stripe on the upper-side of the fore-wings, of which I spoke in the Introduction, and opposite to which also the black of the terminal margin protrudes; so that the black, coming there from both sides, tries to unite and form a black transversal band across the wing, which, however, has succeeded only with a few specimens, and then not even completely (pl. I, fig. 4*a*, 4*b*). In both forms LUCASII Wall., (pl. I, fig. 4*c*), and LEPTIS Felder, especially in the former, this hooked stripe is also indicated, but the increase of the black fails; either that this increase does not yet take place, or that these forms are already in a more advanced stage of colour-evolution, in which the black is again disappearing. Which of these two possibilities is taking place at present, is, as is often the case, difficult to decide; the apparent increase of the black with the type, might indeed just as wel indicate a process of gradual decrease.

What is now the reason of this difference in the increase of the black on the upper-side of the fore-wings between the type and the two other forms? It is apparently of the same nature as that which makes BINGHAM distinguish the type of his APPIAS LALAGE Doubl. from the race LAGELA Moore. But while these two races are generally said to live in different regions, the type and the form LUCASII at least occur in Java both in the same localities, though the latter, as it appears to me, is much less numerous than the type, and I only am acquainted with the ♂ specimens of that form while I possess both sexes of the type and of the form LEPTIS; FRUHSTORFER seems, however, to have got both sexes of the form LUCASII too. Partisans of the doctrine of seasonal varieties certainly want to explain the said differences in that way, but besides the reasons already given in the Introduction, why I may not simply accept such an explanation, it is difficult to understand in this way why with the form LEPTIS, which seems to live as a rule as a separate race in other localities than the two other forms, the condition of the black is always the same, and for this reason is certainly not influenced by seasonal stages. It is certain that, before a definite decision can be given about the way in which the type and the form LUCASII appear beside each other, a closer research is necessary; this, however, does not seem doubtful to me, that the said difference in all its forms is merely the consequence of the process of colour-evolution which is not in the same stage of evolution, neither in the different individual insects of the same species, nor in those of the different races.

It is certain that the tendency to become gradually paler, which tendency belongs

to that process, also appears in the three above-mentioned forms, but in a different degree; strongest in the form LEPTIS and least advanced in the type: which makes it probable that also the black on the upper-side of the forewings happens to be in a stage of decrease, and for this reason has still the greatest development in the type; the type would in this case represent the oldest form of colour which still exists.

Yet it is a fact that the union of the hooked stripe and the black of the terminal margin of the fore-wings has not progressed so far on the under-side as on the upper-side, which, seeing that, as a rule, the former has proceeded less far in the course of colour-evolution than the latter, may lend support to the view that the extension of the black is still in the period of increase. That the original colour is simultaneously in a state of etiolation does not clash with this, seeing that each of the evolutions independently follows its own course. Nor can the fact that the dark colour on the under-side of the hind-wings evidently also contains much black, and that this is also disappearing, at all militate against this, as this special increase of the black may be caused by the secondary operation of some external influence, which has been mentioned on page V of the Introduction. The whole subject however still continues very difficult. An answer to the question whether the black is in a state of increase or decrease, is always very difficult to give, because it is only clearly evident when remains of that colour are present, in which case a decrease must naturally take place. As such f. i. loose, spread, black spots, like those on the upper-side of the fore-wings of the European PIERIS BRASSICAE L. are to be recognized, because the increase of the black, as we have seen, follows fixed rules, to which the said spots do not answer, whilst the decline of that colour has not such a regular character. But such remains are far from being always present, and when they are not, from that fact alone it may not, forsooth, be concluded that an increase of the black takes place. Nor are general conclusions, in this respect, possible, for with the one species it differs from what it is with the other, yet in general it seems acceptable, that among the Pieridae, an old family of the Rhopalocera, the process of colour-evolution will be pretty far advanced and that, therefor, the fact that so many species of them have grown almost white, may be ascribed to this, and that thus, especially with those in which the white is so strongly extended, the black will already have reached the period of decrease.

This process of getting paler shows itself strongest in the colour of the under-side of the hind-wings. In the type this colour is mostly dark brown, sometimes mixed with more, sometimes with less yellow; this brown, however, gets paler and becomes greyish. This happens particularly in the form

LUCASII; some specimens are growing much paler and then the colour is really yellowish. In the form LEPTIS this getting paler has proceeded much further, and the under-side of the hind-wings of the ♂ has already got pure white, whereas those of the ♀ are a little more yellow whitish (*ochroleucus*), in some specimens even still a light yellow, and in that case approach the palest specimens of the form LUCASII. On the upper-side the three forms differ only in the already mentioned extension of the black; for the rest they are always white; in the collection FRUHSTORFER I, however, saw a ♀ from the Gedeh mountains in W. J., the upper-side of which was yellowish.

W. J. I never found this butterfly in lower localities than Tjampea (160) and Buitenzorg (265), and then even the butterflies which were caught there, all belonged, if I well remember, to the form LEPTIS Felder, which seems to form a separate race there; in the higher localities (1400—1700) of the Gedeh-, the Salak- and the Wajang mountains on the contrary, only the type and the form LUCASII Wall. were found, the type at least in great numbers. On the mountain-pass (1482) of the Megamendoung, on the frontier between the province of Batavia and the province of Prajangan, they are generally seen to be sitting on the wet sand drenched with urine.

A more extensive knowledge of the early stages of these mountain butterflies than I have been able to obtain, will solve the question whether the form LEPTIS Felder must be considered to be a race of this species or a distinct species.

C. J.?

E. J. Pouspa (630) in the Tengger mountains and in Banjouwangi. FRUHSTORFER found the butterfly very common in E. J., also in the form LEPTIS Felder, but the latter also never higher than at 700 metres. At Tjampea I found the caterpillar of the form LEPTIS Felder on TARAKTOGENOS BLUMEI Hassk., it was, however, just going to pupate, and so perhaps the colour had already turned a little paler. It was smooth, pale yellow-whitish (*ochroleucus*), with many black spots; on the skin there were small sharp spines. The pupa had the common PIERIS type, pale yellow, also with many black dots. On the head there was a hooked projection bent backward; on the middle of the back of the thorax there was a transverse yellow ridge of only small height; while on each side of the back of the foremost abdominal segments there were three projections of a yellowish colour like the head-process, but with a black extremity and black margins.

On the 3rd of April the pupation took place and on the 7th of April the imago emerged from the chrysalis.

7. PAULINA Cram. (Pl. I, fig. 5 *a*, *b*, *c*).

CRAMER, *II p.* 21 *pl.* 110 *E*, *F* ♀ (1779).	Pap. Paulina.
BOISDUVAL, *Spéc. Gén. I p.* 480 ♂ (1836).	Pieris Albina.
SNELL. v. VOLL., *Mon. d. Piér. p.* 44 (1865).	„ „
STAUD., *Exot. Schm. p.* 30 *pl.* 17 (1884—88).	Tachyris „
SEMPER, *Schmett. d. Phil. I p.* 246 *pl.* 40 *fig.* 6—8 ♂ ♀ (1886—92).	Appias „
BINGHAM, *Fauna of Br. India p.* 210 (1907)	„ Paulina.

PIERIS ALBINA Bsd. is the ♂ of P. PAULINA Cram. The APPIAS ALBINA of BINGHAM (II p. 212), however, is not this species but PIERIS ROUXII Bsd.

W. J. A few times at Dèpok (95) and also in the Gedeh moutains.

C. J. In the province of Rembang.

E. J. Pouspa (630) and Tosari (1777) in the Tengger mountains, Banjouwangi.

The study of this butterfly, especially the comparison of its colour and pattern with those of the very closely related species PIERIS AMASENE Cram. is very important as to a just understanding of the phenomenon which I call the colour evolution. The upper-side of the ♀ of both species are very much alike, there is only a slight difference in the manner in which the black has extended itself. The ♂, on the contrary, differ clearly. But now the female so-called variety of P. PAULINA, figured on pl. I fig. 5*b*, shows agains clearly the same system of colouring as the ♂ of P. AMASENE. How is this to be explained? Only by means of the knowledge of the said phenomenon does this seem possible. Both closely related species follow the same direction in that evolution. The ♀ of both species have kept pace with each other in this respect and, therefore, are nearly alike but for a slight difference. But the evolution does not always keep pace in both sexes, and so the ♂ of P. PAULINA, which have already lost all the black, have evidently proceeded much further than the ♂ of P. AMASENE; so that the figuration of colour and markings of this sex differs in the two species. Not only with regard to species and sexes, however, does this evolution not continue equally, it does not happen either with respect to individuals of the same species and the same sex; so that also some individuals alter less than others. Such a one that has remained behind, is the said ♀ variety of P. PAULINA; this one is still in the same stage, which the other ♀ of this species have already left, and for this reason resembles the ♂ of P. AMASENE, which are all still in this less advanced stage in the same process of evolution.

The condition of extension of the black on the upper-side of the ♂ of

P. Amasene and in the said female variety of P. Paulina is intermediate between the more advanced stage in the colour-evolution, reached by the ♂ of P. Paulina, which have already lost the black entirely, and an earlier stage in which that black must have had a still much larger extension. So is, for instance, the black on the upper-side of the fore-wings of the European Pieris Brassicae L. nothing but a remnant of the black, which, in a less advanced stage of colour-evolution, had there a much larger extension; this is clearly indicated by the races of this butterfly, which still exist in Japan and in the Canaries and which, being still less changed, are intermediate between these two stages and, therefore, have still much more black than the European race, though already much less than must have been the case in a still less advanced stage.

Though at present the general colour is nearly always white already, Fruhstorfer has still caught some yellow ♀ in E. J., and also some, whose upper-side is already white, but whose under-side is still yellow. According to this entomologist yellow ♀ are common in Lombock. De Nicéville mentions white as well as yellow ♀ of Sumatra. Consequently in this respect the same process of colour-evolution can be observed, which draws still much more the attention in the following species P. Panda Godt. According to Neville Manders (*Trans. Ent. Soc. of London*, 1904) this species belongs to the migrating butterflies in Ceylon in the mountainous regions. This is, as far as I know, not the case in Java, where, indeed, the species is not numerous enough to attract attention to the matter.

8. Panda Godt.

Godart, *Enc. Méth. IX p.* 14 *N.* 102 (1819—23) . .	Pieris	Panda.
Boisduval, *Spéc. Gén. I p.* 485 (1836)	„	„
Hübner, *Zuträge fig.* 943, 944 (1837).	„	„
Felder, *Wien. Ent. Mon. VI p.* 285 (1862)	„	Nathalia.
Snell. v. voll. *Mon. d. Piér. p.* 32 *pl.* 4 *fig.* 4 ♀ (1865)	„	Sulphurea.
„ „ „ *p.* 44 (1865).	„	Panda.
Snellen, *Lep. of Centr. Sum. p.* 22 *pl.* 2 *fig.* 6—11 (1887)	„	„
Distant, *Rhop. Mal. p.* 317 (1882—86)	Saletara	„
„ „ „ „ *pl.* 26 *fig.* 1, 2	„	Nathalia.
Bingham, *Fauna of Br. India p.* 217 *fig.* 14, 15 (1907).	„	Chrysaea.

A butterfly which is caught in Java as an exception only outside the mountains proper, and then even not yet in the low alluvial districts, but which, according to Dr. Martin lives in Sumatra on the contrary in the low woody

districts, and which, according to Dr. Hagen, occurs there in the higher as well as in the lower regions. The phenomenon of colour-dimorphism shows off very strongly in this species, Moore mentions the same of Catophaga Neombo Bsd. of Ceylon, which is found there also in the mountains. It is a phenomenon of evolution in which the irregular progress of the process of paling, which in this case chiefly differs locally, is distinctly perceptible. In Malacca it seems to be most advanced already; according to Distant both sexes living there are white, forming thus the variety Nathalia Felder; of this species from the Philippines and from Sumatra on the contrary only the ♂ are white already, but the ♀ are yellow, at least as far as I know; from Nias, however, a yellow ♂ has been figured (*Tijdschrift voor Entomologie XXXVIII*), and another one from Engano is in the museum at Leyden. In the form from the Nicobars (Chrysaea Fruhst.), figured by Bingham (*Vol. II pl. XVII fig.* 114, 115) the ♂ is dark yellow, which colour even passes into orange on the upper-side of the hind-wings, and the ♀ dark yellow also, with broad black margins.

In Java distinctly perceptible transition forms are found; there yellow ♂ as well as white ones are found, of which the latter are still always yellowish, viz. have always still a few yellow scales. Among the ♀ there are some whose upper-side is entirely yellow or whose upper-side of the fore-wings only is white, while that of the hind-wings is still yellow. Moreover the yellow of the ♂ from Nias is considerably darker, approaching still more the orange colour than that of the ♂ from Java, whereas that of the specimen from Engano is an intermediate shade between these two. Only the theory of the colour-evolution gives an explanation of these different things, which is not contradictory to anything, and is therefore acceptable; the more so as it is founded on the principle of evolution.

W. J. Once I caught this species in the Botanic Gardens at Buitenzorg (265), but it is common in the Megamendoung- and Gedeh mountains (1400); I received it also from the districts on the south-coast in the vicinity of the Tjiletou or Sandbay.

C. J. In the province of Japara.

E. J. At Malang (445), from the Semarou mountains (800) and at Pouspa (630) in the Tengger mountains. Also from Banjouwangi.

The metamorphosis is still unknown.

9. Lyncida Cram. (Pl. I, fig. 6, *a*, *b*, *c*, *d*, *e*).

Cramer, *II p.* 52 *pl.* 131 *B* (1779) . . . . . Pap. Lyncida.
Boisduval, *Spéc. Gén. I p.* 482 (1836) . . . . . Pieris „

Boisduval, *Spéc. Gén. I p.* 481 (1836)	Pieris Eleonora.
Snell. v. Voll., *Mon. d. Piér. p.* 42 *N.* 55 (1865). . .	„ Hippo.
Snellen, *Tijds. v. Ent.* 33 *p.* 272 (1890)	„ Lyncida.
„ „ „ „ 34 „ 247 (1891)	„ „
Bingham, *Fauna of Br. India p. p.* 203 (1907)	Appias Hippo.

This butterfly, whose eyes during life are pale grey, is, I think, the same as the Appias Taprobana Moore of Ceylon. In this species also the process of the colour-evolution reveals itself as colour-dimorphism, but not, as in the former one, also in the same country. The ♀ have become white all over at the same time showing a strong increase of the black; but the ♂ have become white in some regions only, but have remained partly yellow elsewhere. In Java all the ♂ are white already, but there are also such, whose white shows still a strong yellow hue, certainly because a certain number of scales have preserved the yellow pigment. For little by little, and very irregularly, does every evolutional change advance.

W. J. Common in the forest of Pademangan in the lowest part of the surroundings of Batavia, but rare in the somewhat higher regions there (3—14). Further at Dèpok (95), Buitenzorg (265), in the localities adjacent to Pelabouan Ratou or Wijnkoopsbay (± 150) on the south-coast, and from mount Tjerimai in the province of Tjirebon.

C. J. Touban (2) on the north-coast, Bojonegoro (258) and from the province of Madioun (500); Semarang (4).

E. J. Malang (445), Kediri (64), in the Wilis mountains, and at Jember (98) in the province of Besouki.

At Buitenzorg the caterpillar feeds on *kapok outan* (Crataeva Magna d. c.); in Ceylon, according to Moore, it feeds on Crataeva Religiosa Forst.; in the Botanic Gardens at Buitenzorg I found it also on Roydsia Inaveolens Rub. It is of the Pieris type, head and back are greyish-green, with a gold-coloured dorsal stripe and sprinkled over with small black dots which, when magnified, proved to be sharp spines. The under-side and the sides are pale green, while an indistinct white line forms the edge between these two. The pupa is closely related to that of P. Nerissa F. On the thorax there is a transverse ridge which ends in a long, laterally flattened projection of the head. The middle of the back is broadened, which broader part ends on each side in such another, but shorter projection, beside which there are still two much shorter ones. The common colour is sometimes grey, but generally greyish-green sprinkled over with black dots; the upper edge of the transverse ridges or enlargements and of the processes, however, is brown, broken here

and there by yellow-whitish. Of two caterpillars in a rather dark chip-box, in which there was only a dried leaf, one changed into a pale grey pupa; but when afterwards a fresh dark green leaf was given to the other caterpillar, this one on the contrary changed into a pale green chrysalis.

From a chrysalis formed on the 21st or 22nd of May, the imago emerged on the 28th of May. My figures are better than those by MOORE; STOLL also gave figures of the larva and the pupa, the latter, however, is not beautiful and the former is totally irrecognizable.

10. NERO F. (Pl. I, fig. 7 *a*, *b*, *c*, II, fig. 1).

FABRICIUS, *Ent. Syst. III* 1 *p.* 153 *N.* 471 (1793)	Pap.	Nero.
DONOVAN, *Ins. of India pl.* 32 *fig.* 1 (1800)	„	„
BOISDUVAL, *Spéc. Gén. I p.* 485 (1836)	Pieris	„
SNELL. v. VOLL., *Mon. d. Piér. I p.* 47 (1865)	„	„
DISTANT, *Rhop. Mal. p.* 311 *pl.* 24 *fig.* 9, 10 (1882—86). .	Appias	„
BINGHAM, *Fauna of Br. India p.* 202 *pl.* 16 *fig.* 108 (1907) .	„	„

W. J. I never saw this species in the environs of Batavia, but it is common at Dèpok (95) and at Buitenzorg (265). I received it also from different parts of the province of Prajangan; among others from the vicinity of Pelabouan Ratou (Wijnkoopsbay) (150) on the south-coast.

C. J.?

E. J. Malang (445). FRUHSTORFER found his species much more common in East Java than in West Java, especially in the southern mountains.

This fast-flying butterfly, whose eyes during life are pale green, is common in woody regions principally and is closely related to the species of Celebes P. ZARINDA Bsd.; perhaps a closer examination of the sexual organs will prove that both are only races of the same species, as f. i. has already been proved of PAPILIO MEMNON L. of Java and P. ASCALAPHUS Bsd. of Celebes. In both the original red colour has been preserved in its oldest forms; whereas, for the rest, they show many differences in colour, according to the stage in the process of the colour-evolution in which the races, the sexes or the individual insects happen to be; in consequence of the ignorance about this phenomenon these differences have been considered, partly at least, to be separate species. Of both species there are ♂ which are blood-coloured on the upper-side, also some that are orange-coloured; others that are of a pale brick-red, and lastly such as are pale-yellow. Of the brick-red ones I have figured a specimen

captured in Java by FRUHSTORFER, but now in my collection, which bears a strong resemblance to the P. (APPIAS) NEBO from Upper Birmah, figured by GROSE SMITH *(Rhopalocera exotica III)*. The yellow ones are not known as living in Java; I saw, however, such a pale yellow ♂ of NERO from Perak in the collection of CH. OBERTHÜR, and another one from West Borneo in the Leyden museum. This French lepidopterologist, just mentioned, also presented me with a yellow ♂ of ZARINDA, which for this reason I figure here also. Dr. HAGEN mentions a very pale orange specimen from Sumatra, which colour may be a transition to this yellow; among the specimens from Borneo the under-side also is always almost yellow already. On the upper-side of the wings of the ♂ a beginning of the tendency to get darker by the increase of the black, is to be noticed in the particularly thick and black indication of the veins in the wings in some specimens, while even some—as Bingham also mentions of the British-Indian ones—show some irroration of black scales near the apex of the wing. But in the ♀ whose ground colour on the upper-side is also paler already than that of the ♂, the black shows itself in a much higher degree; not only by the extension along the margins and the appearance of the spot in the interspace between veins 2 and 3 on the fore-wings, already spoken of in the Introduction but especially very distinctly by the hooked stripe which so well characterizes the beginning of this increase, and about which I also spoke there, which stripe in this species, it is true, is not strongly hooked, but somewhat rounded, but which can, however, easily be recognized as the same. I also possess a ♀ on which this black has still much more increased, so that it resembles much some ♀ of the form ZARINDA Bsd, the more so, as also the red of the upper-side has already turned into orange. I also give here a figure of it (Pl. II, fig. 1), because I do not think it impossible that it was caught in Java, as I found the specimen in a box which contained only butterflies caught by me in Java. It is true, however, that this specimen bore no special label, so that it may after-all prove to be an error. In that case this specimen is probably from S. E. Borneo.

The under-side of the ♀ is always much paler than the upper-side, this is particularly the case in ♀ from Nias (RAMOSA Fruhst.) and from Palawan (PALAWANICA Stdgr.); in the ZARINDA ♀ from Celebes the colour-evolution has proceeded much further still. Some of those resemble the ♀ of NERO, but with a stronger increase of the black, and the orange having remained still very bright. In others on the contrary the black has already extended over the whole upper-side with the exception of some pale orange spots on the same places, in which there is still a bright orange in the first-mentioned ♀, and which therefore are undoubtedly remnants of it. When ♀ are still further advanced, this orange

becomes yellow; such a ♀ has been figured and described as a separate species, FATIME, by SNELLEN VAN VOLLENHOVEN in the *Tijdschrift voor Entomologie*, 1865. When still more advanced, this yellow becomes white; a ♀ which has for the greater part already reached this stage has been figured by Dr. STAUDINGER (*Exotische Schmetterlinge, pl.* 17). In this case the under-side is grey, sometimes of a paler, sometimes of a darker shade, and with black and white spots. In the specimens from the Philippine Islands, of which a separate species, DOMITIA Felder, has been made, the ♀ has changed in the same direction but still more as to the colour, so that its upper-side does not only show white spots, but for the greater part is not covered any more by the black and thus shows again the ground colour, which in the meantime has become paler, partly lemon-yellow, partly white. These so strongly deviating ♀ have first been taken for a separate species and have been called P. ZAMBOANGA Felder. TACHYRIS GALBA Wall, described from N. India, PIERIS ASTEROPE Felder, described from Luzon and APPIAS MINDANENSIS Butler also are but synonyma of the same species.

The metamorphosis seems still to be unknown.

11. PHILONOME Bsd. (Pl. I, fig. 8*a*, *b*.)

BOISDUVAL, *Spéc. Gén. I p.* 453 (1836). . . . . Pieris Philomone.
SNELL. v. VOLL., *Mon. d. Piér. p.* 21 (1865). . . . . „ „

This species and the next one are mountain butterflies, of which the former is confined to Java. They are classed among the genus PRIONERIS Wall.; against the admittance of this genus, however, as against that of the genus TACHYRIS, arises with Mr. SNELLEN the systematic difficulty that it is based on only one sex. In Java PHILONOME is exclusively common in the surroundings of Lawang (500) in E. J. in the province of Pasourouan and is only now and then found elsewhere. I possess one caught on mount Tjerimai (700) in the province of Tjirebon in W. J., and also one from Banjouwangi in E. J.

In the Leyden museum there is a specimen from mount Arjuno in the province of Pasourouan in E. J.

In the FRUHSTORFER collection I saw a very light-coloured ♀ whose black had also turned paler into brownish. In some specimens the black extends itself in pale black stripes across the discoidal cell, in others this is not the case. The early stages are not known.

12. Autothisbe Hb.

Hübner, *Samml. Exot. Schm.* (1806—27).	Delias	Autothisbe.
Boisduval, *Spéc. Gén. I p.* 452 (1836)	Pieris	„
Moore, *Cat. Lep. E.I.C. I pl.* 2a *fig.* 4 (1857). . . .	„	„
Snell. v. Voll., *Mon. d. Piér. p.* 20 *pl.* 3 *fig.* 5 (1865)	„	„
Staud., *Exot. Schm. p.* 35 *pl.* 20 (1884—88)	Prioneris	„

Of this butterfly, whose eyes during life are dark brown, the ♂ are common in W. J. in the Megamendoung, the Gedeh and the Wajang mountains at altitudes above 800 metres. I possess also a ♂ from mount Karang in the province of Bantam, caught there in the middle of the dry season. On the mountain pass of the Megamendoung (1482) they are always to be seen in great numbers, sitting on the wet sand. The ♀ on the contrary are rare; Distant and Dr. Martin mention the same thing concerning Prioneris Clemanthe Doubl. from Malacca and Sumatra, and the latter also concerning P. Hypsipyle Weymer from Sumatra, species which are also common in mountainous regions. Autothisbe is also found in the mountains of E. J., but seems to be less common there. Fruhstorfer differentiates the specimens of E. J. as a form Orientalis from those of W. J.; I must, however, doubt the soundness of this separation. Everything he gives as a characteristic of the E. J. form is found also among the W. J. ones.

The metamorphosis is still unknown; yet De Nicéville mentions Capparis Tenera Dalz as the foodplant of the related P. Sita Feld.

In series of ♂ the progress of the evolutional increase of the black on the under-side of the hind-wings is distinctly perceptible. The yellow there is sometimes very bright, but pales into white, and in that case is often covered more and more by black scales.

Partisans of the Mimicry theory maintain that the ♀ of this species mimics Thyca Crithoe Bsd. Both species are indeed common in the same mountain districts. But the profit which ought to be derived from this likeness is very little conformable to the fact that exactly this would be protected ♀ is rare, and the unprotected ♂, on the contrary, very common. An equal stage in the process of the colour-evolution, to which both species are subject, explains this likeness better. De Nicéville also maintains in the same way and for the same reason that the Sumatra species P. Hypsipyle Weymer in both sexes mimics those of Thyca Belisama Cram, Glauca Butl.

Genus THYCA Wllgr.

This genus is generally called DELIAS Hb. But Mr. SNELLEN is of opinion that the systematist need not count with the names given by HÜBNER, because the diagnoses of this author concerning these names are very incomplete and sometimes even incorrect, so that the animals cannot be recognized by them with certainty. The best rules are, indeed, of no use, when practised without intelligence; this is certainly also the case with the principle of systematical priority which has been admitted now for good reasons, and in the acknowledgment of such names as those given by HÜBNER, which are not sufficiently justified, Mr. SNELLEN thinks he sees such an application of this system. This opinion may certainly be defended. I, however, prefer to keep to the names once given which have a claim to being maintained by universal use.

The THYCAS are butterflies that live on trees. The caterpillars of the 4 Java species, whose life-histories I have observed, all feed on species of LORANTHUS; I noticed the same concerning those of T. ROSENBERGII Voll. in Celebes, while MOORE and DE NICÉVILLE mention it also concerning the larva of T. EUCHARIS Drury which lives in India and in Ceylon, and RAINBOW says the same concerning the three species of this genus which occur in Australia. WEALE (*Trans. Ent. Soc. of London*, 1878) mentions the same plant also as the foodplant of some species of PIERIS.

1. EGIALEA Cram. (Pl. II, fig. 2).

CRAMER, *II p.* 141 *pl.* 189 *D, E.* ♀ (1779)	Pap.	Egialea.
„ *III p.* 115 *pl.* 258 *D, E.* ♂ (1782).	„	„
BOISDUVAL, *Spéc. Gén. I p.* 450 (1836).	Pieris	„
SNELL. v. VOLL., *Mon. d. Piér. p.* 7 (1865)	„	„
STAUD., *Exot. Schm. p.* 34 *pl.* 20 (1884—86)	Delias	„

W. J. Common at Batavia (3—14), Buitenzorg (265), Sindanglaya (1082) and Soukapoura (70) in the province of Prajangan.

C. J. Touban on the north-coast.

E. J.?

The eyes of the butterfly during life, are of a pale bluish grey. With respect to the black on the upper-side of this species, the same thing may be said as has been mentioned concerning the colour of PIERIS JAVA. Without doubt this species only differs from several other suchlike forms occurring in other islands, in the stage of colour-evolution which they have reached. I do

not, however, possess enough material to be able to investigate this sufficiently.

The caterpillars live sociably close to each other on the leaves of the plant which is called at Batavia *pasilan* and *mengadou* or *kemadouan* (LORANTHUS PENTANDRUS L.), of which they eat by preference the not yet full-grown leaves. They have the PIERIS form, are of a dark reddish-brown colour with transverse golden lines. On the sides the spiracles are on these lines. Two long subdorsal golden hairs protrude from these lines on the back of each segment and on each side also such another hair protrudes, forming all together lengthwise four rows of such hairs. Head, anal segment and spiracles black. The figure, added here by me, has succeeded very well. These caterpillars are much tormented by small larvae of Braconidae, which surround them, as is also the case with the caterpillars of P. BRASSICAE L., with their pale-yellow cocoons without, however, enveloping them entirely.

The pupae are of the same colour as the caterpillars, but darker and have also the common PIERIS type, with a white spot in the middle and a few more white spots or dots. They are fastened very close together on a leaf; once I counted 9 on the same leaf which was not very large. They are not, however, as RAINBOW mentions concerning the Australian species T. HARPALYA Don., fastened to a web which the larvae spin across the leaves of their foodplant, for the caterpillars of the Java species have not got this custom. Sometimes the larvae and pupae of this species are found on the same leaf with those of T. BELISAMA Cram. I believe I may conclude from my notes that the imagines emerged from the chrysalis on the 10th day.

2. CRITHOE Bsd. (Pl. II, fig. 3, *a*, *b*).

BOISDUVAL, *Spéc. Gén. I p.* 450 (1836).	Pieris Crithoe.
SNELL. v. VOLL., *Mon. d. Piér. p.* 7 (1865)	„ „
WALLACE, *Trans. Ent. Soc. of Lond. Ser.* 3 *vol.* 4 *p.* 346 (1867).	Thyca „
FRUHSTORFER, *Ent. Nachr.* 14 *p.* 335 (1893).	Delias Bromo.
DE NICÉVILLE, *Journ. Asiat. Soc. of Bengal* 63 *p.* 44 *pl.* 5 *fig.* 7 (1894)	„ Dymas.

W. J. Mountain butterfly which flies rather high on flowers growing on trees. It is not found in regions situated lower than Buitenzorg (265), but it is common in the Salak, Megamendoung, Gedeh and Wajang mountains between 1000 and 1600 metres and perhaps still higher. I also received specimens from mount Tjerimai (700) in the province of Tjirebon.

C. J. ?

E. J. In the Tengger, Semarou and Arjouno mountains the form BROMO Fruhst. occurs in which the mixture of white and yellow on the upper-side of the hind-wings is still much more yellowish, but which is principally characterized by the amount of red on the upper-side near the basis of the hind-wings, whereas this red in the W. J. form is almost entirely replaced by black. This is a phenomenon of colour-evolution, as is clearly proved from the circumstance that also in the specimens from W. J., when magnified, several red scales become visible in that place, and which are thus probably relics of the red which was there formerly, as it is now still in the form BROMO. The form CRITHOE has in this respect advanced further than BROMO in the colour-evolution, a circumstance to which also refers the fact, already mentioned, that the yellow whitish on the upper-side of the hind-wings in the form CRITHOE may still be called yellow in BROMO. This may be a result of some local influence, but also more likely only of the circumstance that the separation, caused by the lower country between, has turned these butterflies of the eastern and of the western mountains into two separate races, in each of which the evolutional development continued its course independently.

A similar difference of race between butterflies of the same mountains shows itself also in PAPILIO ARJUNO Horsf.

The early stages of this species are still unknown, I once found a chrysalis on a shrub, on which there were also many LORANTHUS leaves, which had been already gnawed, and from this pupa there emerged a specimen of this species. But according to the description I then made, this pupa differs so strongly from other THYCA pupae that, fearing a mistake, I do not wish to publish that description yet.

3. BELSIAMA Cram. (Pl. II, fig. 4, *a*, *b*, *c*, *d*, *e*, *f*, *g*).

CRAMER, *III p.* 114 *pl.* 258 *A—D* (1782).	Pap.	Belisama.
HORSFIELD, *Cat. Lep. E. I. C.* 1 *pl.* 4 *fig.* 10*a—e* (1857).	Pieris	„
BOISDUVAL, *Spéc. Gén. I p.* 464 (1836)	„	„
SNELL. v. VOLL., *Mon. d. Piér. p.* 16 (1865) . , . . .	„	„
SMITH-KIRBY, *Rhop. Exot. pl.* 19 (*Delias I*) *fig.* 1—4 (1889).	Delias	Nakula.
STAUD., *Iris IV p.* 78 (1891)	„	Belisama.

In the year 1863 and from 1864—1869 when I resided at Batavia (3—14) and studied the butterflies, I never found this species there. Yet it catches the eye by its size and its very striking coloration, the more so as it flies, not very fast and at moderate heights, on the trees, and, moreover, I had

often seen it at Buitenzorg where it was then also very common. So I think we may admit that it was then still confined to the mountainous regions. Dr. HAGEN and Dr. MARTIN mention this species from Sumatra also only from the more elevated regions. After having spent then some years out of Java, I came in 1878 and 1879 in E. J. and did not find the butterfly there either at Kediri (64) or at Berbek (13), but I did in the Wilis mountains. Therefore I was very much astonished to find it in 1879 in C. J. as well at Touban on the north-coast, as at Semarang (4) and at Jogjokarta (113), and when I came again to Batavia in the same year, it occurred there also and has since remained common. In 1894 I also found the butterfly in E. J. in the low country. Evidently this species spread itself between the years 1869 and 1879 in W. J. from the higher region to the lower ones, and probably the same has happened in other parts of Java.

W. J. Batavia (3—14), Tjampea (160), Buitenzorg (265) and the mountains of the province of Prajangan up to 2000 metres, also on mount Karang in the province of Bantam, in the middle of the dry season.

C. J. Semarang (4), Touban (2) on the north coast, Jogjokarta (113), Magelang (-500) and mount Tjerimai (700) in the province of Tjirebon.

E. J. Jember (98) in the province of Besouki, in the Wilis, Semarou (725) and Tengger mountains (630 and 1777), at Malang (443) and on mount Arjouno.

The eyes of this species, during life, are pale grey, somewhat greenish. It flies in the mountains already against half-past six in the morning, so much earlier than other Pieridae and also when there is no sunshine. The butterflies differ rather in size, but above all in coloration. The fact that the process of the colour-evolution advances very unequally among the individual insects causes here also all kinds of varieties, which cannot be explained without the knowledge of this phenomenon. In the journal SOCIETAS ENTOMOLOGICA, *Vol. XX*, *pag.* 113—114. FRUHSTORFER enumerates the following forms:

BELISAMA BELISAMA Cram.

BELISAMA NAKULA Smith (1889) = VESTALINA Stdgr.

BELISAMA NAKULA forma ERUBESCENS Stdgr.

BELISAMA forma ALPINA, AURANTIA Doherty 1891 = BELISAR Stdgr. 1891.

BELISAMA GLAUCA Butl. (Sumatra).

This division however cannot be maintained as the enumerated forms really do not represent races or so-called local varieties; geographically separated is only the form of Sumatra, which differs but little from the Java one, and really only in this, that sometimes the shade of the white on the upper-side of the ♂ is more or less bluish—the reason why BUTLER called this form GLAUCA—and that often the apical stripes on the under-side of the fore-wings are wanting,

at least are never so strongly developed as in the Java specimens, showing thus only a somewhat stronger development of the black at that spot, a phenomenon which appears also in the Java butterflies on other parts of the wings. The specimens of this species from Bali, which are also separated geographically from those of Java, do not differ from these at all. All the forms of Java often occur beside each other in the same districts. It is only a matter of individual differences caused by a more or less advanced stage in the colour-evolution, and which are sometimes found in some region or other in larger numbers than in another, but always mixed and pairing with each other. [1]) There is no reason whatever for accepting some local influence in this; yet it seemed to me that the rather numerous, very small specimens were principally found in the mountains, especially in the Tengger mountains in E. J., where, beside these, occur, however, also those of a normal size.

The species is limited to Java, Sumatra and Bali, but only from Java are the above mentioned considerable differences in coloration known. Very nearly related are specially T. DESCOMBESI Bsd., which occurs on the continent of India as well as in Malacca, but also in Lombock, Soumbawa and Flores, and besides T. ZEBUDA Hew. from North Celebes and T. EUMOLPE Grose Smith from Borneo. The original colour was probably red, which colour at present only survives in an oval vermilion streak near the costa on the underside of the hind-wings. In many other species of THYCA such relics of colour are also found; strongest of all in T. ARUNA Bsd., a butterfly, which has on its wings relics of all the different colours, appearing in the process of the colour-evolution and which shows at the same time a strong development of the black. The upper-side of the ♂ is nearly the same as that of the oldest preserved ♂ form of T. BELISAMA, which has been discerned as BELISAR or AURANTIA. In the other species just mentioned, which are closely related to T. BELISAMA, one sees exactly the same vermilion relic spot as in this one; we may, therefore, suppose that the development of all those out of the same original form did not take place until the red had already disappeared as the general colour, and that for this reason this spot had remained as a relic on that part of the wing, and such in the peculiar form which answered the causes unknown to us, which prevent just in that place the normal contination of the process of colour-evolution from red into orange or yellow. Such a thing may take place on different parts of the wings where, in this way, persistent spots of the former general colour may be preserved a long time. On certain parts

[1]) So at Aden YERBURY found the typical DANAIS CHRYSIPPUS L. and the form DORIPPUS Klug., both such evolutional forms of the same butterfly as are meant here, *in coitu*.

of the wings this often occursion the upper-side, and still oftener on the under-side of the fore-wings, near the apex for instance, as well as on the under-side of the hind-wings near the basis. But also in other places such relics of colour may sometimes be found.

As to the colour-evolution in T. BELISAMA, it follows in each sex an independent course. Though it may happen that, in this respect, in both sexes the same thing occurs—this course being of the same nature in both—it is inaccurate to consider such specimens as the two sexes of a certain form; they are only specimens of a different sex which have reached a nearly equal evolutionary stage. Female butterflies of the above-mentioned male evolutional form BELISAR occur indeed just as little as male ones of the old form CATILLA of CALLIDRYAS POMONA F. which will be treated of later on. What have been taken as such in the above mentioned erroneous idea, are but ♀ which still belong to the least advanced and for this reason most coloured ones, but which may not be separated from the ordinary form BELISAMA BELISAMA; in this case there is by no means such a great difference of colour as to have caused some ♂ to get a different name.

The matter is exactly the same as the one which shows itself also in the form CATILLA just mentioned, with this difference, however, that in these the older stage of colour-evolution has remained in the female sex and as to BELISAR in the male sex.

Thus among the ♂ the oldest stage of coloration still existing, is that one in which the upper-side is still quite orange with black margins, and which for this reason has been distinguished as BELISAR or AURANTIA. In the Leyden museum there is, it is true, a ♂ whose colour is still much darker, namely rusty *(ferruginous)*. So this specimen may represent a still older stage of colour; but it is the only one known to me, and not only is the district where it was caught in Java unknown, but it is an old specimen and not at all in a fresh condition; yet for the present I am not convinced that it has been subjected to a change of coloration by some chemical influence. For indeed, it is not only the upper-side that has the colour I have already mentioned, but also the under-side of the hind-wings is much more reddish than the darkest orange-yellow which is seen in other specimens. But now I possess a specimen that was collected in Java by FRUHSTORFER only a few years ago, the upper-side of which is white with a little yellow, but the colour of the under-side of the hind-wings of which corresponds with the reddish orange mentioned by STAUDINGER of his form ERUBESCENS and, evidently forms a transition from the orange that occurs in the more common specimens on the same under-side, to that which occurs there in the above-mentioned specimen in the

Leyden museum, from which it differs little and apparently only evolutionally. Now it is, however, but little probable that such an influence should have attacked the under-side only. I have had this Leyden specimen figured, (Pl. II, fig. 4*c*) as well as another small specimen, (Pl. II, fig. 4*d*) also a ♂ from the same museum, also old and not known where it has been found, the upper-side of which still shows a particularly dark orange, darker than is the case in the form BELISAR, and in my opinion corresponding with the dirty orange which, according to STAUDINGER, characterizes the upper-side of his form ERUBESCENS. In the collection of Dr. MARTIN at Diessen am Ammersee I also found a ♀, whose colour on the upper-side was very dark yellow and on the under-side approached closely the form ERUBESCENS. But this specimen also, acquired from the SOMMER collection, was very old. Yet, if anybody were to admit that the said alteration has been caused by some chemical influence which had affected these specimens in their dried state, he would have to do so also with respect to the above-mentioned specimens STAUDINGER and FRUHSTORFER, though the latter at least is certainly not old and well preserved, which renders the inworking of such an influence but little likely. Then the form ERUBESCENS should be suppressed. It is with the view to promote the solution of this question that I publish the figures of the two doubtful colour-forms of the Leyden museum.

For the rest the orange on the upper-side of the ♂ has already turned into white, but among these there are sometimes found some in which the evolution has not yet proceeded so far and whose upper-side therefore, especially of the hind-wings, is not yet quite white, but as a transition more of less lemon-coloured. (Pl. II fig. 4 f.) The under-side of the wings of these ♂ does not really differ from that of the above mentioned old form BELISAR, except that the under-side of the fore-wings is not strongly irrorated with yellow as is the case in the aforesaid form; gradually, however, the orange of the hind-wings and of three short, but rather broad streaks near the apex of the fore-wings is bleaching, so as to become at last a pale yellow on the hind-wings and even white in the three above-mentioned streaks. This stage of colour-evolution is connected by many transitions with the former—the BELISAMA BELISAMA of FRUHSTORFER (Pl. II, fig. 4*e*)—but is differentiated from this one in the most advanced specimens as the form NAKULA Smith or VESTALINA Stdgr. So the specimen figured by GROSE SMITH as the ♂ of the form NAKULA, in which the under-side of the hind-wings is already yellow, but the streaks near the apex of the fore-wings are not yet white, belongs to the transitions just-mentioned. STAUDINGER mentions the form VESTALINA from Magelang in C. J. and I found it indeed very common at Jogjokarta, situated not far from that locality; but also in E. J. this form

is not rare. From Batavia I possess only one such specimen but in the Leyden museum there are many, caught at Tjimahi in W. J. (Prajangan). For the rest I found in W. J. only the above-mentioned transitions. This same way of getting paler appears also strongly in the already mentioned related species T. DESCOMBESI Bsd.

As to the ♀ the upper-side has no white as in the ♂ but yellow and the black on it has extended a good deal, so as to occupy a great part of the fore-wings. This black there is in a stage of evolutional accretion, so that in the specimens which, in this respect, are most advanced, there remains of the yellow only a small part near the basis of the wing. The yellow on the contrary is in the stage of evolutional paling; in the specimens which represent still the oldest stage of colour, and which for this reason have been taken for ♀ of BELISAR and have been figured by GROSE SMITH as ♀ of the form NAKULA, some orange is still found but it is turning paler into yellow, further into yellow whitish and at last into white. All these transitions exist. From Bali also I saw in the MARTIN collection just mentioned, ♀ whose yellow on both sides was very dark. In the afore mentioned specimens which have advanced furthest in the process of colour-evolution, the under-side has consequently turned paler (Pl. II, fig. 4*g*) in the same manner as in the ♀ of the form NAKULA-VESTALINA. In all BELISAMA's, except in those in which the said process has proceeded very far, one sees on the fore-wings at the extremity of the discoidal cell, a yellow or white double spot, visible sometimes on both sides, generally, however, only on the under-side, and occasionally very distinctly, but sometimes also hardly perceptible. In reality this spot is nothing but one of the above mentioned persistent spots where, by influences still unknown to us, the colour-evolution has been temporarily prevented, and where therefore in this case the accretion of the black cannot take place, but where the old colour still remains, though gradually growing paler into white also and in the meantime becoming entirely surrounded by the black. Later on only does this opposition seem to cease, and then the black covers also those spots. So in the oldest form of the ♀—the one in which they have been taken for those of BELISAR—this spot is, of course, most strongly developed; it is however, incorrect to see in this a characteristic of race or species, as STAUDINGER does.

The caterpillar feeds on leaves of the same plant, on which also the larva of T. EGIALEA Cram. lives, and perhaps also on those of other kinds of LORANTHUS; that it lives also on DIOSCOREA, as HORSFIELD mentions, must be a mistake. I found the larva and the pupa sometimes with those of T. EGIALEA Cram. and of T. HYPARETE L. on the same leaf. The caterpillar is pale green with a black head, black spiracles and fore-legs and with long yellow or white

hairs implanted in the same manner as in the first mentioned of these butterflies, while along the sides also bundles of short hairs project.

The chrysalis has sometimes the same dark reddish-brown colour as that of T. EGIALEA Cram., but is much bigger; sometimes, however, it is dark yellow, but with thorax and wing-cases still darker. It has a nail-like head process at the extremity of the thorax and six crooked spines or hooks along the back of the abdomen; on the sides also, under the wings there are still three such hooks, two of which are much smaller. All the projections are black. The pupae are, just as those of the above-mentioned species, fastened close to each other on the upper-side of a LORANTHUSleaf, or also on a leaf of a plant on which the LORANTHUS grows as a parasite.

A caterpillar pupated on the 14th of February gave a butterfly on the 24th. It happened that from 14 of my pupae 6 ♀ emerged on the 6th of April and 8 ♂ on the next day. Another breeder told me that he had made the same observation with a still greater number of pupae. The chrysalides and caterpillars remain unharmed on the same leaf among dying larvae of F. EGIALEA Cram. which are enveloped by cocoons of Braconides. The figure of the caterpillar given by HORSFIELD and MOORE is not to be recognized, the one of the chrysalis only tolerably well. The figures added here by me, have succeeded very well.

4. DORYLEA Feld. (Pl. II, fig. 5 *a*, *b*).

FELDER, *Novara Lep. p.* 182 (1867) . . . . . Pieris Dorylaea.
SNELL. v. VOLL., *Mon. d. Piér. p.* 38 (1865) . . . . „ Gabia, var.
VON MITIS, *Iris VI p.* 109; *p.* 144 *pl.* 3 *fig.* 2 ♀ (1893). Delias Dorylaea.

I possess this species only from the mountains of W. J.; it is not very common there. Gedeh mountains (1700) and Sindanglaya (1074). Early stages unknown.

According to SNELLEN (*Tijdschrift voor Ent. XXXVIII, p.* 27) this butterfly belongs to the same species as T. GABIA Bsd. FRUHSTORFER (*Entom. Nachr.* 1893, *s.* 333) indicated the Java specimens as ALTIVAGA, but according to SNELLEN they do not differ from the typical form GABIA from New Guinea.

5. HYPARETE. (Pl. II, fig. 6).

LINN, *Mus. Lud. Ulr. p.* 247 (1764) . . . . . Pap. Hyparete.
SULZER, *Abgek. Ges. d. Ins. p.* 143 *pl.* 15 *fig.* 8 (1776). . „ „
CRAMER, *II p.* 138 *pl.* 187 *C, D.* (1779). . . . . „ Antonoe.

Boisduval, *Spéc. Gén. I p.* 455 (1836)	Pieris	Hyparete.
Snell. v. Voll., *Mon. d. Piér. p.* 9 (1865)	„	„
Piepers, *Tijds. v. Ent.* 19 *p.* 154 (1875)	Cathaemia	„
Distant, *Rhop. Mal. p.* 292 *pl.* 24 *fig.* 13, 14 (188·—86)	Delias	„
Semper, *Schm. d. Phil. I p.* 231 *pl.* 36; *pl. B. fig.* 8 (1886—92).	„	„

One of the most common butterflies in Java, chiefly in the lower districts; I found it even on the little coral island of Edam at about an hour's distance to the north of Batavia.

W. J. Batavia (2—14), Dèpok (95), Buitenzorg (265), and also in the Salak and Gedeh mountains (± 1500).

C. J. Touban (2) on the north coast, in the provinces of Tegal and Kediri (± 500) and at Jogjokarta (113).

E. J. Sourabaya situated in the low country near the sea, Berbek (13), Kediri (64), as well as in Madura.

The eyes, during life, are pale bluish grey. In consequence of the irregularity of the evolutional process, there exists colour-dimorphism between the sexes, namely in that period in which the covering by the black is again decreasing, which decrease has much further advanced in the ♂ than in the ♀. I possess, however, some ♀ from Java, on whose upper-side the black has already more or less been replaced by white, though not yet so much as in the ♂, and whose colour for this reason forms a transition to that of the ♂. In general on the upper-side of the one ♀ there is much more black than is the case with the other; which is also the case with the black near the apex on the upper-side of the ♂. So the more advanced stage of the ♂ of this species in the process of the colour-evolution is also indicated by the circumstance that, as a rule, there has remained more yellow on the under-side of the ♀, though sometimes this yellow has also already partly changed into white, and that also the white streaks near the apex on the upper-side of the fore-wings of the ♂ are still more yellowish in the ♀. This is especially the case in the few specimens that I possess from E. J. and from Madura, in which also the shade of the upper-side is, in general, a little yellowish; but also in a ♀ from Bandoung in W. J. I found the same thing, and the ♀ figured by Cramer also shows those yellow streaks in a specimen, which is said to have been caught at Semarang in C. J.. Snellen v. Vollenhoven mentions a ♀ from Java, whose under-side was the same as that of the ♂. The red spots on the black terminal margin of the under-side of the hind-wings in some specimens are also considerably smaller than with others, owing to a larger extension of the black.

Between the specimens caught in the wet and in the dry season no difference is to be observed.

It is a quarrelsome animal, the ♂ at least; I once saw such a butterfly chase away a big XYLOCAPA from a flower and pursue it in its flight and attack it several times. Once I was also in the opportunity to observe the copulation. When the ♂ had been flying for some time around the ♀ which sat on a leaf with closed wings, this latter one flew up and sat down again in the same position on another leaf. Then the ♂ sat down beside the ♀, also with closed wings after which both sideways stretched forth to each other the tip of the abdomen and thus the copulation came about. Then the butterflies flew up united and sat down again on a leaf at some distance.

The caterpillar is gold-coloured or more or less dark orange, from each segment project on the back two long white or yellow subdorsal hairs, and on the sides there is a small bundle of the same short hairs. Head, anal segment and prolegs black. It is much attacked by Tachiinae. It feeds on the leaves of the already mentioned plant LORANTHUS PENTANDRUS L. and is for this reason also often found on all sorts of plants, on which the LORANTHUS lives as a parasite, which has led to the erroneous belief that it eats those leaves; the pupae also are sometimes found fastened against the under-side of such leaves. The young caterpillars are pale yellow with a black head and gnaw the surface only of a LORANTHUS leaf, beginning at the point and ending at the stem, while their excrements remain lying on the part which has been gnawed already. First they are pressed close together, but as soon as the leaf is broad enough, they march in line, the black heads showing in this way as a black streak.

The chrysalides have the PIERIS form and are more or less bright yellow with black dots, especially on the numerous appendages and at the extremity; most times there is also a black streak on the wing-cases. In consequence of the great difference in the quantity of the black on the pupae in which the separate spots seem to turn little by little into a general black colour, we may suppose that here also it is a question of colour-evolution in which a suchlike increase of the black pigment is a normal phenomenon. The evidently constant direction which reveals itself in this, and the great difference between the minimum and the maximum in that accretion, do not permit us to consider this a matter of variation only. One may compare what is going to be said about the caterpillars of CALLIDRYAS POMONA F.

The head of the chrysalis ends in a nail-like projection. On it are still to be seen a subdorsal row of short spines; the foremost pair of these which are also the smallest, are just on the edge between thorax and abdomen.

Dorsal spines are found on the three segments, preceding the anal segment.

A chrysalis of the 14th of April gave the butterfly on the 22nd of that month; with others this happened after 9 days. The figure of the caterpillar has succeeded very well.

6. Peribaea Godt. (Pl. II, fig. 7 *a*, *b*).

Godart, *Enc. Méth. IX p.* 154 *N.* 124 (1819—23).	Pieris	Peribaea.	
Boisduval, *Spéc. Gén. I p.* 453 (1836) . . .	„	„	
Snell. v. Voll., *Mon. d. Piér. p.* 8 (1865) . .	„	„	
Rothschild, *Iris V p.* 441 *pl.* 5 *fig.* 2 (1892) .	„	„	var. Wallacei.

W. J. During the many years I lived there I never found this butterfly. Not until later, in 1894, did I receive a specimen from the eastern part of the province of Prajangan, where it is said to have since become very common, especially near Bandoung. Dr. Martin f. i. found this species there very frequently in January 1906. Proofs that it has been found in more westerly districts of Java, were not known to me at that time. In January 1908, I received, as already stated, a collection of about 5000 Rhopalocera, all caught at Batavia and in its neighbourhood, and among these 34 specimens of this species. And in the collection also referred to caught there in the dry season, were many butterflies of this species too. Therefore I suppose that only during the latter years has this species begun to spread from the eastern to the western part of the island. Snellen van Vollenhoven also knows it only from Sourabaya. Between the specimens caught in the wet and in the dry season no difference is observable.

C. J. Semarang (4), Jogjokarta (113), Bojonegoro (258) and in the province of Tegal.

E. J. Common in the low country at Sourabaya, at Kediri (64) and in Madura. Found also at Malang (445).

The species shows the same colour-dimorphism in both sexes as the preceeding one. On the under-side of the hind-wings the black has disappeared still more than in the latter one. Both species are closely related, but in each of them the said evolution has followed another course. In the Leyden museum I also found a specimen from Allor, in which only the red on the under-side of the hind-wings had extended a little more than in the specimens from Java. The form from Soumba, described by Rothschild as Fasciata, differs more from it, especially on the under-side; this also is only a matter of a different stage in the said evolutionary process. In a ♀ from Bali in the

MARTIN collection, above-mentioned, the black on both sides has a strong extension.

The eyes during life, are pale-grey. Once I saw this butterfly attack a big BOMBUS and pursue it from flower to flower.

The caterpillar resembles that of the preceding species; the few specimens I saw, were not orange, however, but yellow. It lives also on LORANTHUS PENTANDRUS L., and is, for this reason also found on all kinds of plants on which this parasite grows. The pupa resembles also that of the preceding species. From a chrysalis, formed on the 21st of May, an imago emerged on the 29th; from one formed on the 24th of January this happened on the 2nd of February.

7. MOMEA Bsd. (Pl. II, fig. 1 *a*, *b*.)

BOISDUVAL, *Spéc. Gén. I p.* 477 (1836)	Pieris Momea.
SNELL. v. VOLL., *Mon. d. Piér. p.* 31 (1865)	„ „
HONRATH, *Berl. Ent. Zeitschr.* 36 *p.* 434 *pl.* 15 *fig.* 4, 4*a* (1892)	„ Fruhstorferi.
ROGENHOFER, *Verh. Zool-Bot. Ges.* 1892 *p.* 572. . . .	Delias Hageni.
VON MITIS, *Iris VI p.* 113; *p.* 151, *pl.* 3 *fig.* 5 (1893) .	„ Hageni.
DE NICÉVILLE, *Journ. Bombay Soc. of Nat. Hist.* 8 *p.* 17 *pl. L. fig.* 8 (1893)	„ Datamas.
SNELLEN, *Tijdschr. v. Ent. XXXVIII p.* 28 (1895) . .	Thyca Hageni.

Mountain butterfly, as Dr. HAGEN also mentions, from Sumatra.

W. J. In the mountains in the province of Prajangan (1500—1600), but not very common.

C. J.?

E. J. In the Tengger and Semarou mountains. In those regions, however, in the form FRUHSTORFERI Honrath, which differs distinctly from the type in W. J. by much more white. Between the stages in the colour-evolution of these two types stands the Sumatra form DATAMES De Nic., which still shows a greater amount of yellow and for this reason is still nearer the original red.

According to SNELLEN (*Tijdschrift voor Ent. XXXVIII p.* 29), the forms HAGENI Rogenh. from Sumatra and NYSSA F. from Australia belong to the same species.

Genus IPHIAS Bsd. (Pl. III, fig. 2, *a*, *b*, *c*, *d*, *e*, *f*.)

Usually this genus is indicated by the name HEBOMOIA given to it by HÜBNER. This name is indeed the oldest (1816). But Mr. SNELLEN does not want to accept it because of the reason mentioned above concerning the genus THYCA. In my opinion, however, the more practical profit of not changing names which are used universally, is of more importance.

1. GLAUCIPPE L.

LINN., *Syst. Nat. Ed. X p.* 469 (1758)	Pap.	Glaucippe.
DRURY, *Ill. Exot. Ent. I pl.* 10 *fig.* 3 (1773)	„	„
CRAMER, *II p.* 104 *pl.* 164 *A—C* (1779).	„	„
HORSFIELD, *Cat. Lep. E. I. C. p.* 130 *pl.* 4 *fig.* 7, 7*a* (1828)	Colias	„
BOISDUVAL, *Spéc. Gén. I p.* 596 (1836)	Iphias	„
SNELL. v. VOLL., *Mon. d. Piér. p.* 52 (1865)	„	„
DISTANT, *Rhop. Mal. p.* 318 *pl.* 26 *fig.* 9 (1882—86). .	Hebomoia	„
BINGHAM, *Fauna of Brit. India p.* 274 (1907)	„	„

This pretty butterfly, whose eyes during life are pale grey, has a high, strong flight and likes to fly on the flowers of trees and shrubs, but often sits down also on wet sand. It occurs in the higher as well as in the lower regions, but is in Java more common in the lower districts, whereas in Sumatra, according to HAGEN, the contrary seems to be the case.

W. J. Batavia (3—14), Buitenzorg (265), the Gedeh and Wayang mountains (1500). I received also a pair from Batavia, caught there in the middle of the dry season, the ♀ of which very fresh; differences between these and those caught there in the wet season, did not present themselves.

C. J. Ambarawa (1500), Bojonegoro (258) and in the province of Tegal.

E. J. Berbek (13), Kediri (64), Klakah (230) and also in Madura.

The genus to which this butterfly belongs, is confined to the Indo-Australian fauna, in which it occurs from Ceylon to the Moluccas in many varieties of colour, each variety representing a different stage reached in the colour-evolution.

In how far local separation has already caused different species to arise there, can only be proved from the examination of their sexual organs; for this reason FRUHSTORFER thinks he may accept two species to which all these local varieties should belong. See his essay published in the „*Deutsche Entomologische Zeitschrift Iris* (*XX s.* 89). Much may probably be learned in this respect from the knowledge of the earlier stages, but so far they are known only of one form.

The progress of the said evolutional process may be studied extremely well in this genus. From the general red original colour there remains only one relict near the apex on the upper-side of the fore-wings; in the ♀ this red is attacked by a strong development of the black, while, in the meantime, it has paled into white in some species without its being proved that here also yellow has been the colour of a transition stage, so that in this respect, there may perhaps have been an somewhat accelerated evolution. In this way it has happened with regard to the ♀ which occur in Morty island, belonging to the northern Moluccas, in the Talaut islands, in Borneo (I. BORNEENSIS Wall.) and in Bouru (I. LEUCOGYNIA Wall.). Transitions which clearly prove this progress, are sometimes found. I here give (pl. III fig. *f*) a figure of a ♀ from the Kangean islands, east of Madura, that belongs to the PAGENSTECHER collection, which shows only a remnant of the said red; I also saw such specimens from Celebes and Tonkin, in Lombock also it is said that some are found. From Soumba I saw in the CH. OBERTHÜR collection a ♀ in which this red had turned into pale orange, and another ♀, in which even of this orange only some indistinct traces were visible. In the closely allied Genus of Pieridae CALLOSUNE Doubl. also, the same spot is to be seen, too, turning paler into all kinds of shades, from blood-red to pale yellow; and in the well-known EUCHLOE (ANTOCHARIS) CARDAMINES L. this spot has turned into orange in the ♂, but has already been entirely replaced by white in the ♀, which has proceeded further in this respect as is also the case in the ♀ of the IPHIAS species or races already mentioned.

For the rest the colour on the upper-side has been turning paler into yellow, which yellow has again turned into a paler shade and at last changed into white, in which colour sometimes more, sometimes fewer traces of the yellow have remained. In the form ROEPSTORFFI Stdgr. there is still a good deal of this yellow, in the GLAUCIPPES from the Philippines, from Flores and from Soumba the remnant of the yellow seems to have been piled up, as has also happened with the red, to the apex of the forewing, forming there a streak on the edge between the red which has remained there and the white which has become the general colour; in the form GLAUCIPPE from Java this streak is also still visible, but has already become rather indistinct. All this shows an extremely clear example of the gradual, as well as varying, progress of the said evolution; it may be that here and there local circumstances have exercised some influence, but it would certainly be incorrect to try to find mainly in these the cause of those varieties; in the same region different forms sometimes occur, whereas specimens from different islands, on the contrary, sometimes differ very little or not at all.

The under-side of this butterfly, in so far as it is not covered while in

rest, shows a peculiar system of colouring, varying between a darker and a lighter shade, which evidently points back to quite a different course of colour-evolution to that at work on the upper-side. The same system of colouring also, however, appears on the under-side in the case of other Rhopalocera and must presumably be ascribed to the secondary inworking of external influences referred to on page V of the Introduction. The under-side of a specimen from Flores is very pale; so it is also the case in some other forms of IPHIAS.

The caterpillar lives on the same kind of CAPPARIS, on which also that of P. JAVA L. Sparrm is found, and perhaps also on *randu* (ERIODENDRON ANFRACTUOSUM Dc.); DE NICÉVILLE mentions different kinds of CAPPARIS and also CRATAEVA RELIGIOSA Forst. It is pale green or greyish blue, shagreen-like, which proves, when magnified, to be caused by sharp little spines entirely covering the back and the sides; for the rest it is spotted with black dots. The under-side is yellow. On the edge between under-side and sides there is a white line, composed of a number of sharp eminences that form the notched edge of the back. The white of this line is yellowish or reddish, and on it two small bumps protrude on each side, a blue one on the second thoracic segment, and a red one on the third. A caterpillar which was said to be found on *randu* (ERIODENDRON ANFRACTUOSUM Dc.) was a little bigger and o a brighter colour; the white line on the side was mixed with orange, and the bumps were for the greater part dark violet, on the top part a little more red and still above this, white; those bumps were moreover shiny. The second and the third pair of fore-legs proceed from thick folds in the skin, by the circumference of which that part of the caterpillar gets much broader and the front part gets a triangular shape, which, seen from above, imitates the head of a snake, in which the two red and blue protruding bumps on the sides of the thorax remind us of eyes. (Pl. III fig. 2 *b*, *c*). This minicry is intensified by the habit of the caterpillar of clinging to a small branch with the middle- and the hind part of the body only and stretching forth the forepart, just as a snake lifts this part of its body. Once I saw the effect of this on a native boy, who was looking for caterpillars for me. When he was about to take hold of the branch to show me the caterpillar, which he thought he had seen on it, he suddenly drew back his hand when the caterpillar took the above-mentioned position, now thinking it was a snake. This was a strong example of mimicry; to him, however, who does not judge about it under the suggestion of ideas of scientific fashion, but with the calmness of the really scientific naturalist, this is no proof that this likeness is of a great advantage to the animal and has developed itself in consequence. In the first place it is not at all certain that the impression made by it on men, is the same as on the

animals which prey upon caterpillars, as birds, lizards or small mammals, not even to mention insects of prey. And, moreover, man perceives his error as soon as he examines the animal accurately and closely, or with a magnifying-glass; the former is also done by those animals as the sharp sight of the birds answers also pretty well to the latter.

A calm examination, indeed, which does not proceed from preconceived ideas about mimicry, but which follows from the observation of facts, leads here also to another view. When we compare the caterpillar mentioned here with other caterpillars which also show a strong so-called snake-mimicry, viz. with several larvae of Sphingidae, we see that with these the mimicry is caused because the caterpillar, when frightened, draws in its head and its two foremost segments into the two next ones. Now these two—the 3rd thoracic and the 1st abdominal segment—are in these species much thicker than the other body-rings; moreover, they have in each side a large eye-like spot, so that the caterpillar in drawing in the forepart of the body looks blunt and very thick, and by the apparent eye on both sides, like the head of a snake. This drawing in of the head to protect it, as other larvae do also, is thus the principal factor in this phenomenon, as has been rightly observed also by POULTON and by MELDOLA. We can readily admit now that the getting thicker of the two above-mentioned segments will simply be the result of it, viz. a formation which serves to advance this drawing in and the protection aimed at by it; perhaps caused by a special development of the muscles which serve this purpose. With this getting thicker of these rings, the ocellated spot may also have got larger; the same spot is still found also, but less developed, on the sides of the other segments that have not become thicker. In this way this seemingly mimetic formation may have originated without any selective doing or mimetic meaning or design. Now the body of the caterpillar of I. GLAUCIPPE L. there where the two last thoracic segments are, is much thicker than elsewhere, which causes the same effect, while the apparent eyes are formed by two bumps on each side, which are nothing but such eminences as those composing the lines on each side, but which in consequence of the getting thicker in that place are also more developed than in other places. So it is very probable that a similar origin may just as well be attributed to the so-called mimicry in this species, as to that of the above-mentioned larvae of Sphingidae, in which the thickering owing to a more or less different cause has taken place also in a somewhat other way.

The chrysalis has no projections, but is very much bent; in this respect it closely resembles the pupae of the genus TERIAS. It is of a dirty yellow or green colour; a few days before the emerging of the imago, its red spots

are already visible through its skin. (Pl. II, fig. 2*e*). From a chrysalis formed on the 28th of February the imago emerged on the 10th of March.

The figure of this caterpillar given by HORSFIELD and MOORE is bad; that of the pupa is a little better but indistinct; in his Lepidoptera of Ceylon MOORE also figures the caterpillar indistinctly, but the pupa a little better. My figures have succeeded much better.

Genus THESTIAS Dsd.

1. VENILIA Godt. (Pl. III, fig. 3 *a*, *b*.)

CRAMER, *II pl.* 157 *C, D.* (1779)	Pap. Aenippe (nec. L.).
GODART, *Enc. Méth. IX p.* 121 (1819—23) . . .	Pieris Venilia.
BOISDUVAL, *Spéc. Gén. I p.* 594 (1836).	Thestias „ .
SNELL. v. VOLL., *Mon. d. Piér. p.* 51 (1865). . .	„ „ .
SNELLEN, *Tijdschr. v. Ent. XXVII p.* 210 *pl.* 11 *fig.* 3 (1883—84)	„ „ , var..

W. J. Very common in some very low-lying regions near the sea in the neighbourhood of Batavia, there where the ground is sandy. So for instance near Tanjong Priok. But in the districts there of a somewhat higher altitude (3—14) I never found a butterfly of this species, neither in other parts of W. J.; once only a specimen from the province of Prajangan was sent to me.

C. J. Common near Touban on Java's north-coast, and at Bojonegro (258). Near the last mentioned place I also caught two specimens of the form ALBA Sn. which have been figured in the XXVII volume of the *Tijdschrift voor Entomologie* pl. 11, fig. 3; and which show that in this species also the yellow is changing into white.

E. J. Gedangan near Sidhoarjo (5), common naer Kediri (64), in the Tengger mountains (700); also received from mount Arjouno.

The butterfly, whose eyes during life are yellowish green, flies not far from the ground. Its early stages are still unknown.

2. BALICE Bsd. (Pl. III, fig. 4.)

BOISDUVAL, *Spéc. Gén. I p.* 593 (1836)	Thestias Balice.
FRUHSTORFER, *Berl. Ent. Zeitschr.* 39 *p.* 246 *pl.* 18 *fig.* 9 ♀ (1894)	„ „ .

This species is rare. I only possess specimens from the mountains along the south-coast of E. J. and I also saw one which had been caught in the

south of the province of Prajangan in W. J. The Leyden museum possesses a specimen from Ambarawa (500) in the mountains of C. J. FRUHSTORFER caught the butterfly on the plateau of Pengalengan (—1700) in the province of Prajangan in W. J. and is also in possession of a specimen from the surroundings of Lawang (500) in E. J. The early stages are unknown.

Genus CALLIDRYAS Bsd.

Strong butterflies which like to sit down on wet sand. In Java the caterpillars seem to live by preference on different species of CASSIA, the same food-plant is mentioned from Ceylon by MOORE; SCUDDER mentions it also of the North-American C. EUBULE L., STOLL of the South-American C. MARCELLINA Cram. = C. EUBULE L., MATHEW of the Indian species.

1. CHRYSEIS Drury.

DRURY, *III. Exot. Ent.* 1 *pl.* 12 *fig.* 3, 4 (1773) .	Pap. Chryseis.
CRAMER, *I p.* 89, *pl.* 58 *A. C.* (1779)	„ Alcyone.
BOISDUVAL, *Spéc. Gén. I p.* 611 (1836)	Call. Pyranthe. (nec. L.).
HORSFIELD-MOORE, *Cat. Lep. E. I. C. I. p.* 56 *pl.* 1 *fig.* 8, 8*a.* (1857)	„ „ .
SNELL. v. VOLL., *Mon. d. Piér. p.* 59 (1865) . . .	„ „ .
DISTANT, *Rhop. Mal. p.* 300. *pl.* 25 *fig.* 1, 2; *pl.* 26 *fig.* 20 (1882—86)	Catopsilia Chryseis.

W. J. I found this species myself at Bidara Tjina (28) near Batavia, at Dèpok (95) and at Buitenzorg (265). But in 1908 I received a large collection of Rhopalocera, all caught in the lowest quarters of Batavia and among these also many specimens of this species. I also received some from the localities adjacent to Pelabouan Ratou (Wijnkoopsbay).

It then made the impression on me that in these latter years this species has become much more common than formerly.

C. J. Bojonegoro (258).

E. J. Jember (98).

According to Dr. MARTIN this species occurs in Sumatra in the lower districts only. Though not rare, it is in Java not at all so common as Dr. HAGEN and MOORE state it to be in Sumatra and Ceylon. According to MOORE in Ceylon these butterflies are said even to appear every year in great

flights as if migrating, which is confirmed by NEVILLE MANDERS, especially about the coast districts. (*Trans. Ent. Soc. of London* 1904). In Java this is not the case, neither does RAINBOW mention this about Australia, though he says that there also the butterfly is a rather common species. They fly low near the ground and like to sit down on wet sand.

In this species the black on the upper-side of the fore-wings of the ♀ is so much more strongly developed than on those of the ♂ that the sexes can easily be recognized by it; it is, however, no secundary sexual characteristic, but only a phenomenon of colour-evolution.

In August I once found 4 caterpillars which—just as their pupae—resemble so much those of C. SCYLLA L. that I took them for these, but which gave both sexes of this species. Dr. HAGEN also has observed this resemblance; Dr. MARTIN on the contrary maintains that the head of the pupa is not pointed as in C. SCYLLA L. and C. POMONA F., but blunt-rounded. These caterpillars feed on *ketèpèng* (CASSIA ALATA L.). The same food plant is mentioned from Sumatra by Dr. MARTIN, as also from China. (*Trans. Ent. Soc. of London* 1905). According to BINGHAM in British India the food plant may be CASSIA OCCIDENTALIS L.

2. SCYLLA L. (Pl. III fig. 5 *a*, *b*).

LINN, *Mus. Lud. Ulr. p.* 242 (1764)	Pap. Scylla.
CRAMER, *I p.* 17 *pl.* 12 *C. D.* (1779)	„ „ .
HORSFIELD, *Cat. Lep. E. I. C. p.* 133 *pl.* 4 *fig.* 6, 6*a* (1828) .	Colias Scylla.
BOISDUVAL, *Spéc. Gén. I p.* 631 (1836)	Callidryas Scylla.
SNELL. v. VOLL., *Mon. d. Piér. p.* 62 (1865)	„ „ .
DISTANT, *Rhop. Mal. p.* 299, *pl.* 24 *fig.* 1, 2. (1882—86).	Catopsilia Scylla.
STAUD, *Exot. Schm. p.* 39, *pl.* 21 (1884—88)	„ „ .
BINGHAM, *Fauna of Br. India p.* 224 (1907)	„ „ .

W. J. Batavia (3—14), Buitenzorg (265), and in the Salak, Megamendoung, Gedeh and Waiang mountains (1500).

C. J. Near Magelang (+ 500) and in the province of Tegal.

E. J. Banioupoutih in the district of Loumajang (45), Jember (98) and Kediri (64).

These localities where I caught this butterfly, are the only ones I have made a note of; in reality it is common all over Java, as well in the low country as in the mountains. During life its eyes are yellowish green. While the process of the colour-evolution reveals itself in C. POMONA F. in a very

large number of different forms, it proceeds much slower in this species; only on the upper-side of the fore-wings of some ♀ from Celebes the basal area is shaded with much black, reminding us of the quantity of black which occurs on the upper-side of many ♀ of C. POMONA F. from the same island, though in ♀ of other regions this is not the case. In Java the process in this species only reveals itself in the paler or darker shade of the yellow, especially on the under-side, and in the number and size of the brown spots there, which are distinctly relics. Among the ♂ these spots are generally insignificant; at least never so strongly developed as in some ♀; there are also ♀, however, in which they are almost entirely wanting. Their nature is of exactly the same character as in TERIAS HECABE L. and they have also the same colour. In specimens, in which they are strongly developed, they sometimes form a figure in the shape of an 8 at the outward extremity of the discoidal cell on the under-side of both wings, (Pl. III fig. 5*b*); evidently the same figure as is common in several species of COLIAS and which will be treated of when speaking of C. POMONA F. We then also sometimes see, however, the same figure, but somewhat smaller or paler, as a black pattern at the same place on the upper-side of the fore-wings (Pl. III fig. 5*a*); something which seems to me not unimportant from a biological point of view. It is indeed evident that we are placed here before the same fact, observed among many butterflies, that sometimes the colour and pattern on one side of a wing repeats itself, though paler, on the other side. Though this fact, however, as far as I know, has only been observed as a repetition of colour and pattern from the upper-side to the under-side, the contrary takes place here.

Indeed the circumstance that this repetition on the upper-side often does not occur at all, and if it does, only in a less developed form than on the under-side, clearly shows that, if here, at least, it is a matter of repetition, it must take place from the lower to the upper-side in the case in question. The reason of this phenomenon is not yet known; and as far as I know, at least, it has not yet been seriously studied. My observation, just mentioned, may perhaps contribute a little to its being done. We might consider the supposition that that peculiar arrangement of the pigment on the under-side is connected with the particularly strong development of the veins on the wings in that place, and then we might further suppose that the same cause will also lead to the same result on the upper-side in respect to the pigment there. But for a general explanation of the phenomenon, this supposition will not do. It seems more admissible to suppose here some correlative influence; among caterpillars also some repetitions of colour and pattern occur, which, undoubtedly, must be of a correlative nature and in which the repetition is always a little more feeble

than the original. When treating of the caterpillars of the Papilionidae I intend to speak about an example of it. The matter still needs explanation. But the above-mentioned fact also again clearly shows that these arrangements of the pigment are led by an evolutional process and that therefore the colours and patterns on the wings of the butterflies are governed by physiological rules and are only exceptionally dependent on external influences.

Between butterflies of this species from different islands there is a somewhat greater difference than between those from Java only where also the ♂ of the dry and of the wet season do not differ either; so the under-side of specimens from Flores still shows distinctly the same reddish yellow which is peculiar also to some ♀ of C. POMONA F. in Java. Evidently the colours and shades of this species prove that it is subject to the same process of colour-evolution as C. POMONA F., though perhaps in some races *epistasy* is taking place.

The caterpillar as whose food plant HORSFIELD and MOORE mention CASSIA FISTULA L. and C. OBTUSIFOLIA L. and Dr. MARTIN C. SOPHERA L. from Sumatra, was found by me on *jouar* (C. FLORIDA Vahl), *kasingsat* (C. OCCIDENTALIS L.), *ketèpeng* (C. ALATA L.) and once on *jambou idjou* (JAMBOSA spec.). It has the common PIERIS form, dark-green, the head also, with a pale yellowish line on the sides, which is sometimes partly, sometimes entirely bright yellow or reddish. Parallel to this line above it there is a row of black dots, sometimes larger, sometimes smaller in number, and sometimes even in great numbers along the whole length of the line. In this last case the foremost of these dots are sometimes steel-blue with a metallic hue. The back looks like shagreen, when magnified this is seen to be caused by small black spines, which cover it entirely. The under-side is pale greenish yellow or bluish grey. The thoracic legs of this caterpillar also have got thicker, but not so thick, however, as those of I. GLAUCIPPE L. The pupa also has the PIERIS form, without eminences, but strongly bent; its colour is pale green with a bright yellow line along the sides. From a chrysalis, pupated on the 2nd, the imago emerged on the 9th of September.

HORSFIELD and MOORE gave as figure of the larva a bad one of I. GLAUCIPPE L. Their figure of the pupa is better.

3. POMONA F. (Pl. III, fig. 6, *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*, *k*. Pl. IV, fig. 1, *a*, *b*, *c*, *d*, *e*, *f*.)

FABR., *Syst. Ent. p.* 479 *N.* 158 (1775) . . . . . Pap. Pomona.
CRAMER, *I p.* 87 *pl.* 55 *C*, *D.* (1779) . . . . . „ Crocale.

CRAMER, *II p.* 138 *pl.* 187 *E, F.* (1779)	Pap.	Jugurtha.
„ *III p.* 63 *pl.* 229 *D, E.* (1782)	„	Catilla.
„ *IV p.* 95 *pl.* 339 *A, B.* (1782)	„	Hilaria.
BOISDUVAL, *Spéc. Gén. I p.* 625 (1836)	Callidryas	Crocale.
„ „ „ „ „ 627 (1836)	„	Alcmeone.
SNELL. v. VOLL. *Mon. d. Piér. p.* 60 (1865)	Catopsilia	Hilaria.
„ „ „ „ „ „ „ 61 (1865)	„	Alcmeone.
DISTANT, *Rhop. Mal. p.* 296 *pl.* 25 *fig.* 11, 12. (1882—86)	„	Crocale.
„ „ „ „ 297 „ 25 „ 15, 16. (1882—86)	„	Catilla.
STAUD., *Exot. Schm. p.* 39 *pl.* 22 (1884—88)	„	Pomona.
BINGHAM, *Fauna of Br. India p.* 219 (1907)	„	Crocale.

It is not necessary to mention the places where I caught this butterfly for it is equally common in all parts of Java; and so it is in many regions of the Indo-Australian territory. It is even doubtful whether any forms that occur in Africa and America, really differ from it specifically. It is this species which forms in Java the great flights of apparently travelling butterflies, which are so often seen there; according to Dr. MARTIN this is also the case in Sumatra. Repeatedly have I been able to observe these so-called migrations, which may often be seen on sunny days, principally in November and December, but also in the following months of the rainy season, especially when the preceeding dry season has been particularly dry. In two essays I have published the results of these observations and the considerations to which I came by comparing these with numerous other ones, made elsewhere, especially in Europe. Both have appeared in the French language in the *Natuurkundig Tijdschrift voor Nederlandsch Indië.* The first entitled: *Observations sur des vols de Lépidoptères aux Indes Orientales Néerlandaises et considérations sur la nature probable de ce phénomène,* in the 50th volume (1890), and the second, entitled: *Nouvelles observations sur les vols des Lépidoptères* in the 57th volume (1897). Without hesitation I dare say that these two essays contain the most complete study about this subject that exists. It seems to me that I. W. TUTT has not assigned the required value to them in his work: "*The Migration and Dispersal of Insects*", published in 1902. The author evidently knows only the former of these essays and has taken the liberty to borrow from it several facts without mentioning the source; he does not know the second, however, and neither f. i. the interesting essay: "*Insektenreisen*" by Prof. KARL SAJO, published in the "*Illustrierte Wochenschrift für Entomologie*" of the year 1897, though his work pretends to be complete. His work has but a compilatory value; the insignificance of his XIXth Chapter alone, entitled: "*Final Considerations*" already shows us clearly

how little he was able to work out the material biologically. Evidently he is not favourably inclined towards me, perhaps because I do not wish to accept the numerous exaggerations and the false observations made by all kinds of persons, who were not in the least accustomed to observe with that accuracy and prudence which are necessary for biological observations, but which are notwithstanding placed by him, without any critical intellect, simply on the same level, and valued as scientifically proved facts. He reproaches me with judging from *preconceived notions;* the only one I have, however, is, that I think much expert criticism is necessary in judging of such observations; but this he does not seem able to understand. He himself, on the contrary, is entirely governed by the preconceived notion that the above mentioned phenomenon consists of real migrations of butterflies, a notion, evidently founded on the Darwinian *idée fixe* that some useful purpose always occasions every biological phenomenon, and that Nature endeavours to attain this end. The facts, also those gathered by himself, do in no respect prove the correctness of this notion. For it is not to be doubted that this flying in such an abnormally strong manner as that which is spoken about here, in special circumstances—among which a certain constant direction of the wind or also a strong gust of wind undoubtedly act a principal part—sometimes causes such a migration as well of a few individual insects as of many, and casually even of whole swarms; and that from it also sometimes the dispersal of a species may follow; but the superficial spectator alone will draw the conclusion that this result has been the purpose of that action. Nothing about this, however, has been proved, but there are on the contrary several facts which indisputably show that sometimes at least such purpose cannot possibly have been the cause of this swarming. TUTT himself informs us that very big swarms of HIBERNIA DEFOLARIA L. have repeatedly been observed in Heligoland, which swarms, however, exclusively consisted of ♂, which could not be otherwise, as the ♀ of this species have no wings. Though in this respect the author also speaks of "migrations", it is evident that in this case no migration and no dispersal of the species can take place. Yet this species occurs from England and Heligoland to Japan and Vancouver's Island. But to such facts, though he mentions them himself, he does not pay attention. Neither does he understand the value of the common observation made in Ceylon, which he mentions also and which can also be applied to other places, that, whence coming no one knows, whither going no one can tell. Something to which we undoubtedly ought to pay some attention, the more so as it is made in a region, as in Ceylon, where the phenomenon is very often observed and has drawn the attention of many people.

While he adds, as is said, nothing of any significance beside his compilation,

to explain this phenomenon, I cannot say, it is true, that I have quite explained the cause of it, but my researches have cleared the way for it more than any hitherto, and have in this respect made our knowledge advance a good deal. They not only prove sufficiently that the above-mentioned far-spread notion about migration, either from want of food for the butterflies themselves, or with the purpose to bring the eggs where there will be enough food for the larvae, or perhaps for reasons of generation, is not seriously supported by facts, but also that probably no real migrations take place at all. Probably all butterflies of species which are capable of it, fly at certain times in a special direction in consequence of some influences not yet known to us, a fact which, though often happening in some seasons at least, only then draws the attention, when such a species is at the same time very abundant, and for this reason many such butterflies are continually seen, all flying in the same direction. In Java I have several times seen individual butterflies of the above-mentioned species fly in this peculiar and uncommon manner, which I know so well, and I think I may connect herewith an observation, made by R. TRIMEN who maintains that it is a general property of the Pieridae to fly straight on and with power, often all in the same direction, every now and then sitting down on flowers, but not visiting all the flowers of the same plant one after the other, as other butterflies generally do. To put this down as a general rule does not agree, however, with my researches, but, therefore, I do not think it improbable that this notion is founded on observations made in cases when evidently meteorological influence caused the butterflies to fly in this peculiar manner, there being at the same time only so few insects, that TRIMEN did not recognize the so-called migration. In the same manner we might perhaps also explain the fact which in any other way is rather incomprehensible, that the CATOPSILIA CHRYSEIS Drury, already mentioned, is seen in Ceylon to migrate every year in large numbers, whereas this never happens with the same species in Java, although the same phenomenon is very common there also in respect to CATOPSILIA POMONA F. For the first mentioned species is very common in Ceylon, whereas in Java it is not exactly rare, but not at all numerous.

Nor in Australia either does this species seem to appear in great flights, but though it is a rather common species there, according to RAINBOW, it has not been proved that it is sometimes very numerous there. So in Australia great flights of PIERIS JAVA SPARRM L. may be seen, but this is never the case in Java, where this butterfly is not at all rare. Probably these species could not multiply strongly in every region. Not every year do the great flights of C. POMONA F. show themselves in Java and according to my observations it is probably when it does happen, it is due to the circumstance that

for some reason or other, in consequence of the temperature f. i., the enemies of this species which threaten its larval life only occur in small numbers and for this reason have not limited its multiplication.

Now if this is observed on the same day, or on succeeding days, in different places, it may easily give rise to the opinion that these butterflies make long journeys, the more so, as sometimes a strong wind, which comes up suddenly, can drive together butterflies flying in this manner, and carry them far away, even across the sea. TUTT also reproaches me with having pretended that migrating butterflies cannot fly against the wind; I meant a strong wind. From my own notes it is apparent that they fly in the direction of the wind as well as against it, but only if it be not too strong. They do not fly on those days, just as little as on rainy days; though at Batavia I saw their swarms daily in November and December 1883, I did not notice anything on such days. Against a strong wind no butterfly can make way, I have often observed this, and if such a gust of wind attacks them from behind or at the side when a lot of them are just flying about, it blows them together in thick swarms and carries them far away, even across the sea, where they generally perish, if they do not chance to be carried in this way to some other country. On the English and on the Dutch coasts this has often been observed. In the same way individual butterflies are often carried away by the wind to ships which are at a good distance from the land. And the proof that this happens against their will is found in the circumstance which has been stated more than once, that such butterflies arrive quite exhausted and often all sit down at once on the shore or on the dunes to take a rest, as well as the fact that such swarms as have come across the sea, not only consist of one kind of insects, but of butterflies, dragon-flies, flies, SPHEX wasps together, insects which are not in the habit of flying together and which have therefore evidently got mixed up together by the wind.

What influence it is, that brings this about, is not yet known; considering it in connection with other observations about butterflies, whether they fly more or less or at certain times, I think it probable that this influence is of a meteorological character, and that, therefore, further researches on this subject will particularly have to take account with the state of the barometer before, during and after this phenomenon.

This opinion which I have developed in detail in the latter of my two above-mentioned essays, has since been supported by the essay of Prof. KARL SAJO, already mentioned, in which he also points out the signifiance of meteorological influences; but especially by a remark of GÄTKE who, in consequence of his observations about the migration of birds and insects made in Heligoland,

is said to have positively mentioned that such influences act a principal part in it. This I only got to know from TUTT's book, who takes it from *Ent. Mo. Mag. XIX p.* 169, and who evidently also only mentions it in compilation, as, for the rest, he is silent about it, obviously under the influence of his "preconceived notions", and not seeing the value of it. The intensity of this influence varies greatly at different times. Sometimes I observed the swarming for months together on every sunny day on which the wind was not very strong, however, from 8 o'clock in the morning till 4 o'clock in the afternoon— the ordinary time for them to fly. The butterflies, without pausing, flew straight on, over all the obstacles which were not too high, for instance over bungalows, and only avoiding dense places, as woods without open paths; bred butterflies which had just emerged from the chrysalides, flew, as soon as their wings permitted them to do so, also at once in the same direction as the swarm. But at other times the phenomenon only took place during some hours of the day, and then it was in no way so intense, so that many butterflies were seen moving away for sexual reasons or sitting down for some time on flowers and after this flying on again in the general direction. Some species of butterflies are also much more sensible to that influence than others; in this respect C. POMONA F. beats the record in the Indian archipelago, just as PYRAMEIS CARDUI L. in Europe; the bright, striking colour of the former, connected with the large number in which it often occurs during the rainy season, make the phenomenon very conspicuous.

TUTT's work on this subject is of little value and the same is the case with what Prof. P. BACHMETJEW has since stated in his compilation, *Experimentelle Studien von physikalisch-chemischen Standpunt aus, II* 1907, very curiously showing that this savant is also acquainted only with the former of my above-mentioned essays. But on the contrary very recently, when this work was already in print, there appeared on this subject a highly important essay by Dr. HARRY FEDERLEY, entitled: *Einige Libelluliden wanderungen über die Zoologische Station bei Tvärminne*, which was published at Helsingfors in 1908 in the *Acta societatis pro Fauna et Flora Fennica*, 31 *no.* 7, and in which the author agrees in many respects with my views about this matter.

Many kinds of superstition are connected with this phenomenon everywhere. Generally the appearance of such a large number of butterflies is considered to be the precursor of an epidemy. In Europe also there exists much superstition about all kinds of uncommon phenomena.

In Sumatra some one heard people call these butterflies *hadjis*, viz. Mohammedan pilgrims, and indeed these also travel, enveloped in white clothes,

in large numbers all in the same direction. So the natives of Ceylon believe that those butterflies, like they themselves are in the habit of doing, are on a pilgrimage to a foot-print of Buddha on Adams Peak in that island. In December 1883 many natives of Java took them for the souls of the more than thirty thousand people who in August of that year had perished by the eruption of the volcano Krakatau, and for this reason they called them Krakatau-ghosts. In the province of Prajangan, near mount Bohong in the district of Tjimahi the opinion then prevailed that in a cave in that mountain the king of the butterflies lived, a butterfly of the size of a peacock, and that this king, fearing the rice-crop was going to fail, had called all his subordined functionaries together to give him information about it, for which reason all those butterflies were now flying towards that mountain. Really a conception which answers entirely to the social life of the Javanese.

The eyes of this species during life are pale green or bluish grey, their upper-half mixed with light brown. It shows one of the most remarkable phenomena of that colour-polymorphism, which results from the process which I call colour-evolution, and which has caused those different forms to be taken for separate species (ALCMEONE Cram., CROCALE Cram., CATILLA Cram., ILEA F.), or some of them to be distinguished as forms of the dry season and of the rainy reason (DIXEY in *Trans of the Ent. Soc. of London* 1903, and LONGSTAFF in the same periodical 1905). In the latter the same unscientifical superficiality unmistakably prevails which also acts such a principal part in the fancies concerning mimicry, warning colours etc. The fact that all CATILLA's Cram. are exclusively ♀ shows already at once that this contention cannot be correct and of course it is not founded on observation and research; yet without hesitation it is cited as a scientific fact.

Only KIRBY in his: *A synonymic Catalogue of diurnal Lepidoptera, London* 1871, and DE NICÉVILLE whose opinion regarding this is surely followed by BINGHAM, have correctly perceived that it is only a question of different forms of the same species; in this respect he controverts the opinion of Dr. MARTIN who on account of evidently incomplete observations wants to accept two species. For I can not agree with the observation of this entomologist that in the swarms of this butterfly already mentioned, the ♀ form CATILLA never occurs; I have always found CATILLA's among them, only 7 %, it is true, but this old form which is gradually becoming extinct, is always much less numerous than the younger forms. The same result followed from breeding the same caterpillars. Moreover CATILLA is by no means only found in the wood, as Dr. MARTIN opines, and the difference in the colour of the

antennae is of no more significance than the difference of the colour on the wings in which the red is also disappearing, it being replaced by white, or partly first by black. Therefore the antennae in the old form CATILLA are still red, whereas in the more recent forms they turn into black, while between these forms, as DE NICÉVILLE has correctly seen, there occur transitional forms. On account of the great number of specimens which I have been able to obtain in Java, particularly during the so called migrations of this butterfly, and which I could also study by breeding, the whole natural history of this species has grown so thoroughly familiar to me, that, in this regard, I cannot have any more misgivings. For this reason I add here figures of the principal colour-forms in which it occurs in Java; by way of comparison I also add some from other regions of the Indian archipelago. From this we shall be able to see how the same forms occur in different islands; with differences between the individual insects according to their being more or less advanced in the process of colour-evolution, and connected with each other by all kinds of transitions. In Java I found nearly all the forms, but it must not be forgotten that from that island a much larger material was at my disposal than from the other islands and from the continent of India. Only the ♀ specimens, on which the black has increased most strongly do not occur in Java; in Celebes and Salaiara, where very dark ♀ specimens occur, some are, however, also found that have not got darker and that, therefore, resemble those of Java and many other islands, which clearly shows that there cannot be any question of local influences. And neither in size, nor in the shape of the wings, is there any difference between those dark specimens and the others.

According to the rule of the process, called colour-evolution, this species originally must have been red, which colour subsequently through different shades of red, orange and yellow paled into white, while in the meantime sometimes a strong increase of the black and after this again a decrease of this colour, took place. Everything, however, very unequal in its progress, according to the different regions, the sexes and also individually, nay, even appearing unequally on special parts of the wings. A number of such different forms of colour has even until now been preserved in this species; very important for the study of the process of colour-evolution. Red butterflies—still existing among other Pieridae, (P. NERO F.) that yet descend from the same original form, — do not exist any more in this species, neither are such important relics found of the red colour as f. i. still occur in I. GLAUCIPPE L., even the evolutionary stage in which the red has turned into a strong yellow, still occurs only in a small number of specimens. In these, however, often something of the red has also been preserved, especially on the under-side of the hind-wings, where, as it was

pointed out on page V of the Introduction and further on page 11, the process of colour-evolution often takes place more slowly than on the upper-side, with the result that more relicts of the original colour can remain.

That red is there then mixed with black which has also been developed there and shows itself as a spot, the size of which is not always the same; where this remnant is still very large, so many red scales have often been preserved, that the spot is still distinctly reddish. In advanced evolution we see in some individuals the red disappear entirely and then of that spot there only remains an indistinct black remnant; in many specimens the red turns into a yellowish brown and then the spot grows gradually smaller. Sometimes there are several suchlike spots, but much smaller, on the under-side; and we do now and then see besides the rather big reddish brown spot of the hind-wings, still another rather big one on the fore-wings. In the said large spot a peculiar figure is often formed at the outward extremity of the discoidal cell, generally consisting of two joined rings in the shape of an 8 and with a pearly centre; on the under-side of the fore-wings this also takes place; here, however, the figure consists of one ring only and has no metallic hue. Evidently it is nothing but the figure already mentioned when speaking of C. Scylla L., the development of which may easily be traced in this species as a transformation of the spots of pigment in that place into one or two united rings, a formation which the pigment has a great tendency to adopt, especially where it surrounds callous spots or other accumulations of pigment, and which causes the ocellar markings or eye-spots which are so common on many butterflies. When the evolution proceeds this figure gets smaller and at last nothing remains of it but a small round spot at the same place in each wing, which spot sometimes as a last relic, retains the red colour; showing hereby that, according to the rule in the process of colour-evolution the black pigment is gradually disappearing again, so that only a few scales of the original relic have been preserved, which have still retained the original colour. Often, however, this remnant is still blackish or of a distinctly reddish brown, viz. black mixed with red.

Both, the said figure, as well as those red relics, also exist in many other Pieridae; among the European species the former is f. i. present in Colias Hyale L., the latter in Gonopteryx Rhamni L. But what the significance of those relics there is, generally remains a mystery to entomologists; not until we study the many forms of C. Pomona F., knowing the phenomenon of colour-evolution, can we understand their phylogenesis and thereby their nature. Such a study clearly shows that the occurrence of particular patterns of colour or accumulations of pigment on the wings is by no means dependent on chance and is not caused by exterior influences either, but that it is the utterance of

a certain process of development, and that this utterance, though the progress of this process remains the same, complies in all kinds of manner with the circumstances and in this way causes that great variety, which is the characteristic of every evolution. It is the same dissimilarity, which may be observed here in the process of the colour-evolution, which has been indicated above concerning the atrophy of the so-called horn peculiar to the larvae of the Sphingidae.

When in the exhumations in Egypt pottery is found ornamented in different manners, people not acquainted with archaeological matters will only consider it as objects made with more or less care and ability, but the expert will know, according to the age of the layers in which those pieces are found, to deduce from them the whole development of the art of pottery. By comparison of such objects from different layers for instance, it will become clear to him how the ornamentation with imitations of plants has really only been a development sprung from an older system of ornamentation with crossed lines, and that this latter has arisen again as an imitation of the plaited baskets which were used before the art of pottery had been invented, and which served as a model for the first productions of this art. In the same way does the study of colour-evolution show the origin of the present ornamentation on the wings of butterflies, but the lepidopterologists of our days as a rule understand just as little of it as the ignorant people above-mentioned concerning archaeological matters. To them all these colour-patterns are only the fantastic result of some climatical or other unknown influence.

For a long time more red may still be recognized in the yellow of the under-side than in the colour of the upper-side. Gradually, however, all the yellow turns into white, first on some parts of the wings and afterwards on their whole surface, while at the same time the black spreads over it, which fact is very strong in some countries. Here also the evolution proceeds very irregularly in different regions. In many ♀ from Celebes and from the isle of Salaiara the black on the upper-side has increased so much, that it covers a great part of, or sometimes entirely, the ground colour which is now bright yellow and then white. But there occur also yellow ♀, on which the black has not spread itself more than on those of Java. Some ♀ of Java, the ground-colour of which has also become white already, but in which the black has also increased, show along the costa of the fore-wings on the upper-side also that peculiar thick stripe which marks the beginning of the increase of the black, and which sometimes also in connection with a black dot on the fore-wings, forms the hooked stripe, which has already been treated of in the Introduction.

It is evident that among the ♂ the said process has not always and everywhere

advanced in the same degree in different regions. In the most common form the middle part of the wings on the upper-side is sulphur-yellow and the rest chalky-white. So it always is f. i. in Java and in many other regions, but in other parts there is a great difference in the extension of that yellow, that is, in the larger or smaller degree in which it has already paled into white, so that sometimes, as f. i. in Celebes the yellow is diffused over the whole surface of the wings. This one has been distinguished as the form FLAVA Butl., here and there numerous transitions occur, while in Banda, Timor and also in Celebes both forms even occur besides each other. On some ♀, which for the rest have turned white already, the same yellow is still to be seen covering a great part of the upper-side, just as in the ♂, which proves that in both sexes the process of bleaching has the same character, though this cannot always be distinctly observed. The circumstance that the transitional forms often do not exist any more may render it very difficult, while in the evolution of the ♂ perhaps an acceleration may sometimes have taken place, in which transitional stages evidently seem to have been skipped. Thus we have already seen that in the changing of the red spot into white, as is to be observed in some ♀ of IPHIAS, the yellow stage has been passed. The fact of these accelerations in the process of development has created the mutation theory; a comparison with the process of the colour-evolution in other IPHIAS forms clearly shows that in these the yellow stage really exists, and that therefore this apparent mutation can only be the result of an acceleration in that process, which prevents its being observed.

I shall now try to give here an enumeration of the different colour-forms in which this species occurs and of the places from where those forms have become known to me. For convenience sake I shall separate those forms into certain groups. It must, however, be borne in mind that this is done only for convenience' sake and therefore artificially: in reality all those forms are connected with each other by transitions. And as to the localities in which they have been found, in my collection, as well as in that of the Leyden museum, there are a good number of specimens of this species from different regions of the Indian archipelago. But the material from Java is considerably larger in number than that from elsewhere, so that my observations concerning the forms occurring in Java, will also be much more complete.

I. ♂ Groups.

α. Upper-side: the common form described above. Continent of India, Java, Bawean, Sumatra, Banka, Rio-Lingga archipelago, Borneo, Nias, Celebes,

Ké islands, Banda, New Guinea, Wetter, Gilolo, Timor, Formosa. In Ceram, New Pomerania and the Salomon islands the white and the yellow are very bright.

Under-side: ground colour very variable, more or less white with a slight to strong ochraceous tinge, greenish-white or sulphur-yellow. (Pl. III fig. 6 *e,f.*).

β. The form FLAVA Butl.; both sides quite or nearly quite yellow, often greenish. Great Sangir, Wetter, Flores. On Salaiara, Ternate, Morty island, Waigiou and Salawati with transitions to *α.* In Celebes, Banda and Timor together with *α.* (Pl. III, fig. 6*g.*).

γ. (HILARIA Cram.) upper-side like *α.* Under-side pale greenish white, more or less shiny. With pale reddish relic patterns, as occur in many ♀. Among them round spots on the outward extremity of the discoidal cell; those in the hind-wings doubled, forming thus the 8 shaped figure with pearly centre. Continent of India, Sumatra, Philippines, Batavia, Central Java, Madura, Borneo, Manouwoko island, Flores, Ké islands. (Pl. III fig. 6*h*).

II. ♀ Groups.

δ. The oldest form, CATILLA and ALCMEONE Cram. Upper-side deep chrome-yellow, paling into paler yellow and further into white. The under-side ever a darker yellow. On the upper-side of the fore-wings fewer or more black spots, especially a round black dot near the outward extremity of the discoidal cell. On the under-side pale rose-coloured along the margins near the apex of the fore-wings and further with brownish or blackish red patterns, among which a larger spot on the outward extremity of the discoidal cell of the fore-wings, and a very large one in the same place on the hind-wings, which is of still greater extend and differs considerably in size in different specimens, and has also grown paler sometimes. In some specimens of uncertain origin whose general colour has already paled into white, all the red has also already disappeared from this spot and only some black has remained which has also grown much feebler. In this very large spot the 8-shaped one with pearly centre. When the colour of the spot is very dark the pearly centre or sometimes ever a part only of it is not visible. Continent of India (BINGHAM), Batavia, Java, Madura, Sumatra, Manouwoko island, Wetter, Aru islands, Timor. (Pl. III fig. 6*i*).

ε. The colour sometimes still just as deep a chrome-yellow as in *δ*, but also paling gradually into all sorts of shades and even into white, so that it can be separated from the former group as a more advanced stage in the evolutional process. The principal difference with *δ* exists in the disappearance

of the very large spot on the under-side of the hind-wings. At the said place of the hind-wings there have still remained pretty large spots in which the 8-shaped figure with pearly centre shows off very clearly; from the large spot on the under-side of the fore-wings only a much smaller, almost round spot is still seen. Continent of India (CRAM.), Batavia, Java, Madura, Bawean, Borneo, Manouwoko island, Flores, Wetter, Timor, Ké islands, (Pl. III fig. 6 *l*).

ζ. A still somewhat further advanced stage in the process of colour evolution. The upper-side paling from sulphur-yellow into white, the under-side from dark yellow to pale brownish yellow. The large spots on that side have quite disappeared; the rose-colour along the margins near the apex of the fore-wings however, and several spots of the same colour have remained. The round spot on the under-side of the fore-wings has also turned paler and gets smaller and smaller; such is also the case with the 8-shaped spot with pearly centre on the under-side of the hind-wings. At last it is reduced to one circle without pearly centre. Malacca, (DISTANT), Java, Borneo, Sumatra, Engano, Nias, Great Sangir, Celebes, Salaiara, Timor, Flores, Soumbawa, Allor, Wetter, Ceram, Banda, Ké islands, New Guinea. (Pl. III fig. 6*k*).

η. Upper-side pure white, the centre part sometimes more, sometimes less extended sulphur-yellow, thus giving back the colour-type of the ♂. The black dot on the fore-wings sometimes quite or nearly quite disappeared; around all the margins a stronger or feebler black border, the beginning of the increase of the black, mentioned in group θ. Under-side yellowish, sometimes a clear sulphur-yellow or sometimes a little ochraceous-white, resembling in colour that of the ♂ *x*. Generally no more relics of the spots, and neither of the 8-shaped figure. Malacca (DISTANT), Batavia, East-Java, Madura, Sumatra, Nias, Rio-Lingga archipelago, Salaiara, Ternate, Wetter, Timor. (Pl. IV, fig. 1 *a*, *b*.) At Batavia at least this ♀ form, which is the most progressive among them, is also the most common, as the least progressive and thus the oldest δ and ε forms, are also the least frequent there.

θ. Increase of the black on the upper-side; parallel to the broad border around all the wings, already present in the former group, another stripe of black spots also arises. The black line along the costa, mentioned in the Introduction becomes more strongly developed and bends in the form of a hook towards the above-mentioned black spot near the outward extremity of the discoidal cell and at last is connected with it. Sometimes the black has

very prominently spread and the colour of the under-side of the hind-wings shines out at their upper-side. Ground colour white as in group *η* or yellow.

Under-side dark yellow mixed with black scales, sometimes pale yellow, quite plain, without remnants of spots or of the 8-shaped figure. Sometimes also in much bleached specimens, white with a mother-of-pearl hue, as this is also to be found in the next group. In that case, as a research in that respect, made for me by dr. VAN DER WEELE, pointed out, a very far advanced stadium in colour-evolution is reached; that hue indeed is due to refraction and caused by the fact that in the scales on the under-side the pigment is already absolutely gone, even more so than I stated relative to the ♀ of APORIA CRATAEGI L. on page IX of the Introduction. Batavia, Central Java, Borneo, Bawean, Flores, Wetter. Of a specimen from the Rio-Lingga archipelago with small increase of the black, the underside is brownish yellow with relic-pattern. (Pl. IV, fig. 1, *c*, *e*.).

ι. The same increase of the black much stronger, so that it extends, especially in specimens from North Celebes and Salaiara, nearly over the whole upper-side of the wings. Ground colour yellow or white.

Under-side plain yellow or white, often also more or less with a mother of pearl hue.

Not from Java, but from Great Sangir, Celebes, Salaiara, Ceram, Ternate, Morty island, Waigiou, Banda, New Guinea, Timor. In Celebes, Great Sangir and Salaiara this form occurs together with the group *ζ*. (Bl. IV, fig. 1, *d.f.*).

All the forms which have been mentioned here are united by all kinds of transitions and occur at the same-time in the same flights, as has already been said, as long as they are not confined to special regions, at least; the oldest, the deep-yellow form CATILLA Cram., however, only in a relatively small number. By far the greater part of the specimens have already surpassed this stage in the colour-evolution, some obdurate conservatives alone go on representing it. Just so all these forms appear from caterpillars which are bred at the same time. So it is evident that these differences have very little to do with the dry or the rainy season as I have stated on page XIX of the Introduction; where such a thing is maintained, it is not founded on serious observation.

I challenge anybody to explain in any other way than by my theory of the colour-evolution all these different forms which occur in several islands beside each other and which follow the same evolutional process; the way in which they change and pass into one another, and the undeniable conformity which such forms, though different, often show between themselves in the process of their alteration. Assertions about external influences and suchlike things, give

no real explanation, but the said theory does entirely, though it can not explain the first cause of this evolution, nor the reason why it does take place. External influences of unknown origin doubtlessly do exist; but the naturalist who attributes everything he cannot explain to such influences, does not really stand any higher than the ignorant man explaining all things he does not understand as happening by magic, or as the work of evil spirits. That is easy enough, but science is another thing. With words like "*Variability*" for instance nothing is explained. That is a thing already known even to HAMLET. But people seem slow to understand this in biological as well as in other sciences, and in our whole social and political life too.

The colour-evolution, treated of here, is of exactly the same nature as the one which appears in the different ♀ forms of PAPILIO MEMNON L., which also occur in the same way beside each other in the same region, but which show in different regions still more small differences. Nor can this polymorphism either be explained in any other way than by the theory of colour-evolution. That the butterflies of the CATILLA form should be avoided by other butterflies, as HAGEN says he had observed, and in which he surmises a phenomenon of selection, is probably nothing but auto-suggestion.

The eggs are laid on the under-side of the leaves of CASSIA, as I have been told, and after 4 days the larvae appear. They are often found in great quantities on *jouar*, called at Batavia *bilalang* (CASSIA FLORIDA Wahl); at Buitenzorg I found them also on a species of CASSIA which is called there *kètèpeng manila*. Dr. MARTIN mentions also CASSIA ALATA L. as foodplant. They also show a strong colour-polymorphism and therein colour-evolution is thus also exhibited. Some are still found that resemble the caterpillars of the two other Java species of CALLIDRYAS; these have preserved the old green colour, common to many larvae of Pieridae, and represent among the caterpillars of POMONA an old stage in the evolution, just as the form CATILLA does among the butterflies. Most of the caterpillars, however, have already left this stage, while the colour of one specimen has changed already more than that of others. Some of them are ochre-yellow, light brown or bronze coloured on the back and the sides, while the pale streak on the sides, which also exists already in the old form, has turned into yellow or into a greenish colour and is sometimes doubled. The lateral row of black dots often changes into a black line, which sometimes gets so broad that it almost covers the ground colour of the back or even entirely, when the black of both sides is united on the middle of the back; sometimes also it grows partly or entirely steel-blue with a metallic hue. The head follows the general colour, the under-side is bluish grey, the fore-legs are yellow. Back and sides look like shagreen; when

magnified this proves to be caused by parallel folds of the skin in each segment, on which there are numerous black dots. The chrysalis resembles that of C. SCYLLA L., but is much smaller. There are, however, also light brown pupas with a dark lateral line. Some pupas also are dark green.

The figure of the caterpillar, given by HORSFIELD and MOORE is bad, the one of the chrysalis is not to be recognized. The different figures of the caterpillars and pupas of C. CROCALE Cram. and C. ILEA F. in MOORE's *Lepidoptera of Ceylon* all belong to this species.

Genus TERIAS Swains.

Butterflies flying low near the ground in slow flight. The caterpillars have the PIERIS form. The chrysalis shows a peculiar shape, because the thorax has become much broader.

1. HARINA Horsf.

HORSFIELD, *Cat. Lep. E. I. C. p.* 137 (1828)	Terias	Harina.
BOISDUVAL, *Spéc. Gén. I p.* 668 (1836)	„	„ .
HÜBNER-GEYER, *Zuträge V p.* 43 *fig.* 979, 980 (1837) . .	Eurema	„ .
SNELL. v. VOLL., *Mon. d. Piér. p.* 65 (1865)	Terias	„ .
DISTANT, *Rhop. Mal. p.* 307 *pl.* 25 *fig.* 13 (1882—86) . .	„	„ .
STAUD., *Exot. Schm. p.* 28 *pl.* 16 (1884—88)	Eurema	„ .
BINGHAM, *Fauna of Brit. India p.* 249 (1907)	Terias	„ .

In W. J. this species is common in the forest of Dèpok (95) but in other localities I always found only a few specimens. I received it also from mount Karang in the province of Bantam. From E. J. I received it from Banjouwangi and from Pringodani (350) in the province of Pasourouan. According to HAGEN in Sumatra it is exclusively a wood butterfly. Early stages still unknown.

2. VENATA Moore. (Pl. IV fig. 2, *a*, *b*.)

MOORE, *Cat. Lep. E. I. C. I p.* 65 *pl.* 2*a fig.* 2 (1857). .	Terias	Venata.
SEMPER, *Schm. d. Phil. I p.* 252 *pl.* 41 *fig.* 1, 2 (1886—92).	„	„ .
BINGHAM, *Fauna of Brit. India p.* 246 (1907)	„	„ .

In W. J. once in the Wajang mountains (1700) and in E. J. at Kediri (64). FRUHSTORFER also found this species in the mountain-range along the south-coast of E. J., but not common.

Early stages unknown.

3. Brigitta Cram.

Cramer, *IV pl.* 331 *B, C.* (1782)	Pap. Brigitta.
Horsfield, *Cat. Lep. E. I. C. p.* 137 *pl.* 1 *fig.* 13 (1828).	Terias Drona.
Boisduval, *Spéc. Gén. I p.* 675 (1836)	„ „
„ „ „ 676 (1836)	„ Brigitta.
Snell. v. Voll., *Mon. d. Piér. p.* 69 (1865)	„ Drona.
Moore, *Lep. of Ceylon, p.* 120 *pl.* 46 *fig.* 3, 3*a.* (1881) .	„ „ .
Staud., *Exot. Schm. p.* 28 *pl.* 16 (1884—88), ...	Eurema Brigitta.
Bingham, *Fauna of Brit. India p.* 247 (1907).	Terias Libythea.

I only know specimens from W. J.. Several times at Batavia (3—14): some more were sent to me from Soukapoura (65) and Manondjaya in the province of Prajangan, from the mountains of that province, from mount Karang in the province of Bantam and from the district of Buitenzorg (1600). This species was also found by Fruhstorfer in the mountains along the south-coast of E. J., but not common. Metamorphosis unkown.

4. Hecabe L. (Pl. IV fig. 3, *a, b, c, d, e, f, g, h, i.*)

Linn., *Syst. Nat. ed. X p.* 470 (1758)	Pap. Hecabe.
Cramer, *II p.* 40 *pl.* 124 *B, C.* (1779).	„ „
Boisduval, *Spéc. Gén. I p.* 669 (1836)	Terias „
„ „ „ „ 672 (1836)	„ Blanda.
Snell. v. Voll., *Mon. d. Piér. p.* 66 (1865)	„ Hecabe.
„ „ „ „ „ „ „ 67 (1865) , ...	„ Blanda.
Snellen, *Midd. Sumatra Lep. p.* 23 *pl.* 1 *fig.* 6, 7, 10, 11 (1880)	„ Hecabe.
Moore, *Lep. of Ceylon, I p.* 119 *pl.* 45 *fig.* 4, 4*a.* (1881).	„ Citrina.
Distant, *Rhop. Mal. p.* 304 *pl.* 26 *fig.* 11, 15, 19 (1882—86)	„ Hecabe.
„ „ „ *p.* 466 *fig.* 129 (1882—86). . . .	„ Lacteola.
Bingham, *Fauna of Brit. India p.* 250 *fig.* 60, *a, b,* 61, 62 (1907)	„ Hecabe.

It is of no use mentioning every place where I found this butterfly. It is perhaps the most common butterfly of Java, and so it is also in a large territory outside of this island. In Java I found it everywhere, in the coral-island of Edam in the roadstead of Batavia as well as in the mountains (1600—1777) in W. J. and E. J.. Also in the dry season it is common, and between the specimens of the dry and the wet season there is no difference. The so-called variety Blanda Bsd. also occurs everywhere, the colour forms Citrina Moore

and LACTEOLA Dist. are found also in the same regions as the type and approaching this one by all kinds of transitions. Thus the same thing occurs as in the form BELISAR of T. BELISAMA Cram., which is also found at the same time and in the same localities as the type, and connected with this latter one by transitions.

During life the eyes of this species are pale-green. It is also very remarkable for the study of colour-evolution. Nearest to the red colour, originally common also to this genus, are still some American species, as T. NICIPPE Cram. and some which still have a bright orange colour; in other species as f. i. in T. ELATHEA Cram., there are only a few relics of this red. Among the numerous species of this genus we now find a complete series of all the degrees of paling, down from the orange, through all the shades of yellow, to the pure white of the South-American T. ALBULA Cram.; and that in the great inequality which characterizes every evolutional change, sometimes occupying the whole wings, sometimes only one side or even only some parts, while at the same time an occasionally stronger or occasionally feebler accretion of the black takes place. In the Java species yellow is usually the colour, but this yellow has different shades, sometimes it approaches the pale orange, and very often it is very pale; in the form LACTEOLA Dist. already mentioned, it has even turned into white. Moreover, the same evolutionary process of the colour is very obvious on the underside of T. HECABE L. On that side there are still often yellowish brown spots of the same colour as are often also found in the CATILLA ♀ of C. POMONA F. on the same side of the wings, and that also occur there more or less numerously, being for this reason recognizable as relics of the same nature, caused by a mixture of the much paled red with a later developed black. In many ♂ specimens of Java and also in many of Sumatra those spots have nowadays quite or almost entirely disappeared, but in other ♀ of Java they still exist, especially, but not only, in the specimens of the mountainous regions. It has been pretended that it is a sexual characteristic whether or not these spots occur on the underside; Dr. VAN DER WEELE, who has made a special study of this subject, has, at my request, examined in this respect a number of HECABES, caught at Batavia at the same time; he found that there exists no difference between both sexes in this regard. The greater or lesser extension of the black border on the upper-side of the hind-wings, on the contrary, is generally a sexual characteristic. As a rule this border is narrower in the ♂ and separated sharper from the inner part than in the ♀. Yet sometimes there are ♀ which it is difficult to distinguish from ♂, because this black is also in a state of evolutional transition. On the upper-side we can observe that the black border of the fore-wings is not always equally strong,

f. i. that gave rise to the BLANDA Bsd., variety which simply consists of those specimens in which the evolutional increase of the black on the upper-side of the fore-wings in that peculiar way in which it takes place in this species and perhaps generally in the genus TERIAS Swains, has advanced still far less than in most specimens of the same species.

In the evolutionary colour process on the under-side, the same thing may be observed as also draws attention in IPHIAS GLAUCIPPE L., but appearing there on the upper-side viz. that the colour which is disappearing seems to keep longest near the apex of the forewings, where it seems to be concentrated and can be retained a long time. Thus we see that the above-mentioned brown spots on the under-side of T. HECABE L. have often increased especially near the apex of the wing much more than anywhere else, nay, sometimes even to such an extent that lepidopterologists, who ignore this process, doubt whether there is a specific difference between this species and T. SARI Horsf., which latter species has also arisen from the same ground form as T. HECABE L. In T. SARI Horsf., however, this spot takes up the whole apex of the wing, in T. HECABE L. it is sometimes entirely wanting or occurs in a very insignificant degree as a first beginning, but it sometimes also gets rather large, though never so large as in T. SARI Horsf. and never forming a united spot which touches the terminal margin as well as the costal one, as is the case in this latter species.

The colour and the form of these spots, as well as the place where they are found, the inequality of their occurrence and also the difference of colour and shade between the numerous species of this genus, may easily be explained in this way by a knowledge of the colour-evolution process, but remain an insoluble mystery without this knowledge. In consequence of these differences MOORE f. i. in his *Lepidoptera of Ceylon* enumerates many species of TERIAS, as is also the case with C. POMONA F.; so does DE NICÉVILLE, and in this way about fifty species have gradually been distinguished which must all be brought back, however, to T. HECABE L. This is also the case with the so-called species T. SILHETANA Wall. In the afore-said description of the Rhopalocera of Sumatra by DE NICÉVILLE and Dr. MARTIN this form is also mentioned of Sumatra, while as characteristics of difference is given that in T. HECABE L. there never should occur more than two dark streaks or spots in the discoidal cell on the under-side of the fore-wing, in addition to the reniform spot on the disco-cellular nervules; in T. SILHETANA Wall. three and in T. SARI Horsf. only one. But this is without any foundation, perhaps a result of studying a too limited material. I possess HECABES with three and also SARIS with two such spots, and even HECABE's without any spot at all. These streaks or spots are simply relics of pigment, which occur sometimes

in larger, sometimes in smaller numbers, in proportion to the more or less advanced stage in the evolutionary process. It has also been said that the colour of the upper-side of the front part of the hind-wings, where the scent-glands are, should be greyish violet in T. HECABE L., but rose-coloured in T. SILHETANA Wall., indeed a very subjective characteristic, from which no difference of species can be deduced. According to a note of WATSON in *Journ. Bombay Soc.* 1896 the caterpillar of T. SILHETANA Wall has a black head and lives gregariously, whereas that of T. HECABE L. has a green head and lives solitarily, according to my observations, however, it is the caterpillar of T. HECABE L. which has, generally at least, a black head and which undeniably lives sociably, sometimes even in such numbers together that it becomes destructive. The caterpillar of T. SARI Horsf., on the contrary, has a green head. Always at his hobby, but not in consequence of serious observation, DE NICÉVILLE pretends that the specimens of T. SILHETANA Wall., which have the apex of the fore-wings on the under-side marked with brown, should represent the form of the dry season!

The caterpillars generally live together on the same plant; they may often be seen sitting close together on the stem of a leaf, which has been eaten. They are very common on the leaves of the tree which is called *bilalang* at Batavia, but *jouar* (CASSIA FLORIDA Vahl) elsewhere, and also on the *touri* (AGATI GRANDIFLORA Desv.), the *jengkol* (PITHECOLOBEUM BIGEMINUM Mrt.), the *koupang* (perhaps MACROTROPIS SUMATRANA Miq.), the *kajou gabous* (ALSTONIA SCHOLARIS R. B. R.), the *pètik* (PARKIA spec.), the *dawon klitji*, called in Sundanese *mata hiang* (GUILANDINA BONDUC L.), and on plants called *kajou wangkal* and *katok*, as I have been told. In June 1894 they appeared in such numbers at Buitenzorg on the *ketimour* (ALBIZZIA MOLUCCANA Miq.) that they were distructive. This polyphagy is probably one of the reasons why this species is so common and is so widely spread. It is also evidently an animal with a strong power of assimilation; in the middle of the dry season when it had not rained for more than six weeks at Batavia, a whole nest of such caterpillars on *jengkol* leaves was brought to me. Its colour is generally greenish yellow in many shades up to real green, with a more or less bright yellow streak on the sides, while the transparency of the back makes the dorsal vessel appear like a dark dorsal line. The body looks like shagreen and seems sometimes to be covered with small bluish grey or black spots; when magnified this proves to be caused by some parallel folds in the skin of each segment, which folds bear small black spines, the tops of which show like the said spots. Sometimes we see at the top of each spine a small bubble. On the back and the sides a few white hairs protrude. The head is sometimes, but not always strongly notched on

the upper-side and therefere looks double-pointed; it is black, which colour it only seems to get after one of the last moultings; in earlier stages its colour is the same as that of the body. Immediately after the moult here mentioned, the head, however, has still the same colour as the body; only gradually it gets darker, till after about an hour it has turned black, or at least so dark green by the increase of the black pigment, that it looks like black. But I do not know for certain whether all the caterpillars get the black head, or whether perhaps part of them that have not yet enough advanced in this process of evolution, retain the general colour of the body just as those of T. SARI Horsf.

The chrysalis is pale green, sometimes mottled with very dark green or black spots; there are also some which are yellow or dark-brown and even dark-yellow. The head ends in a pointed snout, which is sometimes white. It has the peculiar shape common to the TERIAS pupae. When the larvae are very plentiful, as in 1894 at Buitenzorg, many pupae may be seen hanging on the stems of the leaves of the foodplant which have been eaten; and then they look like small fruit, seeds or withered leaves, but whether this greatly protects them, as DE NICÉVILLE boldly pretends, should certainly require clearer proofs. Some butterflies emerged from the chrysalides on the 4th, others on the 6th or 7th day. According to Dr. MARTIN the eggs are laid singly, or sometimes in a rhomboid shape on the leaves of the foodplant. Of the figures given by HORSFIELD and MOORE only that of the pupa has succeeded tolerably well. Mine are also better than those in MOORE's *Lepidoptera of Ceylon*.

5. SARI Horsf. (Pl. IV fig. 4, *a*, *b*, *c*, *d*.)

HORSFIELD, *Cat. Lep. E. I. C. p.* 136 (1828) . . . . . Terias Sari.
DISTANT, *Rhop. Mal. p.* 305 *pl.* 25 *fig.* 3, *pl.* 26 *fig.* 7 (1882—86) „ „ .
BINGHAM, *Fauna of Brit. India p.* 255 *fig.* 64 (1907). . . . „ „ .

W. J. Batavia (3—14), Buitenzorg (265), Tjampea (160), Soukapoura (65) in the province of Prajangan. I also received them from the districts near the Tjiletou or Sandbay on the south-coast of Java, and from mount Karang in Bantam. In the above named collection of butterflies, gathered in the heart of the dry season at Batavia, the number of fresh specimens of this species was particularly large and compared with those of TERIAS HECABE L. much larger than among those caught during the wet season, though during that period too TERIAS SARI Horsf. was not scarce.

C. J. Magelang (± 500).

E. J. According to FRUHSTORFER common in the mountains along the south coast.

In many places this species is not at all rare, but far less common than the preceding one. It has probably originated from the same original species as T. HECABE L., with this difference, however, that the relics of pigment on the under-side which still show in this latter species as brown spots, have for the greater part been concentrated in T. SARI Horsf. into one large spot near the apex of the fore-wing. This spot ending towards the middle of the wing more or less triangularly, is distinctly separated from the rest of the surface of the wing and fills up this apex entirely, which is never the case in such specimens of T. HECABE L. mentioned before, as show at the same place an almost similar spot. It is, moreover, in one specimen larger than in another; in a few specimens I also found lower down on the same wing near the dorsal margin another small brown spot. In the shade of the yellow in this species which sometimes approaches pale orange and sometimes almost pales into white, the same evolutionary dissimilarity prevails as in T. HECABE L. The outer margin on the upper-side of the hind-wings also shows the same sexual difference as in this species. All the caterpillars and pupae that I have seen were green without exception, though the shape did not differ from those of T. HECABE L., but the head of the larva of T. SARI Horsf. always keeps that general colour of the body. Therefore it seems to me that the difference of these two species has only arisen from the divergence of the first-mentioned from the common original form, when the change of the colour of the caterpillar's head has also begun. It seems that at that epoch a period of evolutionary change of colour began for some of those caterpillars, which was not the case, however, with a number of other caterpillars of the same original form, which have thus remained unchanged, and that the imagines issued from each of those two categories of caterpillars have since followed each their own way, too, in the course of colour-evolution, which has brought about a separation of the two species.

In T. SARI Horsf. this process revealed itself as the concentration of the brown of the under-side into the apex of the fore-wings, at the same time with some increase of the black pigment, which therefore does not yet exist in the form HECABE, though a tendency to follow the same way of evolution is also clearly obvious in them. One may presume that the cause of this separation has been the circumstance that a certain number of those caterpillars did not confine themselves anymore to their original foodplant, but also began to feed on other leaves, which difference of food may have had an influence on their constitutions, that showed itself in a tendency to evolutional change. For, indeed, I did always find the larvae of T. SARI Horsf. on one plant only, namely on the leaves of the *jengkol* (PITHECOLOBIUM BIGEMINUM Mrt.) on which, as has been already said, those of T. HECABE L. also occur, but these latter

also live on a lot of other plants, partly mentioned already. The same thing we have already observed with respect to the difference between CALLIDRYAS SCYLLA L. and C. POMONA F., two closely related species that have evidently arisen from the same original form, and in which exactly the same relics of pigment appear on the under-side as in the above mentioned species of TERIAS. Of the former, a species which varies little even as imago, I only saw uniform caterpillars, always living on the same plant; but of the other species, whose imago occurs in many different forms caused by the process of colour-evolution, the caterpillars also differ much in colour and live not only on the plant on which the other species occurs and which perhaps therefore has already been the foodplant of the original form, but also on several other plants. For this reason I suppose that the change from a monophagous way of living of the caterpillars into a polyphagous manner of life, which has been caused by particular circumstances, may have been the cause in the two above-mentioned cases of the rise of a specific difference between butterflies of the same species according as some have undergone during the larval state that change in their manner of living and others have not.

6. TILAHA Horsf.

HORSFIELD, *Cat. Lep. E. I. C. p.* 136 (1828). . . . . Terias Tilaha.
BOISDUVAL, *Spéc. Gén. I p.* 668 (1836). . . . . „ „ .
SNELL. v. VOLL., *Mon. d. Piér. p.* 65 (1865). . . . . „ „ .
DISTANT, *Rhop. Mal. p.* 303 *pl.* 25 *fig.* 8 (1882—86) . . . „ „ .

This butterfly seems to me not to be common in Java; Dr. MARTIN mentions the same about Sumatra. I only received it from the province of Prajangan in W. J.. Namely from Soukapoura (65) and from the south-coast from the districts near the Tjiletoe or Sandbay. FRUHSTORFER, however, found the species common in the mountains along the south-coast of E. J.. Early stages unknown.

Genus NEPHERONIA Butl.

I take this genus to be an Indo-Australian form of the African genus ERONIA Hb. in which a strong increase of the black has taken place, which has, however, only followed the veins of the wings, while on the parts of the wings between these, the process of growing paler continued in the meantime in its different stadia from red into yellow and white. Just the same phenomenon has occurred among many Indo-Australian Danaidae, which differ also from the African species of this family by this process of colour-evolution, so

that we must, without a doubt, attribute it to the same influence, still unknown to us; a similar influence to that which in South America among many species of families, as those of the Acraeidae and Pieridae, has caused the oblong shape of the wing which is peculiar to that region, but which does not occur among species not living in South America, and neither among some species which do live there, but which have not yet proceeded so far as regards that process of changing. This gives a strong support to the aforesaid declaration of Prof. WEISMANN that alterations of colour are really nothing but alterations of form. Also among some Papilionidae and Nymphalidae of the Indo-Australian, zone, the process of colour-evolution occurs in the same manner; the strong resemblance between such butterflies, especially between the Nepheronias and some Danais species, which are very common in that region, explains it superficially as mimicry.

1. VALERIA Cram. (Pl. IV fig. 5, *a*, *b*, *c*.)

CRAMER, *I p.* 133 *pl.* 85 *A* (1779)	Pap. Valeria.
BOISDUVAL, *Spéc. Gén. I p.* 444 (*nec. var. A*) (1836).	Pieris Valeria.
SNELL. v. VOLL., *Mon. d. Piér. p.* 56 (*nec. var.*) (1836)	„ „ .
BUTLER, *Cist. Ent. II p.* 431 (1879)	Nepheronia Lutescens.
DISTANT, *Rhop. Mal. p.* 320 *pl.* 26 *fig.* 14 (1882—86)	„ „ .
STAUD., *Exot. Schm. p.* 36 *pl.* 21 (1884—88) . . .	Eronia Valeria.
BINGHAM, *Fauna of Brit. India p.* 280 *pl.* 18 *fig.* 124 (1907)	Pareronia Pingasa.

W. J. Batavia (3—14) and also in the forest of Pademangan which is situated still lower; Buitenzorg (265), the Gedeh and the Wajang mountains (1650). I received it from mount Tjerimai (700) in the province of Tjirebon.

C. J. Touban (2) on the north-coast, Bojonegoro (258), Ambarawa (500).

E. J. Kediri (64) and on mount Arjouno. From the island of Bawean I received a particularly small dwarsfish ♂.

A butterfly with a powerful flight, whose eyes during life are bluish grey. In the ♂ the white has become bluish in consequence of some structural cause. In the ♀ the black has sometimes turned paler into a lighter brown. By the unequal progress of the process of colour-evolution there occur both white and yellow ♀; BOISDUVAL already observed this. Between those ♀ there also exist specimens of a transition colour. I add here good figures of the ♂ as well as of both forms of colour of the ♀. The Indian form, figured by BINGHAM on pl. 18, fig. 125 only differs by an increase of the black. The form LUTESCENS also occurs in Java.

INDEX

OF

JAVA PIERIDAE.

EXPLANATION OF PLATE I.

Fig. 1. PIERIS JUDITH F. ♂.

„ 2. PIERIS TAMAR Wall. ♀.

„ 3. PIERIS NERISSA F. CORVA Wall. *a*. ♂. The dark-yellow spot that appears on the under-side at the base of the hind-wings is not so completely wanting in the ♂ as is the case in the plate; *b*. ♀ The colour of the ♀ is rather a little too dark, especially on the upper-side; *c* under-side of the hind-wings of the less dark coloured form; *d* larva; *e* pupa.

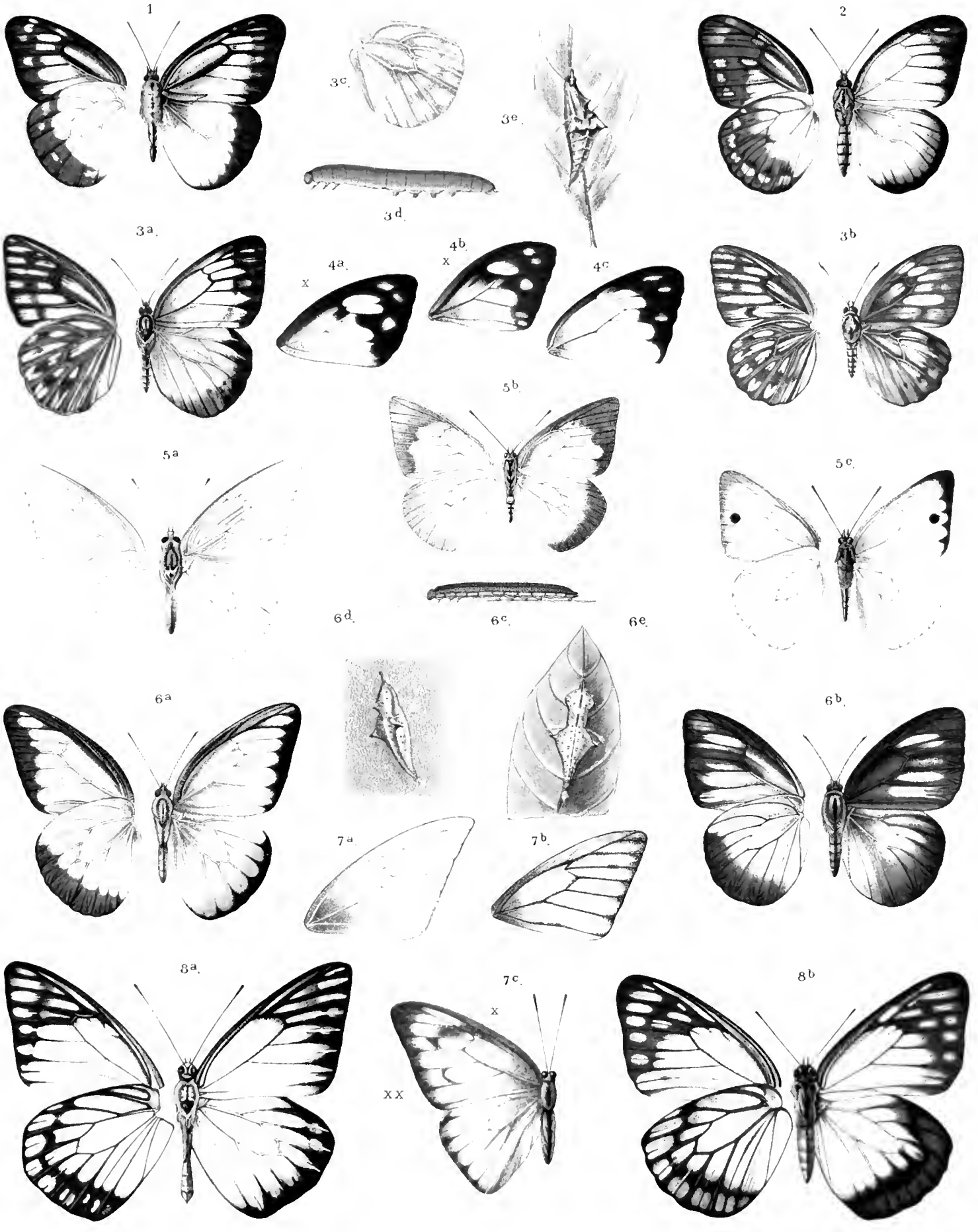
„ 4. PIERIS PANDIONE Hb. Upper-side of the fore-wing. *a*, *b*, the hooked stripe *X* in different evolutionary stadia; *c* form LUCASII Wall.

„ 5. PIERIS PAULINA Cram. *a* ♂; *b*, *c*, ♀ in different stadia of colour-evolution.

„ 6. PIERIS LYNCIDA Cram. *a* ♂; *b* ♀; *c* larva not quite full-grown; *d*, *e*, pupa.

„ 7. PIERIS NERO F. *a* ♂ yellow form ZARINDA Bsd. (Celebes); *b* ♂ turned pale (Java); *c* ♀ West Java, *X* the hooked stripe, *XX* the first appearing of the black in the middle of the wing.

„ 8. PIERIS PHILONOME Bsd. *a* ♂; *b* ♀.


1
2
3c.
3e.
3d.
3a.
3b
4a.
x
4b.
x
4c
5b.
5a
5c.
6d.
6c.
6e.
6a
6b.
7a.
7b.
8a.
7c.
x
xx
8b

EXPLANATION OF PLATE II

Fig. 1. PIERIS NERO F. ♀. It is very doubtful whether this form is from Java.

„ 2. THYCA EGIALEA Cram. larva.

„ 3. THYCA CRITHOE Bsd. *a* ♂, *b* ♀.

„ 4. THYCA BELISAMA Cram. *a* larva; *b* pupa; *c*, *d*, *e*, *f*, ♂ various colour-forms; *g*. ♀ form VESTALINA Stdgr.

„ 5. THYCA DORYLAEA Feld. *a* ♂; *b* ♀.

„ 6. THYCA HYPARETE. L. larva.

„ 7. THYCA PERIBAEA Godt. *a* ♂, *b* ♀.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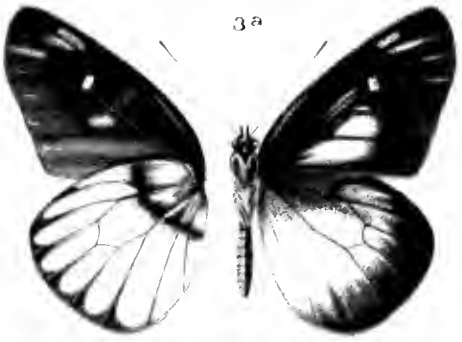
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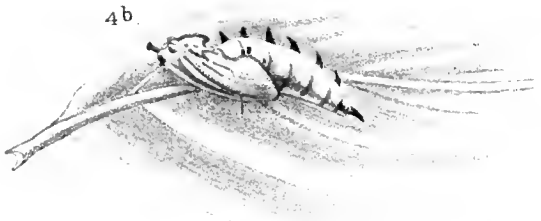
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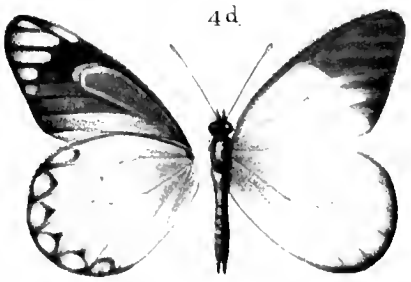
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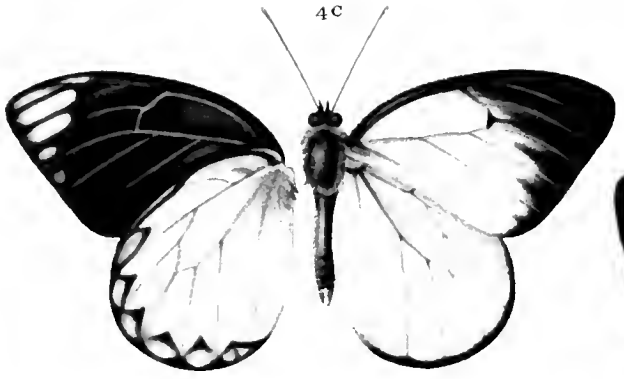
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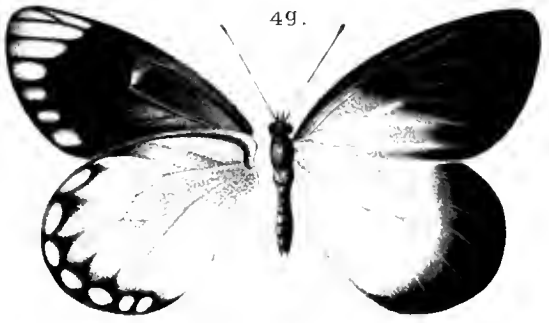
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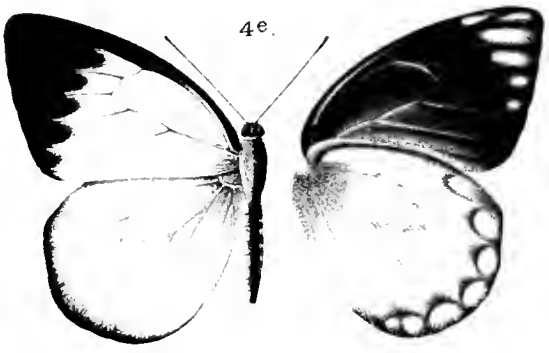
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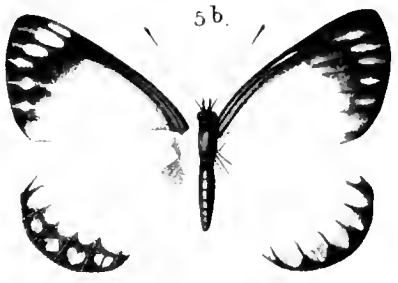
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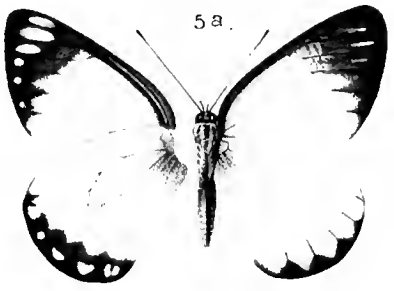
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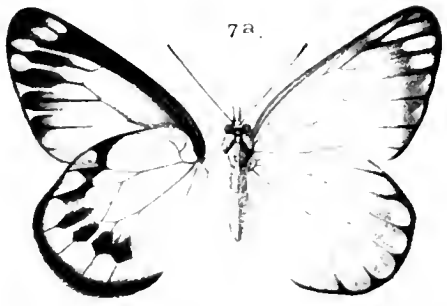
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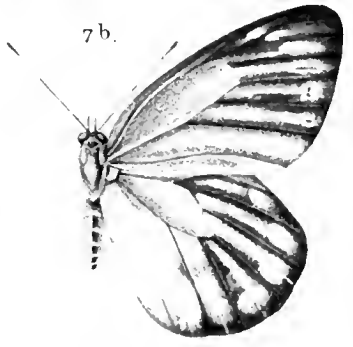
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6

EXPLANATION OF PLATE III.

Fig. 1. THYCA MOMEA. Bsd. *a* ♂; *b* ♀.

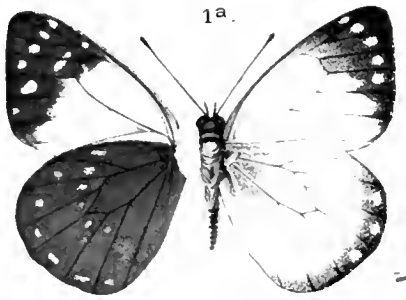
„ 2. IPHIAS GLAUCIPPE L. *a* larva; *b* fore-legs of the larva; *c* snake-mimicry of the larva; *d* pupa; *e* pupa, on the day before the emerging of the imago; *f* ♀ showing only remnants of the apical red. (Kangean isles)

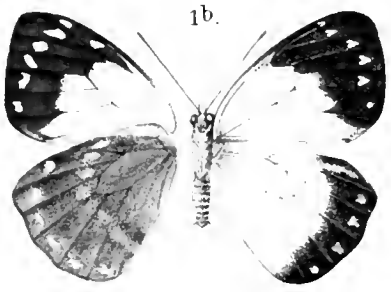
„ 3. THESTIAS VENILIA Godt. *a* ♂; *b* ♀.

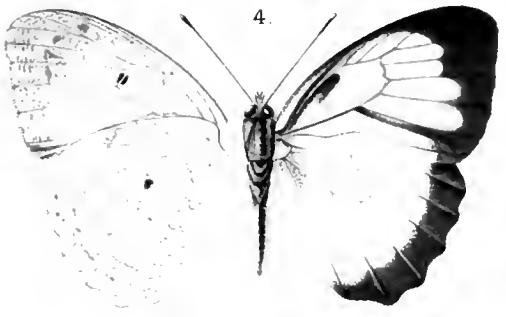
„ 4. THESTIAS BALICE Bsd. ♂.

„ 5. CALLIDRYAS SCYLLA L. ♀, *a* upper-side, *X* the 8 figure; *b* under-side.

„ 6. CALLIDRYAS POMONA F. *a*, *b*, *c*, various colourated larvae; *d* pupa; *e*, *f* ♂ group α, under-side; *g* ♂ group β, form FLAVA Butl; *h* ♂ group γ (HILARIA Cram), the under-side is often more greenish; *i* ♀ group δ (CATILLA Cram. ALCMEONE Cram.). The yellow of the under-side is that of a very dark specimen, but is often clearer, though always darker than the upper-side. The great spot on the under-side of the hind-wings is also not so dark brownish but more reddish than the figure shows. The figuration of the body, taken after a badly dried specimen, has not succeeded; the colour is right, but the form must evidently be the same as that of the other ♀ forms of this species. *k* ♀ group ζ under-side; *l* ♀ group ε under-side.


1a.


1b.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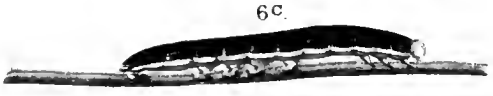
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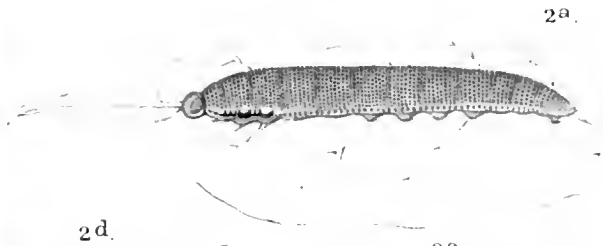
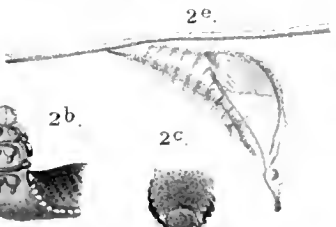

2a.


2d.


2e.

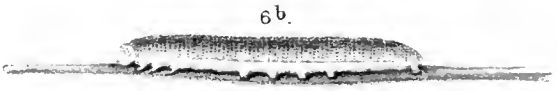
2b.

2c.


5a. x

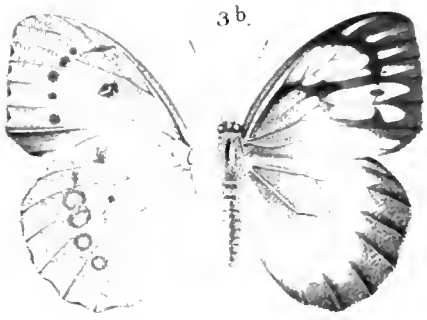

5b.

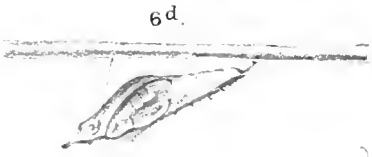

6a.


6b.


2f.


3a.


3b.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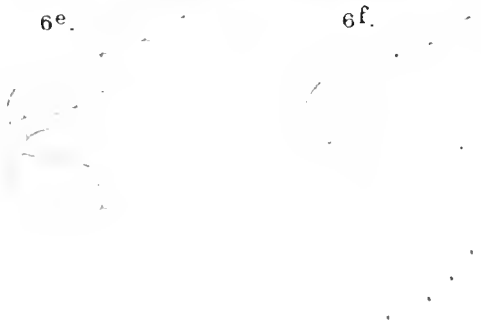
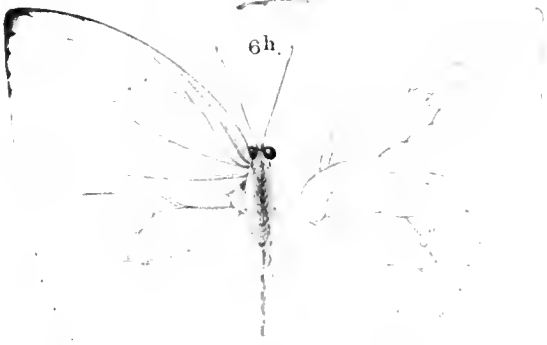

6e.

6f.


6l.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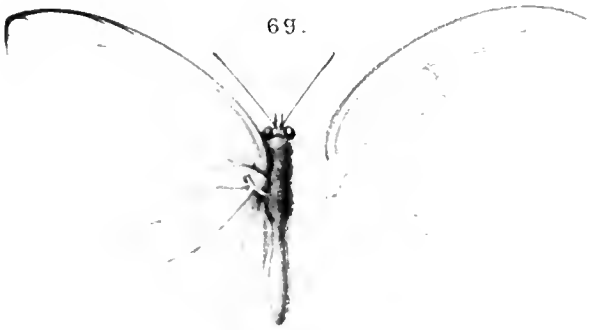
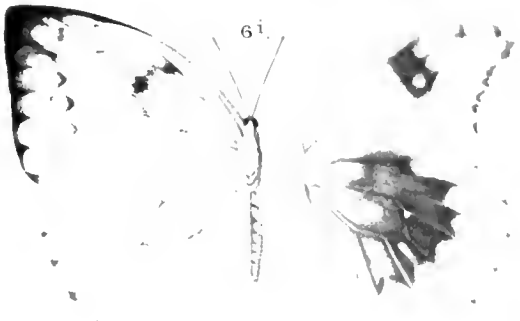

6g.


6k.


6i.

EXPLANATION OF PLATE IV.

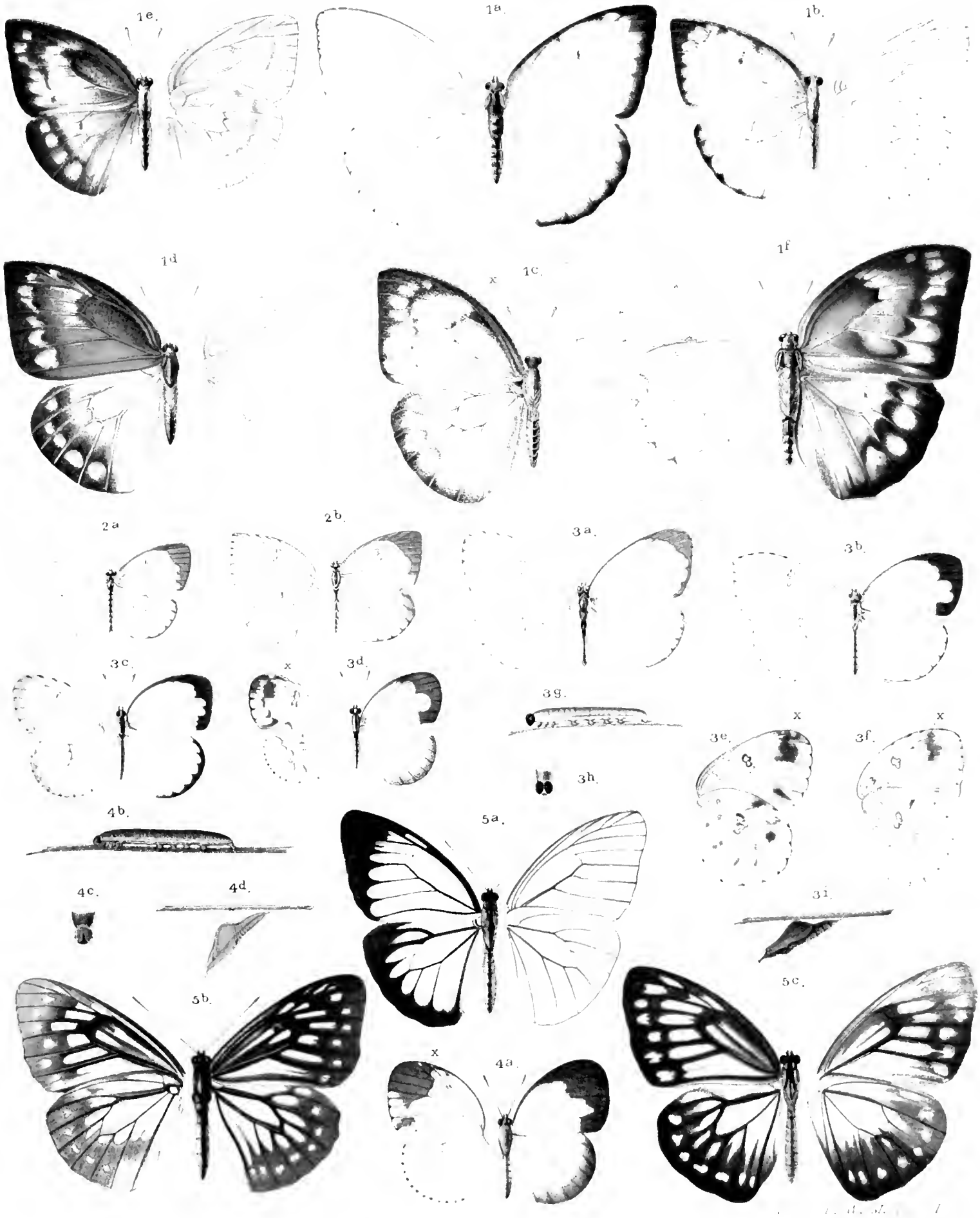
Fig. 1. CALLIDRYAS POMONA F. *a*, *b*, ♀ group *η*; *c*, *e*, ♀ group *θ*. The figurated specimen *c* is from Halmaheira; *X* the hooked stripe; *d*, *f*, ♀ group *ι*. The specimen *f* is from North-Celebes; the nervures on the wings of specimen *d* are inexactly figurated, but the colour is right.

„ 2. TERIAS VENATA Moore. *a* ♂; *b* ♀.

„ 3. TERIAS HECABE L. *a* form BLANDA Bsd. ♂; *b* form CITRINA Moore ♂; *c* ♂ oldest now existing colour-form; *d* form LACTEOLA Dist. ♀; *e*, *f*, *X* the brown spot on the under-side in specimens from W. J.; *g* larva; *h* head of a larva; *i* pupa.

„ 4. TERIAS SARI Horsf. *a* large ♀ (Batavia), *X* the characteristic brown spot on the under-side strongly developed; *b* larva; *c* the head of the larva; *d* pupa.

„ 5. NEPHERONIA VALERIA Cram. *a* ♂, *b*. *c*, ♀.


1e.
1a.
1b.
1d
1c.
x
1f
2a
2b.
3a.
3b.
3c.
x
3d.
3g.
3h.
3e.
x
3f.
x
4b.
5a.
4c.
4d.
3i.
5b.
5c.
x
4a.