

Variation in *Callimorpha dominula*, L. (with 2 plates).

By E. A. COCKAYNE, D.M., F.R.C.P., F.E.S.

South, writing of this species, says, "Except in minor details this tropical-looking moth seems little given to variation in England," but since he wrote his book forms have been bred that necessitate some modification of his statement, and, making due allowance for its small range here, the amount of variation is considerable. We can claim as British ab. *hamelensis*, Pflüemer., ab. *lutescens*, Oberthr., ab. *spaneyi*. Strand, ab. *nigra*, Spuler, and perhaps ab. *persona*, Hb., in addition to the aberrations *bimacula*, *medionigra*, and *juncta* described below.

The form with the spots on the fore-wing all pure white is ab. *hamelensis* and a specimen is figured in Barrett's *Lep. Br. Is.*, Vol. II. Pl. 70. fig. 1c. The hind-wings are noticeably pale in colour. Possibly ab. *rossica*, Kol., with white spots on the fore-wing and hind-wings of a pale clear yellow is the corresponding recessive form. The form with deeper yellow hind-wings and with the basal spots of the fore-wings of the normal orange tint figured by Barrett from a wild specimen has been freely bred by Mr. L. W. Newman and is ab. *lutescens*, Obthr. This is commonly but incorrectly called *rossica*, a form that does not appear to have been taken in this country, though perhaps it, or a form resembling it superficially, would be obtained by interbreeding *lutescens* and *hamelensis*. Oberthür in his *Lépidoptérologie Comparée*, Vol. VI., figures both these forms with yellow hind-wings and clearly points out the differences. *Lutescens* is recessive to the type, and according to Mr. Newman fertile eggs cannot be got by pairing two homozygous recessives, so that to perpetuate the strain it is necessary to cross a homozygous yellow with a heterozygous red, or to obtain a pairing between two heterozygous red ones. Whether *lutescens* is genetically identical with *lusitanica*, the local form in North Portugal, is doubtful. As *lutescens* is infertile it could not form a race apart from the type, and it must be assumed that it is different.

In the Tring Museum there is a specimen with the red of the hind-wings and abdomen replaced by pure white. The scales are very thin and devoid of pigment as in *Heodes phlaeas* ab. *alba*, Tutt. If these forms prove to be hereditary, as I suspect they will, and not due to disease, this and the corresponding form of *Callimorpha quadripunctaria* will require names.

Specimens with all the spots on the fore-wings of a clear orange colour occur sporadically in England and on the Continent. There is a fine series of them in the Oberthür collection from Valais, where it must be a recurrent form. Barrett figures one with rather small spots from the Mason collection, and a number have been bred during the last two years by Mr. Newman from a small colony in the Oxford district. The result of crossing two of these orange-spotted ones in 1926 was interesting and unexpected, for out of a large brood only about ten per cent. were orange-spotted. It is clear that the form stands in no simple Mendelian relationship to the type. Vorbrodt considers that it is a temperature form and says it is not uncommon in the damp warm places in the Rhone Valley. Further evidence is afforded by the fact that one was bred by Standfuss from *dominula* × *persona*, a specimen with small orange spots on the fore-wings and with

hind-wings and abdomen like those of typical *dominula*. The larvae and pupae were kept at a temperature of 77° F. and passed very quickly through both stages. Newman's were kept under artificial conditions and it is not unlikely that a warm damp environment was responsible for their coloration; this explanation of their origin would also account for the ratio of orange-spotted to typical specimens not being a Mendelian one. Staudinger described the race *bithynica* from Asia Minor as having all the spots on the fore-wings yellow or brownish. Seitz whose figure is unsatisfactory says that *bithynica* has more black on the hind-wings and abdomen than the type, and according to Mann the larva has darker yellow spots than that of typical *dominula*. In view of these facts it is almost certain that the orange-spotted European form is not identical with the Asiatic despite the use of the name *bithynica* for both of them by South and Oberthür. Strand named the form ab. *spaneyi* and said it was portrayed by Standfuss (*Paläarkt. Gross-Schmett.* Taf. VI. fig. 16), but it is doubtful if his name is not synonymous with ab. *ochromaculata*, Fuchs. Fuchs gave this name to a form taken near Elberfeld and says that all the spots on the fore-wing are yellow ochre (ockergelben). Even if the two forms do differ slightly in colour they seem to be too much alike to deserve separate names.

The form in which all the light markings on both the fore and hindwings are replaced by black, ab. *nigra*, Spuler, is a very rare aberration and the few known examples are from Kent. It resembles the black forms of *Zygaena* and may, like them, be recessive to the type. The British Museum is fortunate in possessing three specimens in addition to the one in the Doubleday collection, which was figured in Millièr's *Iconographie*, Vol. III., and named by Thierry-Mieg ab. *nigroviridis* (*Ann. Soc. ent. Belge*, 1910, LIV., 386), a name that falls before Spuler's given in 1906.

There is another abnormality in marking which seems to be recurrent and sufficiently distinct to be worthy of a name. Ab. **juncta**, nov. ab. The proximal and distal spots in the discoidal cell of the forewing are confluent and form a mark in shape like a dumb-bell. Two are figured, the smaller labelled 'Howard Vaughan Coll. Angleterre' (fig. 3), and the larger '2245, Ingerheim' (fig. 4). Both are in the Oberthür collection.

In this paper I do not propose to discuss all the variations in the arrangement of the spots in this species, but wish to direct attention more particularly to the different ways in which the dark ground colour may be extended over the fore and hindwings.

Some years ago Mr. Newman saw a very fine aberration, which had been caught wild by a gamekeeper in the neighbourhood of Oxford. In the following spring he collected a number of larvae along the ditch-side to which it is confined, and bred, so far as he can remember, only typical specimens, but from a pairing between two of them some abnormal ones were bred the year after. Two of these abnormal ones paired and in the brood so obtained there was a large number of the same abnormal form and a much smaller number of typical ones and aberrations like the one captured by the keeper. This beautiful and distinct form does not appear to have been met with elsewhere, and I give the following description of it.

ab. **bimacula**, ab. nov. The forewings are glossy green with all

the spots obliterated by black scales with the exception of the two basal spots, which are, as in most members of this colony, rather small and not confluent. In a few specimens some of the other spots are not entirely obliterated and are represented by tiny dots. The hindwings are very heavily marked with black. The most extreme examples have the whole apex black, and the black spots nearer to the base united into a broad black band running right across the wing, and in some cases this black band is united by a narrow black stripe near nervure 3 to the black apical area. There is a good deal of minor variation in the exact extent and distribution of the black markings on the hindwing, and in both fore- and hindwings there is often slight asymmetry. (Pl. VI., fig. 3 and pl. VII., fig. 8.)

The following is a description of the abnormally spotted specimens that gave rise to *ab. bimacula* and were bred with it.

ab. medionigra. In the forewing the orange spot, that lies just internal to the disc and forms the central spot of the wing, is absent or very small; the apical spots are reduced in size and sometimes in number; the large sub-apical blotch is reduced to one fairly large spot and a second very small one posterior to it; the double spot near the inner angle is reduced to a single spot with, in some cases, a dot representing its posterior component. In the hindwing the black markings at the apex are increased in extent and there is an extra black spot lying across nervure 2 between the discal spot and the black spot or spots near the anal angle, all of which are larger than in normal specimens from this colony. The extra black spot may be quite small or so large as to unite with the black markings anterior and posterior to it. (Pl. VI., fig. 2, and Pl. VII., fig. 7.)

There can be little doubt that *ab. bimacula* is the homozygous recessive and that *medionigra* is heterozygous for *bimacula* and the type. If so one of the parents of the brood that produced the first abnormally spotted ones must have been itself abnormal, and either the abnormality was completely overlooked or was so slight that the specimen was mistaken for a typical one. The latter seems to be the more probable explanation. I have bred two *dominula* from a neighbouring locality, one with two tiny specks of black surrounded by a yellow ring and the other with a distinct but small black spot where the extra spot is situated in the hindwing of *medionigra*, but in both cases the central and other spots of the forewing were present though reduced in size. I cannot help thinking that these were heterozygotes, in which the dominance of type over recessive was greater than usual, but I must admit that most of Mr. Newman's heterozygotes were far more clearly differentiated from the types.

The propriety of naming a heterozygote may be questioned, but there are precedents. It has been done unwittingly many times, and in *dominula* itself it has been done deliberately by Standfuss. The heterozygote must be much commoner in nature than the pure recessive, and, if it is a named form, is much more likely to be recognized in other localities both at home and abroad than if it is left nameless. I have looked through the series in the British Museum and have found several with the characteristic features, loss of the central spot and the posterior spot at the inner angle with reduction in size of the other spots on the fore-wing correlated with the presence of a small extra spot in the hind-wing, though these features are not so well

marked as in the Oxford specimens. They are from Digne, Valais, and Fusio in Switzerland, and one from the last named locality is figured by Oberthür (*Lépidoptér. Comp.* 1912. VI. Pl. cxviii. 1040).

In Italy there are two races, in which the increase in the dark areas in both wings has a different distribution from that found in the aberrations mentioned above. In Liguria the race *italica*, Standfuss, occurs and in Tuscany the race *persona*, Hb., is found mixed with a small percentage of *italica*. In the Oberthür collection there are some specimens with an extra spot on the hind-wing in the same position as that occupied by the extra spot in *medionigra*, and in some of them the central spot of the fore-wing is absent. One of these is figured in *Lépidoptér. Comp.* 1912. VI. pl. cxvii. 1030, and my plate VII., fig 6, shows a second one. Though there are slight differences in the disposition of the other dark markings the resemblance to the heterozygous specimens from Oxford would be very close indeed, were it not for the yellow colour of the hind-wings. Standfuss crossed a male *persona* with a female *dominula* and obtained specimens intermediate in their markings all of which had red hind-wings, a result to be expected if the yellow of *persona* behaves like the yellow of *lutescens* as a recessive; in the reverse cross rather less than half the brood had red and rather more than half had yellow hind-wings, a result which can only be explained, if yellow is recessive, by supposing that his *dominula* was heterozygous for yellow. He named these specimens, heterozygous for the factor or factors for dark markings, ab. *romanovi*, and a form identical with, or closely resembling it, is said by Oberthür to occur in a wild state near Turin. There are various gradations linking up the lightest *italica* with the darkest *persona*, and in all probability there is more than one factor for dark markings, so that specimens of *romanovi* must sometimes show markings like the *italica* I have figured, though no such specimen is to be found in the Oberthür collection nor is one shown on the plate in Standfuss' *Handbuch*. The point is not without interest, because it demonstrates that insects as distinct genetically as *romanovi* and *medionigra* may be almost, if not quite, indistinguishable in external appearance. Beyond drawing attention to this one feature of the more lightly marked *italica* and *persona* I do not wish to discuss them further. The distribution of the dark markings is beautifully portrayed by Oberthür in his *Lépidoptérologie Comparée* vol. VI. and by Standfuss in his *Handbuch*. Specimens of *persona* reputed to have been taken in Kent were to be found in the Maddison and other old collections, but I do not know of any recent captures of this form in England and strongly suspect that they were of foreign origin.

Though these Italian races have been dealt with so fully, other forms, which show an extension of the dark markings, and which appear to be recurrent, have attracted little notice. In one of these the extension occurs chiefly on the basal half of the fore-wing.

ab. **basinigra**, nov. ab. In the forewing the basal spot near the costa is absent, and the second basal spot is either absent or reduced in size; the central spot is small and unusually long and narrow; the diameter of the sub-apical blotch is reduced in the long axis of the wing, and from its anterior end a long thin hook-like process runs towards the base almost parallel with the costa, or there is a white dot in the situation occupied by the extremity of this process; the apical

spots are very small, and the two spots near the termen are reduced in size; the two spots at the inner angle are separate but of average size; the black markings in the hindwing are well developed with the two spots near the anal angle united.

Two specimens are represented on the plate VII. (figs. 9 and 10), the first of which has no basal spots on the left side and only a very small one on the right. There are three specimens from the neighbourhood of Paris in the Oberthür collection from the Bellier collection, one of which is figured (*Lépidoptér. Comp.*, 1912, VI., pl. cxviii., 1039), and may be taken as the type. The size and shape of the spots in this form give it a very distinct facies.

Another very interesting aberration is figured in Ernst and Engramelle's *Papillons de l'Europe*, pl. cliii., fig. 197h. The two basal spots are small and narrow, and the central spot is reduced to a mere dot, but the other markings on the forewing are almost normal in size, though those at the inner angles are oblong. There is a considerable extension of black on the hindwing, but no tendency towards the formation of a transverse band. The red on the abdomen is reduced to two lines of dots, one in each sub-dorsal region. The specimen came from Francfort-sur-le-Mein, and its appearance suggests that it may be a mutation rather than a chance aberration.

I give a figure of another aberration from the Oxford locality bred by Mr. Newman in 1927 (pt. VII., fig 5). The left fore-wing is a little crippled and has only one small white spot, the anterior of the two at the inner angle. On the right fore-wing there are three small white spots, the sub-apical, the anterior of the two at the inner angle, and the anterior of the two at the termen. The discal spot on the hindwing is large, but there is no increase in the black on the hindwings at all commensurate with that on the fore-wings.

Ab. marita, Schultz, with the fore-wing entirely glossy black and with the hind-wing sometimes suffused with black was produced by treating the pupae with ice, and *ab. paucimacula*, Schultz., with some spots absent and the others reduced in size was also produced in the same way. In the most extreme examples of *paucimacula* the only remaining spot is the one at the inner angle. Seitz does not mention that these are artificial forms, but Spuler, who says he has some in his cabinet, figures one with other insects produced by temperature experiments (*Schmett. Europ. Taf.* 14. fig. 21) and Krodell figures several in the *Internat. Ent. Zeitschr.* 1905, vol xix. The Oxford specimen was the only abnormal member of the brood and its appearance is sufficiently like *paucimacula* to make one wonder whether it was produced by some external influence exerted during development, though frost cannot have been the cause, rather than by some abnormality of the germ plasm.

In the British Museum there are two specimens, which in the absence of any account of their origin must be assigned to *paucimacula*. Both agree in having a great extension of black on the anterior part of the forewings and some increase in the black markings of the same part of the hindwings. One is in the Oberthür collection labelled 'ex coll. Reynald' and the other labelled Lauban is in the general collection. I give figures of these insects, interesting, if they were not produced artificially, on plate VII., figs. 1 and 2. The white mark

on the hindwing of the Lauban specimen is due to a hole. There is also a British example in the Tring Museum.

From the foregoing remarks it will be seen that there is correlation between the amount of black on the forewing and that on the hindwing, though the increase may be greater in the one than in the other. Only in exceptional cases, as in *nexa*, is the increase confined to one pair of wings. It will be seen also that, when there is an increase in the black in both wings, the situation which it occupies is generally the same. In *persona*, though the whole of both wings is darkened, there is a tendency for the black coloration to be most intense in the central part of the forewings, and in the hindwings for it to spread along the nervures from spots in the centre of the wing on nervures 3 and 1 as well as from the margin. In *medionigra* it is increased chiefly in the centre of the wings, in *bimacula* in the central and distal parts, and in *basinigra* in the proximal half of the wings. In the most extreme forms produced by the action of cold all the light markings of the forewings may be obliterated, but the greatest amount of darkening in the hindwings of these specimens takes place in the anterior part, while in the less extreme there is a greater degree of darkening in the anterior than in the posterior part of both pairs of wings.

Ab. hamelensis, Pfluemer. (ab. *albimacula*, Favre.) *Stett. Ent. Zeitg.* 1879, XL. 158. Spots on fore-wing all white. Recorded from Germany, France, and England.

Ab. rossica, Kolenati. *Mel. Ent.* 1846. 95. Spots on fore-wing all white; hind-wings saffron yellow. Oberthür says "stripe on abdomen broader and size larger. Russia."

(*Ab. lutea*, Stdgr.), *Staudinger's Catalogue*, Ed. I., 1861, 24. "Al. post. et abdomine luteis." Staudinger treats this as a synonym of *rossica* in later editions.

Ab. lutescens, Obthr., *Lép. Comp.*, 1911, Vol. V., part 1, 18. Spots on fore-wing as in type, three basal ones orange; hind-wing orange-yellow; dorsal stripe of abdomen narrow.

Ab. lusitanica, Stdgr., *Iris*, 1894, VII. 256. Fore-wings as in type; hind-wings yellow. Local race in North Portugal.

Ab. intermedia, Rocci. *Atti Soc. Ligust.*, 1914, XXV. 190. Hind-wings and abdomen orange; black markings as in type. Intermediate between type and *rossica* (presumably *lutescens* is meant), both of which fly with it in Piedmont.

Ab. insubrica, Wackz., *Stett. Ent. Zeitg.*, 1890, LI. 216. Fore-wings with smaller spots; hind-wings tinged with yellow (obscure luteis).

Ab. bithynica, Stdgr., *Staud. Cat.*, Ed. II., 1871, 56. Spots on fore-wing all yellow or brownish (chamois leather colour: Oberthür); abdomen with broad dorsal stripe; (more black on hind-wing: Seitz). Local race in Asia Minor.

Ab. ochromaculata, Fuchs., *Jahrb. d. Nassauischen Vereins f. Naturkunde*, 1900, LIII. 41. Spots on the forewing all yellow ochre (ockergelben).

Ab. spaneyi, Strand., *Ent. Rundschau.*, 1912, XXIX. 64. Spots on the forewing orange-yellow and mostly larger; hindwings with typical colour and markings. (Pl. VI., fig. 1.)

Ab. bieli, Stdgr., *Iris*, 1894, VIII. 256. Spots on forewing all

orange-yellow; hindwing reddish-yellow (gelb-roth). Local race in Portugal.

Unnamed. Red of hindwing and abdomen replaced by pure white.

Ab. *domina*, Hb., *Europ. Schmett.*, no. 223. Staudinger says 'al. post nigris, basi maculis luteis, abdomine nigro' and sinks it as a synonym of *persona*. Reference to two copies of Hübner shows in both an insect with central spot of forewing absent and the others small, but with the black markings of the hindwing not much increased and clearly visible on a ground colour of a deep brown except for two small yellow patches. Oberthür quite correctly differentiates it from *persona* and compares the figure with that of Godart (*Nocturnes de l'Hist. Nat. des Lépidopt. ou Papillons de France*. Par. 1822), who depicts a *dominula* typical except that the red of the hindwings is replaced by brown, the usual black markings being clearly shown.

Ab. *nigra*, Spuler, *Schmett. Europe.*, 1910, Vol. II. 140. All light markings on fore and hindwings black.

(ab. *nigroviridis*, Thierry-Mieg.). Synonym of *nigra*.

Ab. *conferta*, Schultz. *Soc. Ent.*, 1904-5, XIX., 148. Forewing: all spots confluent.

Ab. *fasciata*, Spuler, *Schmett. Europ.*, 1910, Vol. II. 140. Spots on forewing confluent in pairs transversely.

Ab. *juncta*. Proximal and distal spots in discoidal cell of forewing united. (Pl. VIII., figs. 3, 4.)

Ab. *radiata*, Krodell, *Internat. Ent. Zeitschr.*, 1905, XIX. Two large white streaks at base of forewing on under-side.

Ab. *italica*, Standfuss., *Iris*, 1885, I. 26. Forewing: spots larger; hindwing very dark yellow, even reddish; (abdomen black with yellow lateral dots: Oberthür). Local race in Liguria, sporadic in Tuscany.

Ab. *donna*, Costa, *Ann. Soc. Ent. France*, 1842, XI. 239, Pl. 9. Forewing of *dominula*; broad black border to hindwing with one yellow spot in it; abdomen black or with yellow lateral dots. Similar to if not synonymous with *italica*.

Ab. *persona*, Hb., *Beiträge*, 1790, II. 4. Forewing: spots small; hindwing with yellow basal streaks and great extension of black. *Italica*, *persona* and intermediates form a local race in Tuscany.

(ab. *donna*, Esp.), *Abbild.*, 1794, IV., Pl. 150, fig. 1. Synonym of *persona*.

Ab. *postochrea*, Stauder, *Soc. Ent.*, 1925, XL. 7. *Domina* with the small pale spot of hindwing red ochre not yellow. I do not feel sure whether this is a form with brown hindwings and a small red ochre patch instead of the two yellow ones shown by Hübner, or a *persona*.

Ab. *romanovi*, Standfuss. Hindwing black increased, only base being red. *Dominula* ♂ × *persona* ♀. A form indistinguishable from these heterozygotes flies wild near Turin.

Ab. *medionigra*. Forewing spots reduced in size and almost always fewer, central spot seldom present; hindwing with black increased and extra black spot.

Ab. *bimacula*. Forewing with only two basal spots or with mere traces of others; hindwing: black at apex increased and broad black band across wing.

Ab. *basinigra*. Forewing with basal spots absent or represented by one small dot; central spot elongated; subapical spot hollowed out on basal side; others reduced in size.

Ab. nexa, Schultz, *Soc. Ent.*, 1904-5, XIX. 148. Forewing normal; hindwing: costal spot fused with those at inner angle and apex forming transverse band.

Ab. pompalis, Nitche, *Verh. zool.-bot. Wien*, 1924-5, LXXIV-V. (65). Hindwing very deep red; marginal spots united to form band; very broad costal spot; abdominal stripe very broad.

Ab. paucimacula, Schultz, *Soc. Ent.*, 1900, XV. 17. Forewing spots reduced in number, those absent being the two at apex, the lower of the two at inner angle, and the central; others small; hindwing normal. Elsewhere Schultz says spots reduced, often absent with one exception, black on abdomen and hindwing increased. This agrees with Krodell's plate (*Internat. Ent. Zeitschr.*, 1905, XIX.).

Ab. marita, Schultz, *Nyt. Mag. Nat. Krist.*, 1905, XLIII. 11. Forewing completely glossy green; no spots; hindwing sometimes dusted with black.

PLATE VI.

LEGEND.

fig. 1. *ab. spaneyi*. Oxford. Shows normal extent of light markings in this colony.

fig. 2. *ab. medionigra*, average specimen.

fig. 3. *ab. bimacula*.

PLATE VII.

figs. 1 and 2. *ab. paucimacula*. British Museum.

fig. 3. *ab. juncta*. England.

fig. 4. *ab. juncta*. Continental.

fig. 5. Oxford specimen near *paucimacula*.

fig. 6. race. *italica* to compare with heterozygote on plate I.

fig. 7. *ab. medionigra*. Heavily marked.

fig. 8. *ab. bimacula*.

figs. 9 and 10. *ab. basinigra*.

Zygaenae, Grypocera and Rhopalocera of the Cottian Alps compared with other races.

By ROGER VERITY, M.D.

(Continued from page 144.)

Melitaea phoebe race *syllion*, Frbst.—Oulx (males from July 4th; females emerge from July 6th till August 9th); Cesana; Clavières. This species contrasts with the preceding by its considerable local variability. The average features of the numerous races are, however, not easy to grasp and to designate, because individual variation is remarkably broad in most localities. Large series of specimens are, on this account, usually required. Most of the European races have been described and named singly, but, to my knowledge, no attempt has been made to group them and contrast them clearly, so that to study those of the Alps it will be necessary to begin by a general survey. The first remark to make is the rather surprising one that all writers have mistaken the author of the specific name. It is persistently attributed to Knoch, whereas it was erected in 1775 by Schiffermüller; if the latter's were to be considered a "nomen nudum,"



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