An elaborate anatomy of the eyes of caterpillars, with a comparison of their structure with that of the facetted eyes of perfect insects, from which it appears that these organs are nearly identical in their essential construction.

PASTEUR, —. Nouvelles études expérimentales sur la maladie des vers à soie. Comptes Rendus, lxiii. pp. 897–903 : November 1866.

——. Observations au sujet d'une Note de M. Balbiani relative à la maladie des vers à soie. Ibid. pp. 441–443 : September 1866. Observations relatives à cette communication [de M. Béchamp]. Ibid. pp. 427–428.

GENERAL NOTES.

GABRIEL KOCH (Die Indo-Australische Lepidopteren-Fauna) has subjected the geographical distribution of this order of insects to an elaborate discussion. He maintains that, as regards the Lepidoptera, we may divide the earth's surface into three great regions :—the American, including the whole of the western continent south of 60° N. lat.; the European, including the whole continent of Europe, with the Mediterranean district, the northern and temperate parts of Asia, and apparently the whole continent of Africa, although this has Indian affinities; and the South Asiatic or Indian, of which the Australian and Polynesian regions are to be regarded as continuations. In support of these views, he dwells, in the first section of his Division I., upon the general laws of the specific diffusion of insects, especially Lepidoptera, in which he admits the coexistence of two momenta—namely, the *simultaneous production of identical species in different places* (which is adopted mainly to account for the occurrence of species having wingless females, *Psychides*, in widely separated localities), and the *gradual dispersion of species by the exercise of their powers of flight aided by atmospheric currents*. In connexion with the latter proposition, he discusses at considerable length the phenomena of the monsoons in the eastern seas, and argues from them in favour of the possibility of the conveyance of insects possessing considerable power of flight, like the Lepidoptera, through the chain of islands forming the Eastern archipelago, to the Australian and Polynesian regions. In a second section of the same division Koch discusses "the production of colours in the pupæ, and the formation of varieties." He maintains that, although light may have some influence on the production of colour in insects, there are many cases in which brightly coloured species pass their pupa-stage either concealed in the burrows formed by their wood-eating larvæ, or buried to a considerable depth in the ground, and therefore sheltered from the direct influence of light; and suggests that the effect of light may be indirect, by its affecting the plants on

which the larvæ feed. The influence of the food-plant appears in all cases to be a very important one in determining variations; and the author seems to be almost as much impressed by it as Walsh, although he does not carry his conclusions to the same length. The causes of variation occupy the whole of this second section, the author's observations being directed more especially to the explanation of the changes taking place in Indian species during their migration to Australia, and after their settlement in that region. In the third and last section of the first division of his work (pp. 34–66) Koch enumerates the species occurring in both the South-Asiatic and Australian regions, many of which present variations consequent upon their change of abode, which have led to their being described as distinct species. These are :—

1. Ornithoptera *priamus* (Linn.), with vars. *richmondia* and *pronomus* (Gray), *arruana* (Feld.), and *crœsus* (Wall.); 2. Papilio *lycaon* (Boisd.); 3. *P. sarpedon* (Linn.)=*choredon* (Boisd.) and *medon* (Feld.); 4. *P. xuthus* (Linn.); 5. *P. agamemnon* (Linn.); 6. *P. erechtheus* (Don.); 7. *P. epius* (Fab.)=*sthenelus* (MacL.); 8. Pieris *philyra* (God.)=*plexaris* (Don.); 9. *P. ada* (Cram.), Amboyna and New Guinea; 10. *P. teutonia* (God.); 11. Terias *hecabe* (Linn.)=*herla* (MacL.); 12. *T. egnatia* (God.); 13. *T. læta* (Boisd.); 14. Callidryas *crocale* (Linn.); 15. *C. alcmeone* (Boisd.); 16. *C. hilaria* (Cram.); 17. *C. pyranthe* (Linn.); 18. Danais *schenkii* (Koch, sp. n.); 19. *D. melissa* (God.)=*Euplœa hamata* (MacL.); 20. *D. chionippe*, var. *affinis* (Hübn.); 21. *D. chrysippus* (God.), vars. *alcippus* (Boisd.) and ? *petilia* (Stoll); 22. *D. darchia* (MacL.)=*polita* (Erichs.)=*fulliolus* (Fab.); 23. *D. orope* (Boisd.); 24. Argynnis *niphe* (Linn.); 25. Vanessa *cardui* (Linn.) [its general distribution indicated]; 26. Junonia *orithya* (Linn.); 27. *J. vellida* (Fab.); 28. *J. ida* (Cram.); 29. Limenitis *heliodora* (Cram.); 30. Diadema *lasinassa* (Fab.), with vars. *auge, melita, antigone*, and *proserpina* (Cram.); 31. *D. alimena* (Linn.); 32. Charaxes *sempronius* (Fab.)=*pyrrhus* (Cram.), *tyrtæus* (Feld.), and *Jasia australis* (Swains.); 33. Cyllo *banksia* (Fab.); 34. Lasiommata *achanta* (Don.); 35. Mycalesis *remulia* (Cram.); 36. Messaras *lampetie* (Cram.)=*erymanthis* (Drury)=*susanna* (MacL.); 37. Lycæna *xanthospilos* (Hübn.); 38. *L. damaetes* ? (Fab.); 39. *L. bætica* (Ochs.); 40. Hesperia *ladon* (Cram.); 41. Nyctalemon *orontes* (Cram.); 42. Nyctemera *lactinea* (Cram.); 43. Euchromia *irus* (Cram.); 44. Macroglossa *cunninghami* (Boisd.); 45. *M. hylas*, var.; 46. Chærocampa *celerio* (Linn.); 47. *C. phœnix* (H.-Sch.)=*vigil* (Deless.); 48. *C. oldenlandiæ* (Fab.); 49. *C. scrofa* (Boisd.); 50. *C. erotus* (Cram.); 51. Sphinx *convolvuli* (Linn.)=*roseafasciata* (Scott); 52. Deiopeia *pulchella* (Linn.); 53. *D. ducis* (Walk.); 54. *D. syringa* (Cram.); 55. Aloa *lactinea* (Cram.); 56. Hypsa *silvandra* (Cram.); 57. *H. borbonica* (Boisd.); 58. Pitane *lydia* (Don.); 59. ? *P. medestina* (Walk.); 60. Oiketicus *doubledaii* (Westw.); 61. Attacus *cynthia* (D'Aubent.); 62. Ophidores *fullonica* (Linn.)=*pomona* (Cram.); 63. *O. cajeta* (Seba); 64. *O. salaminia* (Cram.); 65. Lagoptera *magica* (Hübn.); 66. *L. honesta* (Hübn.); 67. Cocytoides *cærulea* (Guér.); 68. Spirama *retorta* (Linn.), with many vars.; 69. Achæa *melicerta* (Drury); 70. *A. mercatoria* (Fab.) and var *tigrina*; 71. Trigonodes *cephise* (Cram.); 72. *T.*

hypasia (Cram.); 73. Ophiodes *tirrhæa* (Cram.); 74. Ophiusa *achatina* (Cram.); 75. *O. algira* (Linn.); 76. Abrostola *transfixa* (Walk.); 77. Heliothis *peltigera* (W., V.); 78. *H. marginata* (Klem.); 79. Grammodes *mygdon* (Cram.); 80. Prodina *retina* (Friv.); 81. Catagramma *festiva* (Don.).

Koch also mentions (*l. c.* p. 59) that he possesses several species of *Euplœa* and *Thecla*, and of *Noctuæ*, from Queensland, which he believes to be identical with species from the Indian archipelago, and he also notices some *Lycænæ* and *Hesperiæ* about which he is not certain. He believes the number of species common to the two regions and known to him to be more than 100. In an appendix (*l. c.* pp. 60–63), referring especially to Felder's "Species Lepidopterorum &c." (see 'Record,' 1864, p. 476), Koch enlarges his list of varieties of *Ornithoptera priamus*, refers *P. lycaon* and *evemon* (Boisd.) and *jason* (Linn.) to *P. eurypilus* (Linn.), and cites from Felder's catalogue as further examples of Indo-Australian distribution:—*P. canopus* (Westw.) = *hipponous* (Feld.); *P. ulysses* (Linn.) = *teligonus* (Feld.); *P. deiphobus* (Linn.) = *deiphilus* (Feld.); and *P. hector* (Linn.). *P. polydorus* (Linn.) is also noted as a doubtful species.

In the third great division of his work, Koch develops his views upon the general geographical distribution of the Lepidoptera upon the surface of the earth, in which he maintains, as already stated, that we may distinguish three great faunas:—the European, including Africa and the arctic regions; the Indian or South Asiatic, including the warmer parts of Asia, Malasia, Polynesia, and Australia; and the American. He indicates, in the first place, that the distribution of plants and the form of the land are the chief factors in determining the distribution, at all events, of phytophagous insects. The characteristics of each of the great divisions are then discussed in separate sections, both with regard to their climatal and other natural peculiarities and to their Lepidopterous inhabitants. Europe is said to be the region of the genera *Argynnis, Melitæa, Thais, Lycæna, Satyrus, Zygæna, Deilephila*, and the *Noctuæ* generally; Africa the region of the genera *Anthocharis, Acræa, Charaxes*, and *Romaleosoma*; the South Asiatic or Indian fauna is characterized by the genera *Ornithoptera, Danais, Euplœa, Limenitis, Adolias, Diadema*, and *Parnassius*, whilst the Australian subregion gives *Antipodites, Agarista, Hecatesia, Synemon, Teara, Opsirhina*, and *Oiketicus*; and America is the region of the true *Papiliones*, the *Pieridæ, Heliconidæ, Nymphalidæ, Satyritæ, Erycinitæ, Lycænitæ* (especially *Thecla*), and *Hesperidæ*, and of the genera *Castnia, Glaucopis, Euchromia*, and *Hyperchiria*. Africa, however, although represented as belonging to the European or what may be called the "western Old-World" region, especially as regards its northern portion, shows strong Indian affinities in the Lepi-

dopterous fauna of its southern and eastern parts; and these would doubtless appear still more strikingly from the consideration of Trimen's results, with which the author was unacquainted.

Prittwitz (Stett. ent. Zeit. 1866, pp. 259–275) notices Koch's results, with the addition of those derivable from Vollenhoven's *Pierides* of the Dutch East-Indian possessions. The view taken by Prittwitz of the general distribution of Lepidoptera differs somewhat from that advocated by Koch. He assumes four great regions, admitting Africa south of the Mediterranean district to a primary rank; his equivalent for Koch's European region starts from the Sea of Ochotsk, forming a broad band across the whole eastern hemisphere, and includes also the continent of North America, South America being regarded as a distinct region; the Indo-Australian region corresponds with that of Koch. As regards the conditions under which the forms of Lepidoptera occur in their different districts, Prittwitz holds that we may recognize :—

1. *Main groups*, that is to say, families rich in species and subgenera, which
   (*a*) sometimes occur in remarkable quantities in a particular spot, and
   (*b*) sometimes are diffused everywhere with slight modifications.
2. *Remains of groups*. A remarkable form, represented by a few very homogeneous species, may occur
   (*a*) either upon a particular, limited space, or
   (*b*) widely diffused, with a species here and there.

He illustrates these views by the following examples :—

1 *a*. *Melitæa* and *Argynnis* in the Mediterranean (European) region.

1 *b*. The *Vanessæ*, with their subordinate forms, the members of which are distributed all over the world.

2 *a*. The species of *Thais*, *Cyrestis*, and *Sericinus*.

2 *b*. The *Libytheæ*, *Brachyglossi*, and *Parnassiæ*.

Prittwitz remarks upon the species cited by Koch as common to the Asiatic and Australian regions. Of the Pieridæ described by Vollenhoven, *Eronia jobæa*, *Pieris aruna*, *P. bajura*, *P. celestina*, *P. mysis*, and *Terias puella* are Australian species not indicated by Koch. *Pieris teutonia* Prittwitz regards either as a persistent Australian form of *P. coronea*, or as a distinct Australian species. It is unknown to Vollenhoven. Prittwitz further remarks on the following species, chiefly with regard to their geographical distribution :—*Cyllo banksia* (Fab.); *Chærocampa phœnix* (H.-Sch.); *C. oldenlandiæ* (Fab.); *C. erotus* (Cram.) probably only an Australian species; *Ophideus fullonica* (Linn.) occurs in the Fiji Islands, as also *Lagoptera magica* (Hübn.);