

and by their separation through cells of the Malpighian layer. Generally this fluid is again combined with the pigment cells described above, the forms of which, more or less radiated, more massive or more slender, produce again different effects. Under the microscope, the free fluid coloring matter looks generally yellowish, if the effect is yellow; reddish, if the effect is red. Water added to this fluid when taken from the living specimen, causes it to collect in larger and smaller drops, and then their oily character<sup>1</sup> becomes evident by the characteristic blackish margin of the drops. We have still to mention another kind of color, which we see only in one genus of North American Turtles, namely, the white on the head of some specimens of the genus *Cistudo*. This appears under the microscope to be composed of grayish black heaps, and if these are further isolated, we find them composed of thin transparent plates, breaking like glass. All these pieces together produce the impression of a white tint upon the eyes, by interference of the rays of light, just as the powder of glass, the smallest pieces of which are also transparent under the microscope.

The range of variations which the colors exhibit in one and the same species, in many genera of our Testudinata, is almost incredible; and unless these variations are carefully studied, and their transitions watched for a long time, in every stage of growth, it is impossible to know how far they agree with the natural limitation of species. For this reason most descriptions of the colors of our Turtles are incomplete and unsatisfactory, being generally drawn from a few specimens. In several instances, nominal species have been distinguished merely upon differences in the coloration. This has been done to the greatest extent in the genus *Ptychemys*, as we shall see hereafter. Generally speaking, there are, however, certain tints which prevail in some species, while other tints are more common in other species, and in these cases the colors afford, to some extent, good specific characters. But it sometimes happens that not only the patterns of coloration, but even the colors themselves, are the same in every species of the same genus, so that coloration requires a special preliminary and extensive study for every genus, before it can be applied to the systematic characteristics of these animals.

<sup>1</sup> In relation to the nature of this oil, see D. Weinland on Birds' Feathers, in *Cabanis, Journal für Ornithologie* for 1854. He supposes that the yellow oil turns reddish by a kind of oxydation process, and thus, perhaps, also the reddish to brown, and this to black. Such an oxydation takes place, as we know, for instance, with extravasated blood, which turns black very likely by a process of burning. It is true, this is a pathological ex-

perience, and it may not seem proper here to refer to it; but pathology rests upon the same laws of organic chemistry as physiology. For studying these colors in Turtles, we recommend as fine objects the red and yellow rings on the marginal plates of *Chrysemys picta* and *marginata*. The beautiful brown-green color of the dorsal shield of the latter is produced by a network of black lacunæ lying on a homogeneous layer of yellow oil.