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THE PAINTED TURTLES OF THE
GENUS CHRYSEMYS

BY

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THE PAINTED TURTLES OF THE GENUS *CHRYSEMYS*

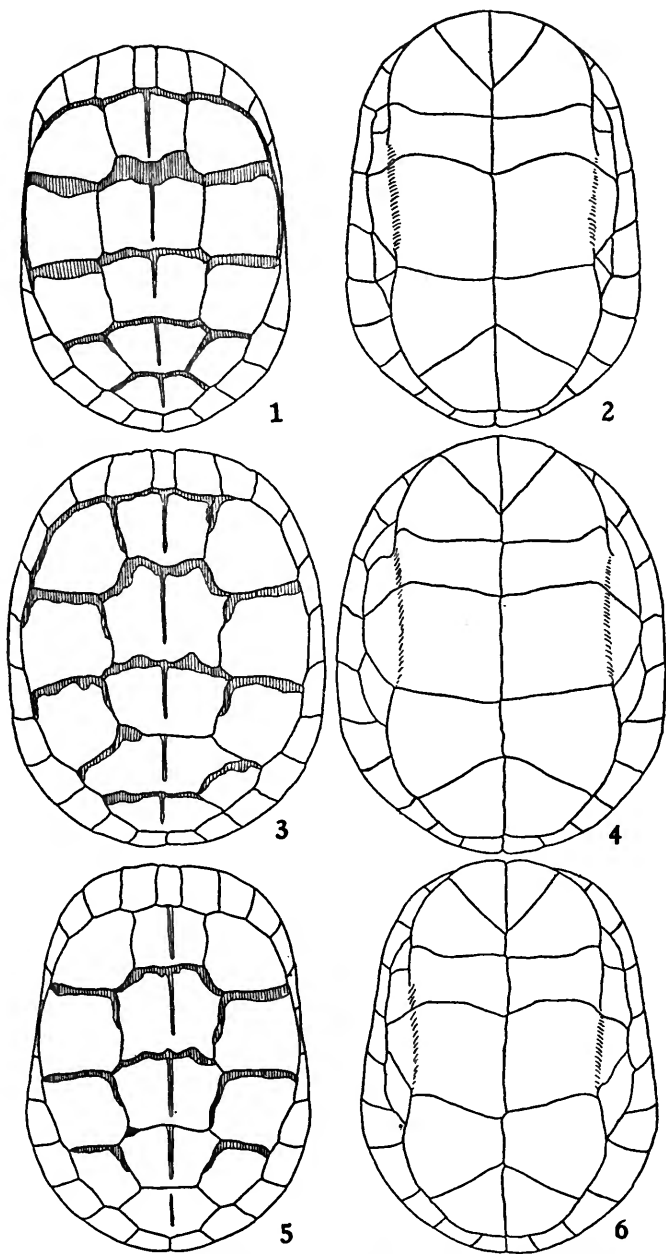
BY SHERMAN C. BISHOP AND F. J. W. SCHMIDT

The difficulty experienced in identifying certain painted turtles from eastern New York with either *Chrysemys picta* or *C. bellii marginata* and those from the vicinity of Chicago with either *C. bellii bellii* or *C. bellii marginata*, has led the writers to examine the specimens of these forms in the collections of various institutions, including Field Museum of Natural History, University of Wisconsin, New York State Museum, College of Forestry at Syracuse University, Cornell University, Hobart College and University of Rochester. To the authorities of these institutions we are much indebted for the facilities placed at our disposal.

Certain results of this study throw light on the general taxonomic problem of intergradation between subspecies. *Chrysemys picta* and *C. marginata* have been found to intergrade in a comparatively narrow area in eastern New York where the ranges of the two forms overlap. The subspecies *marginata* and *bellii* intergrade in a rather broad area in the Chicago region. *Chrysemys treleasei* Hurter, recognized in recent lists as a subspecies of *C. bellii*, has been reduced to synonymy.

Among the turtles placed in the genus *Chrysemys*, *C. picta* has been regarded as specifically distinct, and doubtless, when typical specimens are considered, it is the most aberrant member of the group. On the other hand, *bellii*, *dorsalis*, and *treleasei* have at times been designated as subspecies of *marginata* or, more properly, *marginata*, *dorsalis*, and *treleasei* as subspecies of *bellii*. But if intergradation between closely related forms be accepted as indicating subspecific relationship, the various valid forms mentioned above must be regarded as subspecies of *picta*.

Before attempting to indicate more particularly the status of these forms, it may be pertinent to mention briefly the characters which have been proposed to distinguish them. *Chrysemys picta* was described by Schneider in 1783. It is characterized by having the dorsal plates arranged in nearly regular transverse rows and broadly margined anteriorly with yellow. The plastron is yellow and immaculate. In the other members of the genus, the costal

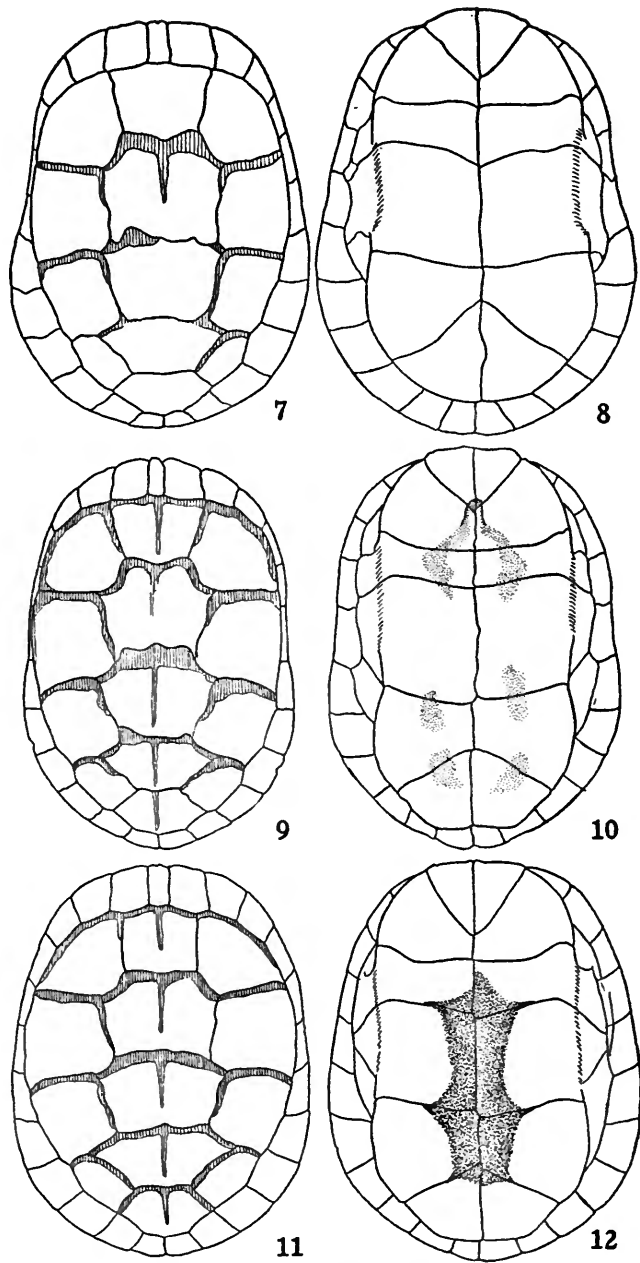


FIGS. 1-6. *Chrysemys picta picta* (Figs. 1-2) and intergrades with *Chrysemys picta marginata*.

plates alternate with those of the vertebral series and the colored margins of the plates are much narrower or absent. *Chrysemys bellii*, described by Gray in 1831, is further distinguished by the presence of net-like light lines on the carapace and by the great development of the plastral marking. In *C. marginata*, described by Agassiz in 1857, the dark ventral figure is much narrower. In *C. dorsalis*, Agassiz, 1857, there is a median dorsal light stripe conspicuously developed and the venter is usually immaculate. *Chrysemys treleasei*, described by Hurter in 1911, was distinguished by the red coloring of the plastron. It should be noted that Agassiz (1857, pp. 438-39) mentioned the occasional absence of the dark ventral figure in *marginata* and said that it was rarely developed in *picta*. Except in the case of *picta*, which has a different plate arrangement, it is obvious that color characters have been mainly relied upon to distinguish the various forms.

In an earlier paper (Bishop, 1923) attention was called to the fact that some painted turtles from eastern New York were intermediate in character between *picta* and *marginata*. Since that time many additional specimens have been collected and of these a sufficient number have been figured to indicate the character of intergradation. The drawings (Figs. 1-24) are reproduced from tracings of photographs which were subsequently bleached, and are therefore accurate.

A typical *picta* from Springfield, Massachusetts, is illustrated (Figs. 1-2, N. Y. S. M. No. 4116, ♀, 133 x 94 mm.). In a specimen (Figs. 3-4, N. Y. S. M. No. 8978, ♀, 140 x 110 mm.) from Hudson, New York, the *picta* characters predominate, but the dorsal plates are less broadly margined and there is a tendency for the costal plates to be slightly out of line with the vertebral. In the Albany, New York, specimen (Figs. 5-6, N. Y. S. M. No. 9017, ♀, 138 x 105 mm.) the dorsal plates are more narrowly or not at all margined and they are slightly out of line. In a single individual from Dunsback Ferry, Saratoga County (Figs. 7-8, N. Y. S. M. No. 9497, ♀, 150 x 112 mm.), the dorsal plates are nearly opposite as in *picta*, some broadly, others only partly margined with yellow. In all the specimens mentioned, the venter is without the dark figure. In a specimen from New Salem, New York (Figs. 9-10, N. Y. S. M. No. 3907, ♀, 161 x 114 mm.), the dorsal plates are broadly margined and intermediate in position while the plastron is provided with a faint interrupted figure. A further development of the ventral figure is to be seen in a specimen from Snyder's Lake, Rensselaer

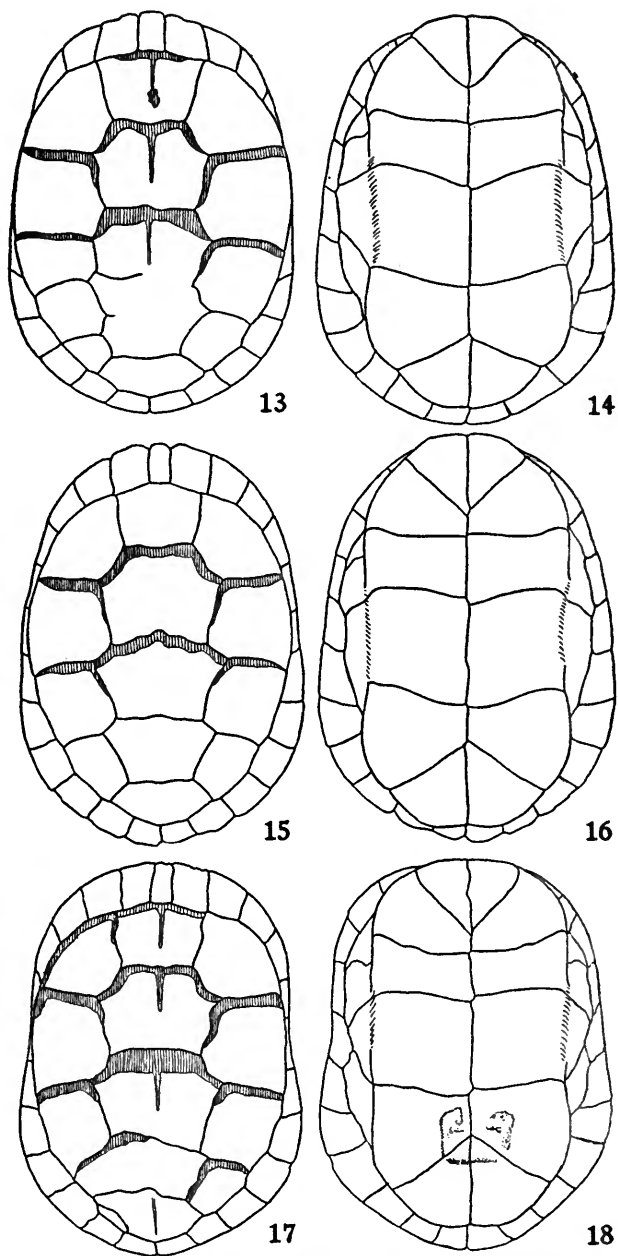


FIGS. 7-12. Specimens intermediate between *Chrysemys picta picta* and *Chrysemys picta marginata*.

County (Figs. 11–12, N. Y. S. M. No. 3906, ♂, 107 x 82 mm.). The dorsal plates are here broadly margined and nearly opposite, but the venter has a bold figure fully as well developed as in many specimens of *marginata*. A turtle from Voorheesville, New York (Figs. 13–14, N. Y. S. M. No. 9273, ♀, 138 x 100 mm.) has about half the dorsal plates broadly margined but nearly alternating; the venter is immaculate. A second specimen from Albany (Figs. 15–16, N. Y. S. M. No. 8960, ♀, 130 x 94 mm.), presents almost the same condition except that the plates are more perfectly developed. The condition noted in the specimen from New Salem (Fig. 9) is almost duplicated in a turtle from Lake Maxinkuckee, Indiana (N. Y. S. M. No. 4712, ♀, 146 x 108 mm.), a region wholly outside the range of *picta*. In this specimen (Figs. 17–18) it is evident that the ventral figure is only slightly developed and the plates are intermediate in position and broadly margined. The figure is introduced to emphasize the fact that occasionally an aberrantly developed individual may be found in any part of the range of a species. The structural and color characters are again intermediate in character in a specimen from Albany (Figs. 19–20, N. Y. S. M. No. 1188, ♂, 128 x 98 mm.). A specimen from Otisco Lake (Figs. 21–22) is typical of *marginata* in every respect except that the venter lacks the dark figure (N. Y. S. M. No. 4710, ♀, 153 x 114 mm.). Typical *marginata* from Lake Maxinkuckee, Indiana, is illustrated (Figs. 23–24, N. Y. S. M. No. 4711, ♀, 134 x 95 mm.). Some Canandaigua Lake, New York, specimens, otherwise typical *marginata*, are also without the dark plastral marking.

Other intergrades not previously mentioned have been noted from Rensselaer, New York (N. Y. S. M. No. 1726); near Saratoga, New York (N. Y. S. M. No. 1951); Thacher Park, Albany County, New York (N. Y. S. M. No. 9242); and Voorheesville, New York (N. Y. S. M. No. 9273). A single specimen from Chain Bridge, Washington, D. C., which was collected by John Greeley of Cornell University (C. U. No. 1052) has the dorsal plates broadly margined, the plate arrangement intermediate and the plastron with a faint figure. Both *marginata* and *picta* were observed at this locality in the same pool, but below the bridge and within the tidal area *picta* alone was seen, while above only *marginata* was noticed.

In a series of fifty specimens from the Palisades Interstate Park, preserved in the collection of the Roosevelt Wild Life Forest Experiment Station at Syracuse University, thirteen females and nine males are intermediate in character while twenty-nine are definitely

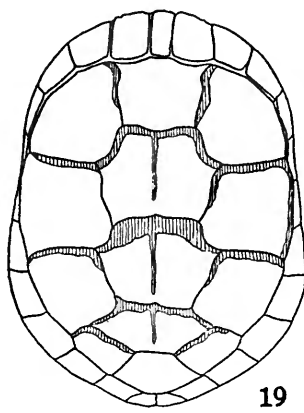


FIGS. 13-18. Specimens intermediate between *Chrysemys picta picta* and *Chrysemys picta marginata*.

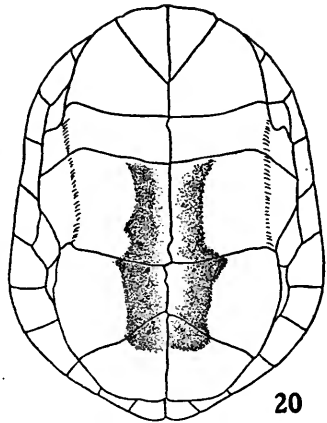
picta, a condition which may indicate that in this area there has been an imperfect amalgamation, due, perhaps, to the comparatively recent invasion of *marginata* from the west. Farther to the north, the valley of the Mohawk has provided an uninterrupted waterway from central New York to the Hudson and the majority of the specimens in the vicinity of Albany are intergrades. Within recent times, the Erie canal may also have served as a means of dispersal.

Long Island, Staten Island, and other southeastern New York turtles we have examined have been typical *picta* except two from the extreme eastern end of Long Island, on which red pigment had been deposited. Only a few individuals with *marginata* characters predominating have been noticed as far east as the Hudson River, one on the East Greenbush road three miles southeast of Albany and one at Ballston Spa a few miles west of the river. All those examined from collections made in the central and western parts of the state have been typical *marginata* except as noted in the case of those aberrant individuals lacking the dark ventral figure, collected in Otisco and Canandaigua Lakes.

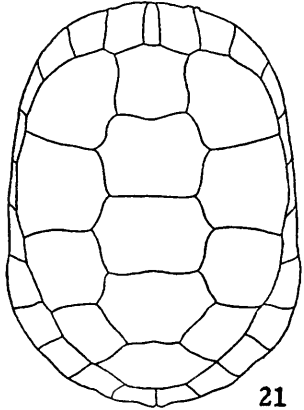
Basing our judgment on the material examined, we may limit roughly the area in which intergradation occurs in New York state to the valley of the Hudson as far north as Saratoga and south at least to the Palisades Interstate Park. How far the area may extend beyond these limits we have not been able to determine. *Chrysemys picta* has been recorded from Lake George and Lake Champlain but it is possible that intergrades occur in both these localities. It is also true that turtles identified as *picta* have been recorded from many localities in central and western New York, but the records are open to serious question. Thus Hall (1870, p. 19) lists *picta* from Irondequoit Bay, but the specimen itself, a skeleton, prepared at Ward's Natural Science Establishment and now in the New York State Museum, is definitely that of *marginata*. Several of the older records of *picta* were published before *marginata* had been established as a distinct species. De Kay (1842, p. 12) remarked that *picta* was to be found in every part of the state, his account antedating the description of *marginata* by fifteen years. Specimens from Fish Creek, St. Lawrence County, recorded by Hough (1852, p. 23) as *picta*, were also doubtless *marginata*. Eckel and Paulmier (1903, p. 394) lacking De Kay's justification for his belief, perpetuated his error with their statement that *picta* is "Very common throughout the state . . ." Other doubtful records are those of Britcher (1903, p. 122), who identified as *picta* turtles from Tully, Otisco,



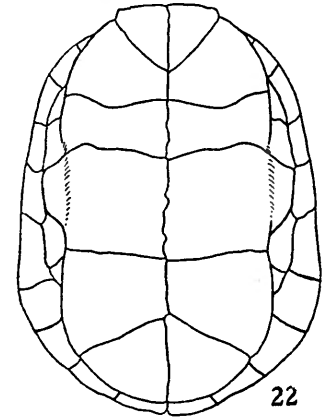
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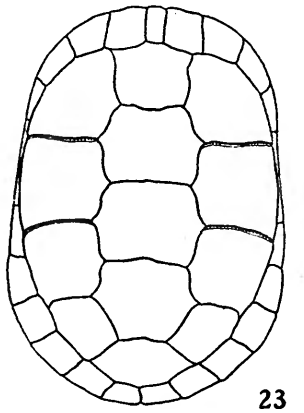
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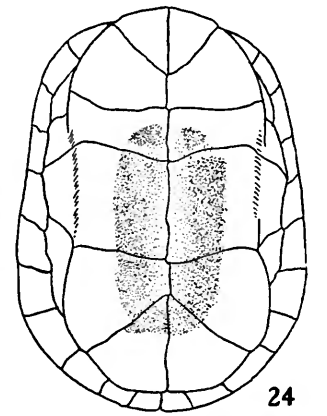
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FIGS. 19-24. *Chrysemys picta marginata* (Figs. 23-24) and intergrades with *Chrysemys picta picta*.

Seneca River and Dewitt, Onondaga County. We have examined a long series from this general region in the Roosevelt Wild Life Forest Experiment Station collection and have not found *picta* represented. The specimen from Axton, Franklin County, mentioned by Evermann (1918, p. 50) as *picta* is preserved in the National Museum (N. M. No. 33854). It is a recently hatched individual with six instead of five vertebral plates, an arrangement which disturbs the true alignment. The venter, however, has a dark figure and we would regard the specimen simply as an abnormal *marginata*. We have examined the specimen through the courtesy of Miss Doris Cochran of the Division of Reptiles, United States National Museum.

As noted, *marginata* and the more western *bellii* differ in a conspicuous color character, the extent of black plastral marking. In *bellii* this is nearly as wide as the plastron and sends out arms along the sutures between the various horny plates (Fig. 27). In *marginata* the black marking is narrower, and does not have the conspicuous projections of the western form (Fig. 25). These contrasted characters are figured, with an intermediate specimen from the Chicago area for comparison (Fig. 26). There do not seem to be any structural characters associated with this difference in coloration. This in itself has some bearing on theoretical taxonomy, for Amaral (1929, p. 86) has objected to the establishment of herpetological subspecies on color characters. In the present case a color pattern character affords an adequate distinction between subspecies which have been widely recognized.

The specimens available for study of the *bellii-marginata* problem fall into three groups: (1) pure *bellii*, from west of the Mississippi and from northwestern Wisconsin; (2) pure *marginata* from Indiana, southern Michigan, southeastern Illinois, Ohio, western Pennsylvania, and western New York; and (3) a highly variable, intermediate series from southeastern Wisconsin as far north as Oconto County, northern Illinois north of Chicago, and western Illinois as far south as the mouth of the Illinois River.

In the pure *bellii*, the greatest width of the black marking exceeds at least 55 per cent of the width of the plastron (the distance between the lateral edges of the abdominal plates) in all of the specimens examined, and it exceeds 70 per cent of all the plastral width in thirty-nine of the forty-four specimens, averaging 74 per cent, and ranging from 85 per cent to 56 per cent.

In fifty-one specimens from western New York, Pennsylvania, Ohio, Michigan, Indiana, and southeastern Illinois, the proportion

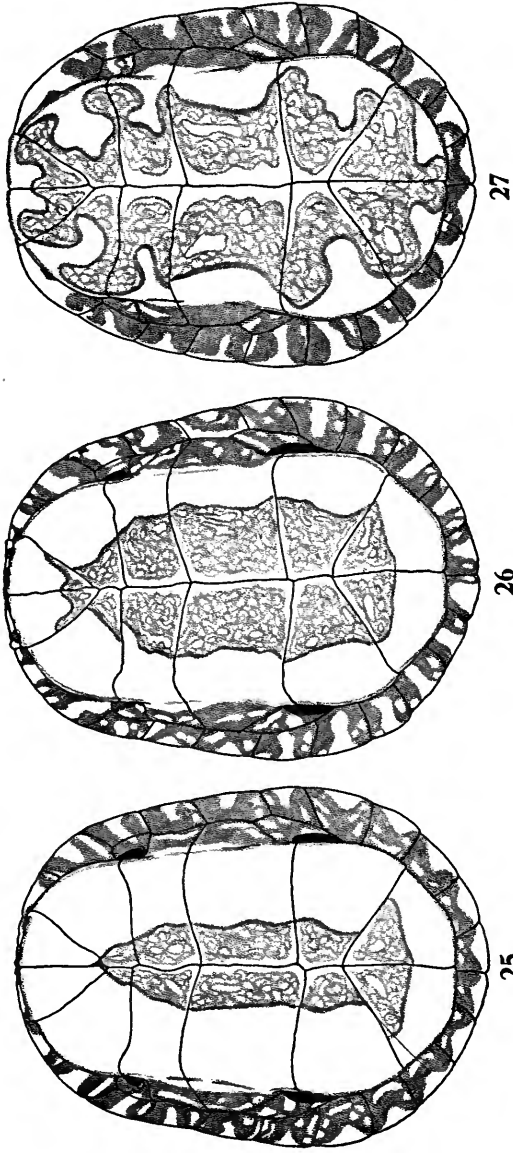


FIG. 25. Typical *marginata* from Mineral Springs, Porter County, Indiana. F. M. N. H. 3318.
 FIG. 26. A specimen from the area intermediate in character between *marginata* and *bellii*. Naperville, Dupage County, Illinois. F. M. N. H. 7453.
 FIG. 27. Typical *bellii* from Black River, below Nellisville, Clark County, Wisconsin. F. M. N. H. 14707.

of the width of the black marking to that of the plastron ranges from .13 to .67, averaging only .36. While there is a considerable overlapping of the higher figure for *marginata* with the lower for *bellii*, the number of specimens which are thus outside the normal figures is small in each case. Only one of the fifty-one *marginata* exceeds .55 in this proportion, and only seven exceed .50, while only five of the forty-four *bellii* fall below .70.

The population of painted turtles in the intermediate area, examined with reference to the average width of the black markings, is exactly intermediate between the average figures determined above; eighty-two specimens yield an average figure of .55, .19 below that of pure *bellii*, and .19 above that of pure *marginata*. The range of variation, in this intermediate population, .15 to .78, corresponds nearly to the whole range for both subspecies. The intermediate population accordingly intergrades with the adjacent purer stocks both by overlap of the numerical value of the distinguishing character with an intermediate average value, and by the existence of a high proportion of specimens in which the actual width is intermediate between the normal values for the two recognized subspecies. These eighty-two specimens range in locality from Oconto County, Madison, and the Mississippi River below Prairie du Chien in Wisconsin, to Cook County, the whole length of the Illinois River, and Madison, Monroe, and St. Clair Counties, in Illinois, that is, the whole of southeastern Wisconsin, and northern and southwestern Illinois. Pearse (1923, p. 145), has already called attention to the intermediate nature of the painted turtle population at Madison, Wisconsin. Broad as it is, the area of intergradation is still relatively narrow in relation to that of the purer populations of *bellii* and *marginata*.

The identification of individual specimens from this area has naturally been a matter of great uncertainty and difficulty, since some have wide, some narrow, and some intermediate markings. If the extremes be assigned respectively to *bellii* and *marginata*, the identification of those with a moderately wide marking is not simplified, for the question as to what limiting value should be placed on this character is plainly dependent for answer on an average value for a series of specimens. Furthermore, the average rises to the westward and diminishes to the eastward, within the belt of intergradation as above determined. Specimens from the intermediate area may best be designated as "Intergrades between *bellii* and *marginata*." They should not be divided up between the two sub-

species as has recently been done by Pope and Dickinson (1928), and by Cahn (1929).

The taxonomic relations indicated are evidently those of a typical pair of subspecies, geographic forms which intergrade along their boundary. The breadth of the area of intergradation in the present case is apparently due to the absence of physical barriers of any effectiveness between the two subspecies. It is not impossible that the two forms have differentiated while isolated during the last advance of glaciation, and that their intergradation is due to intermingling and hybridization in their meeting ground on their subsequent reoccupation of the glaciated territory. Genetic experiments both with pure stocks and with stock from the area of intergradation would throw light on this question.

Burt (1928) has considered a somewhat similar problem in the case of the collared lizards, *Crotaphytus collaris collaris* and *C. c. baileyi*. He finds that the western population of this species differs from the eastern in a character of the head scales, with a reciprocal overlap in the figures for the character employed of 22 per cent and 19 per cent. The amount of this overlap would be very greatly reduced if the intermediate population, in Texas and New Mexico, were separately considered. While his conclusion that it is not useful to maintain *C. c. baileyi* as a distinct form may be justifiable, the geographic relations indicated by his study seem to present an interesting illustration of an extreme case of inter-subspecific intergradation, in which the area of intergradation is actually wider than that of the uniform populations of the two subspecies themselves. This condition may well indicate an early stage in the formation of subspecies; but there is the alternative possibility that it is due to the reamalgamation of two formerly distinct forms. In either case, the comparability of the *collaris-baileyi* problem in *Crotaphytus* with that presented by the subspecies of *Chrysemys* is evident. These several pairs of subspecies therefore indicate that the sub-specific category includes a continuous graded series of possible types of intergradation, from species which intergrade on a narrow boundary to forms in which the pure stock is confined to opposite borders of the total range, the area of intergradation occupying the greater part of the intermediate area.

Chrysemys treleasei, described by Hurter from specimens collected in Madison, Monroe, and St. Clair Counties, Illinois (opposite St. Louis), was distinguished, in the original diagnosis, by the red coloration of the plastron. Specimens from Monroe and St. Clair

Counties in Field Museum have red plastrons, but attentive examination shows that this is due to a superficial deposit of a red pigment (doubtless an oxide of iron). Further examination of specimens of *Chrysemys* from widely scattered localities proves that such a deposit of red pigment may take place wherever this pigment is present in the water in sufficient quantity. A few such specimens, in illustration of this fact, are described below.

F. M. N. H. No. 5937. Dune Park, Indiana. Entire shell covered with a closely adherent red deposit, more evident on the plastron, where the ground color is lighter.

F. M. N. H. No. 2852. Miller, Indiana. Red pigment on the plastron, worn off on the lateral edges.

F. M. N. H. No. 2669. St. Clair County, Illinois. Entire shell covered with red pigment, which has been worn off on the plastron except for the gular, humeral, and anal plates, and for the grooves of the growth rings on the remaining plates.

F. M. N. H. No. 14706. Clark County, Wisconsin. Red deposit on both ends of the plastron and on the carapace. In this dried shell the deposit has cracked and may easily be rubbed off.

In the specimens figured by Hurter as typical of *treleasei* (Hurter, 1911, Pl. 24) the red deposit on the plastron may be seen to be worn off along the edges of the horny plates, while it is retained in the grooves of the growth rings, where it is protected against friction during locomotion. In his description (*ibid.*, p. 235-36) he says, "In the young of the first year the red plastron is divided into squarish fields by the proportionately wide yellow sutures." This coloration is shown (Pl. 23, Fig. 3). The yellow sutures are obviously the new growth of horny shield, on which red pigment has not yet been deposited, while the squarish red fields are the primary plates (that is, the horny plates of the first year's growth), which have not yet been shed. This same figure shows that the primary right anal plate has been shed, and hence there is no red on this plate. It seems perfectly evident that the red color of the specimens on which *treleasei* was based is due to this inorganic and superficial deposit of red pigment. A similar superficial deposit of red pigment is mentioned by K. P. Schmidt as occurring on two species of Chinese turtles, *Clemmys mutica* and *Cyclemys trifasciata* (Schmidt, 1927, pp. 405-6).

Although Hurter's specimens were evidently covered with a superficial deposit of inorganic red pigment, organic red pigment commonly occurs in specimens of *bellii*, somewhat more frequently in juvenile examples than in adults. The organic red pigment differs

from the inorganic in that it is not superficial, but is found in the Malpighian layer of the skin (the layer next to the bone). About half the living specimens examined from Madison, Wisconsin, had red plastrons, with organic red pigment as described above. These are intergrades between *marginata* and *bellii*. Five out of six specimens of *bellii* from Clark County, Wisconsin, had the plastron red in life. A juvenile specimen from Miller, Indiana (typical *marginata*), had the plastron coral red (Ridgway). Thus the painted turtles with a red plastron do not seem to have any relation to geographic range, and do not form a subspecies. It may also be noted that the organic red pigment of the plastron turns yellow in alcohol, while specimens with superficial inorganic red pigment remain unchanged.

Although we have tentatively included the area assigned by Hurter to *Chrysemys treleasei* in the area of intergradation between *bellii* and *marginata*, there is a distinct approach to *bellii* in the series from lower Illinois River, Monroe County, and St. Clair County, Illinois. In order to simplify the synonymy, we accordingly propose that *C. treleasei* be placed under *bellii*. The changes from the nomenclature of the "Check List of North American Amphibians and Reptiles" (Stejneger and Barbour, 1923) involved in this arrangement and in the recognition of intergrades between *picta* and *marginata* are indicated below.

Chrysemys picta picta (Schneider).

Testudo picta Schneider, Naturg. Schildkr., p. 348, 1783.

Chrysemys picta Gray, Cat. Shield Rept. Brit. Mus., pt. 1, p. 32 (part), 1856.

Chrysemys picta bellii (Gray).

Emys bellii Gray, Syn. Rept., p. 31, 1831.

Chrysemys marginata bellii, Stejneger and Barbour, Check List N. Amer. Amph. and Rept., (1), p. 118, 1917.

Chrysemys bellii bellii Ruthven, Sci., 59, p. 340, 1924.

Chrysemys treleasei Hurter, Trans. Acad. Sci. St. Louis, 20, p. 235, pl. 23, fig. 3; pl. 24, 1911.

Chrysemys picta marginata (Agassiz).

Chrysemys marginata Agassiz, Contr. Nat. Hist. U. S., 1, pt. 2, p. 439; 2, pl. 1, fig. 6, pl. 5, figs. 1-4, 1857.

Chrysemys marginata marginata Stejneger and Barbour, Check List N. Amer. Amph. and Rept., (1), p. 118, 1917.

Chrysemys bellii marginata Ruthven, Sci., 59, p. 340, 1924.

Chrysemys picta dorsalis (Agassiz).

Chrysemys dorsalis Agassiz, Contr. Nat. Hist. U. S., 1, pt. 2, p. 440, 1857.

Chrysemys marginata dorsalis Stejneger and Barbour, Check List N. Amer. Amph. and Rept., (1), p. 118, 1917.

The range of *Chrysemys picta bellii* extends from the Rocky Mountains to the Mississippi River, southward to New Mexico and Texas, presumably intergrading with *C. picta dorsalis* somewhere in Louisiana, Arkansas, and Texas, westward to the Pacific coast in Washington and British Columbia, and eastward through north-western and northern Wisconsin, upper Michigan (Ruthven, Thompson, and Gaige, 1928, p. 159) and the Lake Superior drainage of the province of Ontario (Logier, 1928, pp. 290-91). This extension of what is in the main a plains species through the heavily forested area of Wisconsin, Michigan and Ontario seems explainable in part by the highway for dispersal supplied by the valley of the St. Croix and by Lake Superior itself.

The range of *Chrysemys picta marginata* extends from eastern New York through western New York and western Pennsylvania, Ohio, Indiana, and the lower peninsula of Michigan and southeastern Illinois, intergrading with *C. picta bellii* in Illinois and Wisconsin, and presumably with *C. picta dorsalis* somewhere to the south of the Ohio River, the southeastern border of its range being ill defined.

It is unfortunate that nomenclature does not indicate more perfectly actual relationships. It is probable that *picta* is an eastern and *bellii* a western derivative of *marginata*. *Chrysemys dorsalis* may more easily be derived from *marginata* through the loss of the ventral figure than from *bellii* (whose range it also touches), in which the development of the plastral marking is much more greatly emphasized.

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