

## COLOR PHASES IN *HELICINA ORBICULATA TROPICA* 'JAN' PFR.<sup>1</sup>

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An interesting shell-color phase occurs in *Helicina orbiculata tropica* 'Jan.' Pfr., a small land snail found in abundance in northeastern, southern, and central Texas. Pilsbry and Ferris<sup>2</sup> have noted color variations in this species, stating that "some colonies are all white; others are mingled with red or blue shells".

Large colonies of these land operculates are characteristically found in sparsely timbered tracts of prairie land. While usually encountered in the more open type of limestone prairie habitat, this species is occasionally found in heavy woodland along streams. It also exhibits arboreal tendencies, and some individuals have been taken ten or fifteen feet above the ground on the hackberry (*Celtis occidentalis* and *C. mississippiensis*) and the cedar elm (*Ulmus crassifolia*).

They are active, it appears, only during rainy periods, when they move about, feeding on the lichen-covered trunks of trees, on tender shrubs, and on beds of humus. In a few localities near Dallas, they are so abundant that on several occasions as many as sixty-two snails have been collected from an area of not more than two square feet, and from four to nine distinct color patterns were represented in each such population.

<sup>1</sup>Descriptions of shell-colors are based on Ridgways' nomenclature (1912, *Color Standards and Color Nomenclature*). The color scale used by Ridgway "is represented by adding progressive increment of neutral gray to any color." Thus, colors numbered 1-71 represent colors unmixed with gray; colors 1'-71' contain 32% neutral gray; colors 1"-71" contain 58% neutral gray; colors 1'''-69''' contain 77% neutral gray; colors 1""-69"" contain 90% neutral gray; colors 1""", 15""", 23""", 35""", 49""", 59""", and 67""", contain 95.5% neutral gray, and are in reality colored grays. The term "tint" herein used, designates any pure or broken color "weakened by high illumination or (in the case if pigments) by admixture of white, or (in the case of dyes or washes) by excess aqueous or other liquid medium; as, a deep, medium, light, pale, or delicate (pale) tint of red." The term "tint," then, is in direct contrast with "shade," which designates any pure or broken color "darkened by shadow or (in the case of pigments) by admixture of black."

<sup>2</sup>Pilsbry, and Ferriss: "Mollusca of the Southwestern States, II", *Proc. Nat. Acad. Sci.*, Vol. 58 (1906), p. 125.

Most dead shells exposed in open fields or woodland areas are so much bleached that the color has faded completely.

The extensive series of shells of this species in the Carnegie Museum and Southern Methodist University collections, plus a small series lent to the writers by John Litsey of Dallas, give a good representation of the color range of this species in Texas.

COLOR DESCRIPTIONS OF SHELLS COMPILED FROM REPRESENTATIVE SETS IN THE CARNEGIE MUSEUM, SOUTHERN METHODIST UNIVERSITY AND LITSEY COLLECTIONS

Table I

The following table, based on collections (Carnegie Museum. Nos. 11258, 11549, and 11965) from Kendall County in south-central Texas, shows a preponderance of buff tints: eighty-six out of one hundred and ten shells displaying varying shades of this tint.

Color Number	Name of Color	Tints	Number of Specimens
15"	Y-O	Pinkish Cinnamon (b), fading to Light Pinkish Cinnamon (d), fading to Pale Pinkish Cinnamon (f), with an Ivory Yellow (21" f) lip.	1
15" " "	Y-O	Pale Mouse Gray (d), fading to Pallid Mouse Gray (f), with a Tilleul-Buff (17" f) lip.	1
17"	O-Y	Pallid Mouse Gray (f), fading. Cinnamon Buff (b), fading to Pinkish Buff (d), fading to Pale Pinkish Buff (f), with a whitish lip.	4
17"	O-Y	Pinkish Buff (d), fading to Pale Pinkish Buff (f).	1
17"	O-Y	Cinnamon Buff (d), fading to Pinkish Buff (d), fading to Pale Pinkish Buff (f).	7
17"	O-Y	Pinkish Buff (d), fading to Pale Pinkish Buff (f).	17
17"	O-Y	Pale Pinkish Buff (f).	4
17"	O-Y	Avellaneous (b), fading to Vinaceous Buff (d), fading to Tilleul-Buff (f).	1
17"	O-Y	Tilleul-Buff (f), fading to almost white.	2
17"	O-Y	Tilleul-Buff (f), fading.	10
17"	O-Y	Drab Gray (d), fading to Pale Drab Gray (f).	1
19"	YO-Y	Cartridge Buff (f), with the lip darkening to Cream Buff (d).	2
19"	YO-Y	Cartridge Buff (f), fading to whitish	1
19"	YO-Y	Cream Buff (d), fading to Cartridge Buff (f).	20

Color Number	Name of Color	Tints	Number of Specimens
19"	YO-Y	Cartridge Buff (f), fading to white, with an Ivory Yellow (21" f) lip.	2
21"	O-YY	Deep Colonial Buff (b), fading to Colonial Buff (d), to Ivory Yellow (f).	1
21"	O-YY	Ivory Yellow (f), fading to whitish.	1
21" "	O-YY	Olive Buff (d), fading to Pale Olive Buff (f).	2
		Pale Olive Buff (f), fading to almost white.	6
21" "	O-YY	Pale Olive Buff (f), fading.	8
23"	Yellow	Marguerite Yellow (f), fading to white, with a Pale Pinkish Buff (17" f) lip.	1
23"	Yellow	Primrose Yellow (d), fading to Marguerite Yellow (f).	1
23" " "	Yellow	Light Olive Gray (d), fading to Pale Olive Gray (f), fading to whitish.	2
		Pale Olive Gray (f), fading to whitish.	6
25" "	YG-Y	Mineral Gray (d), fading to Light Mineral Gray (f).	1
35" " "	Green	Pearl Gray (f), fading to white.	3
37" "	GB-G	Glaucous Gray (f), fading to whitish.	1
41" "	BB-G	Pale Media Blue (f), fading to whitish.	1
45"	BG-B	Light Alice Blue (d), fading to Sky Gray (f).	1

Table II

An examination of the following table (Carnegie Mus. Nos. 6178 and 11548) of shells from Kauffman County in northeastern Texas, shows forty shells from a collection of forty-six that display color tints in the gray series.

15" " "	Y-O	Light Mouse Gray (b), fading to Pale Mouse Gray (d), fading to Pallid Mouse Gray (f), to a Whitish lip.	1
		Pale Mouse Gray (d), fading to Pallid Mouse Gray (f).	1
17" "	O-Y	Avellaneous (b), fading to Vinaceous Buff (d), fading to Tilleul-Buff (f).	1
		Tilleul-Buff (f).	2
17" "	O-Y	Light Drab (b), fading to Drab Gray (d), fading to Pale Drab Gray (f), with white lip.	1
21" "	O-YY	Deep Olive Buff (b), fading to Olive Buff (d), fading to Pale Olive Buff (f), and ending in a white lip.	1

Color Number	Name of Color	Tints	Number of Specimens
21" "	O-YY	Deep Olive Buff (b), fading to Olive Buff (d), fading to Pale Olive Buff (f).	1
		Pale Olive Buff (f).	1
21" "	O-YY	Light Grayish Olive (b), fading to Smoke Gray (d), fading to Pale Smoke Gray (f), with white lip.	1
23" " "	Yellow	Olive Gray (b), fading to Light Olive Gray (d), fading to Pale Olive Gray (f), and with a whitish lip.	2
		Light Olive Gray (d), fading to Pale Olive Gray (f), and to white.	3
		Light Olive Gray (d), fading to Pale Olive Gray (f).	11
		Pale Olive Gray (f).	3
		Pale Olive Gray (f), fading to white.	10
25" "	YG-Y	Tea Green (b), fading to Mineral Gray (d), fading to Light Mineral Gray (f), with a white lip.	1
25" " "	Green	Hatlin Green (b), fading to Dawn Gray (d), fading to Pearl Gray (f), to white lip.	2
		Dawn Gray (d), fading to Pearl Gray (f), with a whitish lip.	3
37" "	GB-B	Dark Glauous Gray (b), fading to Deep Glauous Gray (d), fading to Glauous Gray (f), with white lip.	1

Table III

In the G. H. Clapp collection (Carnegie Mus. Nos. 503 and 504) from Uvalde County (which lies approximately twenty miles southwest of Kendall County), it will be noted that delicate tints of pink, yellow, and buff are displayed. Many of the colors fade to almost white.

Color Number	Name of Color	Tints	Number of Specimens
11"	Orange	Onion-Skin Pink (b), fading to Buff Pink (d), fading to Shell Pink (f).	1
11"	Orange	Onion-Skin Pink (b), fading to Pale Pinkish Buff in lip.	1
15"	Y-O	Pinkish Cinnamon (b), fading to Light Pinkish Cinnamon (d), with a Pale Pinkish Buff (17" f) lip.	1
15"	Y-O	Light Pinkish Cinnamon (d), fading to Pale Pinkish Cinnamon (f).	1
17"	O-Y	Pinkish Buff (d), fading to Pale Pinkish Buff (f).	4
19"	YO-Y	Cream Buff (d), fading to Cartridge Buff (f).	1
		Cartridge Buff (f), fading to almost white	1

Color Number	Name of Color	Tints	Number of Specimens
21"	O-YY	Ivory Yellow (f)	1
23"	Yellow	Marguerite Yellow (f)	
		almost white	6
		Almost white (probably by weather)	2

Table IV

The following table presents color ranges in the Southern Methodist University and Litsey collection. Eighty-six out of one hundred and ten shells exhibit varying tints of buff. This is of interest in view of the fact that in Kaufman County which adjoins Dallas County, to the southeast, gray tints predominate.

Color Number	Name of Color	Tints	Number of Specimens
9	OR-O	Burnt Sienna (k), with a Pale Ochraceous Salmon (13' f) colored lip; a narrow line of Pale Ochraceous Salmon follows indentations of whorls to their peak.	3
11	Orange	Orange Rufous (i), with a White (67"') lip.	2
11'	Orange	Apricot Buff (b), with a Seashell Pink (f) lip; a narrow line of Seashell Pink follows indentations of whorls to their peak.	3
11'	Orange	Seashell Pink (f).	7
15"	Y-O	Pinkish Cinnamon (b), with alternating White (67"') and Pinkish Cinnamon lines running parallel to body whorl	4
17'	O-Y	Warm Buff (d); Light Buff (f) lines radiating out- ward over second whorl and body whorl	22
19'	YO-Y	Naples Yellow (d), with White (67"') lip; narrow Naples Yellow line following in- dentations to peak of spire.	3
19'	YO-Y	Cream Color (f).	3
19"	YO-Y	Chamois (b), with a Cartridge Buff (f) line traversing the middle of the body whorl; a similar colored line following indentations of whorls to nucleus of spire.	6
19"	YO-Y	Cream Buff (d), with an Ivory Yellow (21" f) line traversing center of body whorl; a narrow Cream Buff line following indentations of whorls.	30
19"	YO-Y	Cartridge Buff (f).	10

Color Number	Name of Color	Tints	Number of Specimens
21"	O-YY	Colonial Buff (d), with a Marguerite Yellow 23" f) stripe extending through the center of body whorl; similar line follows indentations of whorls.	15
25	YG-Y	Sulphur Yellow (f).	4
67" "	Y-R	White	2

Table V

The following table presents data from a miscellaneous collection (Carnegie Museum No. 4817) of shells from Texas in which specific locality records are lacking. The wide range of tints (buff, blue, yellow, and gray) may indicate collections from several diverse localities throughout the state.

Color Number	Name of Color	Tints	Number of Specimens
17" "	O-Y	Avellaneous (b) fading to Vinaceous Buff (d), fading to Tilleul-Buff (f)	1
17" "	O-Y	Vinaceous-Buff (d), fading to Tilleul-Buff (f)	1
		Tilleul-Buff (f)	7
19'	YO-Y	Cream Color (f)	2
19"	YO-Y	Cartridge Buff (f), on upper whorls, with Burn Blue (47" f) on last whorl	1
		Cartridge Buff (f), fading to whitish	1
21"	O-YY	Straw Yellow (d), fading to Maddicot Yellow (f)	1
21"	O-YY	Ivory Yellow (f) approaching white below	2
21" "	O-YY	Deep Olive Buff (b), fading to Olive Buff (d), fading to Pale Olive Buff (f), with a whitish lip	2
21" "	O-YY	Pale Olive Buff (f).	2
23"	Yellow	Primrose Yellow (d), fading to Marguerite Yellow (f), to almost white	1
		Marguerite Yellow (f)	1
23" " "	Yellow	Olive-Gray (b), fading to Light Olive-Gray (d), fading to Pale Olive-Gray (f), with a Pale Olive Buff (21" f) lip	1
37" "	GB-G	Glaucous-Gray (f)	1
45" "	BG-B	Russian Blue (d), fading to Pale Russian Blue (f), and whitish around the lip	1
45" "	BG-B	Clear Green-Blue Gray (d), fading to Pale Green-Blue Gray (f), with a Pale Olive Buff 21" f) lip	1
		Whitish (by weathering)	

TABLE VI

Four small collections (Carnegie Museum Nos. 3884, 5856, 5974, and 1213) in which the first three (Comal, Cameron, and Hill Counties) are a part of the G. H. Clapp collection, and merely extend the range of color tints in this species.

Locality: New Braunfels, Comal County, Texas.

Color Number	Name of Color	Tints	Number of Specimens
17'	O-Y	Warm Buff (d), fading to Light Buff (f), with whitish lip.	1
19"	YO-Y	Cream Buff (d), fading to Cartridge Buff (f).	1
25'	YG-Y	Light Chalcedony Yellow (d), fading to Pale Chalcedony Yellow (f), with white lip.	2
Locality: Hillsboro, Hill County, Texas.			
21" "	O-YY	Olive Buff (d), fading to Pale Olive Buff (f), fading to almost white.	1
		Pale Olive Buff (f), fading to almost white.	1
21" "	O-YY	Smoke Gray (d), fading to Pale Smoke Gray (f), fading to almost white.	1
25" "	YG-Y	Mineral Gray (d), fading to Light Mineral Gray (f), to almost white.	3
Locality: Near Brownsville, Cameron County, Texas.			
21" "	O-YY	Olive Buff (d) fading to Pale Olive Buff (f), with white lip.	1
Locality: Near site of Indianola, Calhoun County, Texas.			
19"	YO-Y	Cartridge Buff (f), fading to almost white.	4
		Bleached to white	4

Table VII

Percentages of Component Colors and of Neutral Gray in the Broken-Color Series										Number of Specimens
Color Number	Name of Color	% of Red	% of Orange	% of Yellow	% of Green	% of Blue	% of Violet	% of Color	% of Gray	
9	OR-O	20	80					100		3
11	Orange		100					100		2
11'	Orange		100					68	32	3
11"	Orange		100					42	58	2
13'	OY-Y		91	9				68	32	3
15"	Y-O		80	20				42	58	7
15" "	Y-O		80	20				4.5	95.5	7
17'	O-Y		65	35				68	32	23
17"	O-Y		65	35				42	58	34
17" "	O-Y		65	35				23	77	17
17" "	O-Y		65	35				10	90	2
19'	YO-Y		47	53				68	32	8
19"	YO-Y		47	53				42	58	85

## FIELD AND LABORATORY

Color Number	Name of Color	% of Red	% of Orange	% of Yellow	% of Green	% of Blue	% of Violet	% of Color	% of Gray	Number of Specimens
21'	O-YY		25	75				68	32	1
21"	O-YY		25	75				42	58	25
21" "	O-YY		25	75				23	77	26
21" "	O-YY		25	75				10	90	2
23"	Yellow			100				42	58	27
23" "	Yellow			100				4.5	95.5	28
25	YG-Y			75	25			100		4
25'	YG-Y			75	25			68	32	2
25" "	YG-Y			75	25			10	90	5
35" "	Green				100			4.5	95.5	8
37" "	GB-G				93	7		10	90	3
41" "	BB-G				75	25		10	90	1
45"	BG-B				45	55		42	58	1
45" "	BG-B				45	55		23	77	1
45" "	BG-B				45	55		10	90	1
67" "	Y-R	52					48			11
Total.....										342

## SUMMARY

*Helicina orbiculata tropica* 'Jan' Pfr. shows color patterns ranging through various hues of red-violet, orange, yellow-orange, orange-red, orange-yellow, to yellow; through yellow, green-yellow, yellow-green to green; through green, and blue-green to green-blue. There are no shells whose colors are purely represented in the blue, violet-blue, blue-violet to violet series of hues. The colors are mostly broken or dulled, produced by the mixture of two spectrum colors, as red with violet, orange with yellow, yellow with green, or green with blue; most of which have been further reduced in purity by the admixture of neutral gray in varying proportions. The "warm" colors, near the red-end of the spectrum, (which have the longer wave-lengths) such as red, orange, yellow, and their combinations, are represented in the largest number of specimens. Only a few representatives in the collections show the "colder" colors lying near the violet end of the spectrum, (blue and green blue, which

have the shorter wave-lengths). The individual shells, with few exceptions, range through a graduated series of tints. In many of the shells the upper whorls start with a middle tint (d), and grade off through a paler tint (f); in other shells, however, the upper whorls start with the deepest tint (b), of a full color, and gradually fade through the lighter tints (d) and (f). Still other shells show a distinct color band which follows whorl-indentations or extends through the middle of the whorl. Shells of more or less uniform color are invariably represented by a pale tint (f), which may or may not fade to almost white. None of the shell colors is represented in the shades of a hue shown in the vertical Color Guide scale which runs downward from the middle horizontal line of full colors. There are many cases of a gradual fading from a deeper tone to almost pure white.

## DIATOMS AS A SOURCE FOR CALIFORNIA PETROLEUM: A SUMMARY REVIEW

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### Abstract

The diatom has been variously regarded as the major source, as an accessory source, and as a doubtful source for California petroleum. The two main lines of evidence cited by upholders of the first view are: (1) the intimate association of diatomaceous deposits with the majority of oil producing areas in the state, and (2) the observed ability of living diatoms to manufacture oil, which under favorable conditions could be stored in contemporaneous sediments. Opposed to this view are the facts that (1) some petroliferous areas in the state produce from horizons high above the postulated diatomaceous source beds, (2) some diatomaceous formations have shown no indication of being oil producers, (3) diatomite generally contains little or no hydrocarbons or fixed carbon, and (4) certain organic, siliceous shales, generally admitted to be source beds, contain relatively small amounts of recognizable diatom remains. An intermediate viewpoint holds that California petroleum is polygenetic, asphaltic oils having been derived from vegetable remains, including diatoms, paraffin oils having been derived from marine animals, such as foraminifera.

It has been known since early days of geological exploration in California that diatomaceous deposits are extensively developed within the state. Strata rich in diatom remains range in age from Cretaceous to late Tertiary, although by far the greatest volume of diatomaceous "shales" occurs in