On Brazilian fresh-water shells of the genus
Planorbis

by

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(With plates 15–18).

The fresh-water mollusks are intermediary hosts of the Trematoda, to which belong many parasites of importance for man and domestic animals. On account of this fact their study is not merely of malaco-ological interest, but also belongs to medical zoology, as well as the study of blood-sucking insects.

One of the most important genera of these mollusks is Planorbis, because the intermediary hosts of Schistosomum mansoni belong to it, as was shown in Egypt by a medical commission, directed by LEIPER, and afterwards confirmed by studies, made by me on Brasilian species. In the present paper I shall give the description and determination of the species, used in these studies; they are accompanied by good illustrations and preceded by some general notions for the use of readers less familiar with the matter. I add a catalogue of other Brasilian and South-American species, as found in literature, reproducing the descriptions and drawings, so as to help the determination of any species observed.

The fresh-water mollusks may be divided in Gasteropods and Bivalves. The gastero-pods walk on a single foot, provided with a sole; the head shows two or four antennae and the body is elongated. The simplest type is seen in the slugs which have no shell and show bilateral symmetry. Supposing a slug forming a shell, open at the cephalic end and increasing in width while the animal grows, the shell will take the form of a more or less elongated paper cornet. If one side grows more than the other, it will take a form like a ram’s horn; the circumvolutions may be twisted round each other in various ways, flattening themselves more or less by contact and so forming the enormous variety of shells, used chiefly for the classification of these animals. If the right side grows less, the shell will turn on this side
and become dextral, which is the rule; in the opposite case, it will be sinistral. When the shell is altogether elongated, conical, fusiform or globose, the opening in the dextral is opposed to the right hand of the observer, when the apex is directed upwards and the mouth forwards. In the sinistral, it takes an opposite position, to the left hand of the observer, and, in this case, not only the direction of the shell, but also the position of the organs of the inhabitant is reversed.

The gastropods of fresh water are either operculate or not operculate. The first include the largest forms in the genus *Amphalaria*, characterised by four antennae and a respiratory syphon. Their shell is usually globose, as in the common snails. They are generally known by the name of "arau" in Brazil and principally in the north, where they are eaten. The family *Melaniidae* contains other species, abundant in rivers, the shell being thick and calcareous, of elongated conical form, showing longitudinal sculptures and often a corroded apex. They frequently contain trematodes, but none of them is known to be of greater importance. Many *Melaniidae* are viviparous.

The most important species belong to the family *Limnaeidae*, formed by non-operculate fresh-water snails provided with lungs. In their form they are like many terrestrial species, often found near the water, but they are easily distinguished by their way of living; they are always found in the water (or close by, when they exceptionally leave it). Also they never have more than two antennae and the eyes are at their base. With exception of *Ancyclus* they have a large respiratory cavity, easily seen through the transparent shell.

For distinguishing our genera, the following key may be used:

1. Shell small, flattened like a shield. .................. *Ancyclus*

   Shell with distinct whorls. 2

2. Shell discoid, twisted like a watch-spring. ............ *Planorbis*

   Shell ovoid or sub-conical. 3

3. Shell sinistral. Antennae filiform. .................. *Physa*

   Shell dextral. Antennae enlarged at the base. .... *Limnaeus*

The three last genera have sub-genera; if these are given the value of genera the first pass to the rank of super-genera.

Of *Ancyclus* I observed a species corresponding probably to *A. moricandi* and a few others.

Of *Limnaeus* I observed a species which may be *viator* of D'ORBIGNY and is probably the intermediary host of *F. hepatica*; there are a few other species rarely found.

Of *Physa* I found two species, one of them common.

Of *Planorbis* four species, found in Rio, and seven more, observed in the North, are discussed in this paper.

While the genus *Planorbis* is easily recognized by the typical shell-form, the determination of the sub-genera and species is often very difficult. The former were mostly established long ago, with an insufficient knowledge of many species. These are distributed all over the world and already in 1850 numbered nearly 120. Considering that the species are often widely spread and rather variable, we might expect a large synonymy. The difficulty in obtaining all the literature, as well as the insufficiency of descriptions, often made from empty shells, form other obstacles.

If the characters, taken from the shell, are not sufficient, as a rule, the other ones, also, are not very satisfactory. The radula or scraper, which covers the tongue, has a very variable structure, used for the classification of families and genera but seemingly less useful for distinguishing sub-genera and species.

Our species may be divided in two groups, of which the first contains species with plenty of black pigment and abundant hemoglobin, dissolved in the blood and colouring it red. Form and size of the shell are variable but the whorls are always rather wide in relation to the diameter of the shell. With the animal inclosed the shell appears
very dark; however, when the mollusk, in consequence of a kind of albinism, shows little pigment, the result is a bright orange or reddish colour, due to the red blood. Our species belong apparently to the subgenera *Menetus* and *Taphius*, the latter forming a transition to the second group.

The second group consists of small flat species of light hue, due to the absence of red colour in the blood and of black pigment in the skin. The whorls are numerous, narrow and more or less flattened. The head, at least in three species, shows a yellow spot; the shell assumes a horizontal position. This group seems to belong to the sub-genus *Spirulina*.

Of the first group I observed about seven and of the second three species, figured at the end of this paper.

The shells of the mollusks generally show three layers, the exterior being formed by the epidermis; the middle one has a calcareous appearance, while the inner consists of mother-of-pearl. In the *Limnaeidae* the layers are not distinct; the fresh shells, formed principally by a conchoidal substance, the concholin, are very thin and transparent. Only in pathological conditions, when the epidermis is destroyed and the media attacked by small algae or other aquatic organisms, or in dead and old shells, the calcareous aspect appears, accompanied by a brittle consistence. The inner layer only shows at the opening of the shell where the last whorl ends in contact with the preceding one, forming a milky spot.

The colour of the fresh shell is variable in the same species, also the thickness, which seems to depend on external conditions. Some shells are almost hyaline of amber or honey colour, or rusty, or blackish. During life the colour of the animal shines through the transparent shell which, after death, shows a more variable colour, in consequence of decomposition. The form, resulting from the direction of the whorls, is also rather variable; if the specimens are numerous, some aberrations always exist, which, if found alone, might make the determination very difficult.

The colour of the animal may be light, of almost transparent or of opaque, more or less dirty white, or ocraceous. Many species have abundant black pigment which, however, may be much reduced in some individuals. In the larger and darker species the blood is distinctly reddish, on account of the haemoglobin, dissolved in the plasma. Such species, in specimens with much blood and little pigment, may appear reddish-brown, instead of black. In two species we even found individuals almost without black pigment, showing animals of bright orange colour which seemed to belong to another species. Such specimens are very useful for anatomical studies.

Dimensions ought to be taken from the largest specimens, which are comparatively rare, as only a small proportion attains the age limit. (In many mollusks the propagation takes place before full size is attained). In our group adult individuals do not show the thickening of the lip or free edge of the opening, seen in other shells, and so we run the risk of taking for small forms young specimens, belonging to large species. The dilatation at the mouth of the shell may be observed, as well in young, as in old specimens of certain species.

Characters are taken from the width or largest diameter of the shell, from the number of whorls and the way in which they cover each other, from the form of the perpendicular section and of the mouth or opening of the last circumvolution. The height at the mouth does not necessarily correspond to the largest diameter of the opening which may be oblique. Even the mouth is not perpendicular to the whorl, but more or less inclined and the last whorl may be deflected, upwards or downwards.

For understanding all these relations, nothing is more useful than a perpendicular section, passing through the center of the shell, opening all the whorls and showing the mouth, like those we give in the drawings of almost all the species. I think that
this new proceeding represents a real progress, as it clearly shows as much in one drawing, as three ordinary drawings, and makes a description unnecessary.

Whether the shell in the genus *Planorbis* be dextral or sinistral or variable, according to species, is a question on which the authors do not agree. This is due to the fact that the apex is not well defined. If we put the mouth in sinistral position, the upper face may be depressed and even distinctly umbilicated, which, to several authors, is a sufficient reason for orienting the shell in the opposite way. At the mouth the under side is longer, which to MOQUIN-TANDON is a sufficient reason for considering it as the upper one. Admitting these objections, I however, attribute such characters to secondary changes and adaptations, while, at least in the species I examined, the animal is sinistral (as in the nearest genus *Physa*); in this case the shell also must be considered sinistral. Drawing the shells in this position, we gain the advantage of exposing the mouth opening.

The animals of most European species of *Planorbis* are well described (for instance in the book of MOQUIN-TANDON), but those of other countries are little known.

In our drawings of various species of *Planorbis* the form and the position of the animals, inside and outside of the shell, is well shown. In walking, the animal rests on the sole of the foot, over the front-parts of which appears the head with two lateral lobes. On the under side the mouth is seen and its working may be appreciated when the animal feeds on the side of a glass jar. On the upper side we find the antennae which may be somewhat retracted, but not invaginated, as the eye-bearing antennae of the terrestrial snails. The eyes are situated inwards of their base, while outside and to the left the head and the male genital duct may be seen. The part behind the head and the foot and supporting both of them, may be called the neck, as it moves and turns with great ease. Behind the neck appears a kind of diaphragm, shutting the shell like a curtain, when the animal partly leaves it. It is the fold of the pallium and its posterior side runs backwards, forming the covering of the visceral cavity and the lining of the shell. The first part of the visceral sack is mostly occupied by the respiratory cavity which occupies the length of at least one whorl. It is, as a rule full of air and communicates with the outside by means of an opening provided with a sphincter, the *foramen respiratorium*. The extension of the cavity shows through the shell by increased transparency, which in smaller forms is almost complete.

The intestine and the genital ducts running along the wall are indicated by a more intense pigmentation. There are also spots, or a continuous layer of pigment situated in the pallium. Behind and near the posterior end of the breathing cavity the beating of the heart, formed by two cavities, may be faintly seen through the shell. Near it is the kidney, showing a glandular aspect, and behind it the large liver with its yellowish or greenish-brown colour. Above and inside its apical portion lies the sexual gland which furnishes the products of both sexes. It is known by its granular or vesicular appearance and well distinguished from the liver by its lighter colouring.

The intestine is divided in pharyngeal bulb (containing the radula), oesophagus, stomach and posterior gut. It extends backwards to the liver where it forms a loop returning forwards. The anus is found near to the opening of the breathing cavity.

I shall now discuss several Brazilian species of *Planorbis* which I observed alive, four of them being found near Rio de Janeiro. The drawings given are so accurate that they make the description almost unnecessary. I shall also mention other Brazilian and South-American species, reproducing the descriptions and drawings I found in the literature.

The three first species, given in natural size, are distinguished principally by the shell; the animals of all of them are blackish; the pallium of the respiratory cavity shows velvety
black pigment and the abundant red blood lends its colour to the tissues, principally to these of the visceral sack. The shell is carried more or less perpendicular to the support and has a conocean appearance. In life it is transparent, with ochraceous yellow or reddish-brown tint. In pathological conditions and after death it becomes opaque. All of them have at least five whorls when adult. Young specimens already show differences in the shell, which, however, is less dark, almost vitreous. The tissues also are less pigmented and the tegument of the respiratory cavity is only spotty (fig. 6). The red visceral part and the position of the shell show that they are young forms and not a small species.

The small species in the second plate (magnified) carry the shell generally parallel to the support and the blood is often apparently colourless.

I begin with the largest species, of which there are descriptions and drawings permitting to identify them.

1. Planorbis olivaceus SPIX
(Plate XV, fig. 1, a, b, c, d; XVIII 1, 2).

Syn. Pl. cummingianus (?), Pl. bahiensis DUNKER.

I give, in plate I, good figures of this species which seems limited to the North of Brazil; it does not occur near Rio de Janeiro which is important, as it is one of the principal intermediate hosts of Schistosomum mansoni. It is larger than all the other species. Samples received in large numbers from Aracajú were observed alive during a long period and agreed well with the drawings of SPIX and one of SOWERBY in the Conchologia of REEVE, also with one PIRAJÁ gave of Pl. bahiensis. The large Planorbis of Bahia agree in every detail with those of Aracajú, as I have since observed. Though the drawings mostly represent the shell only, they are sufficient because it is well characterized. The adjective olivaceus does not fit the shell very well, but, combined with brown or black, might refer to the animal which is less black than in the two next species. The two authors, SPIX and WAG-

NER, consider the shell dextral and give the following description:

"Planorbis olivaceus, Tab. XVIII, Fig. 1.
Pl. testa discoidea, tenui, superne plano depressa, inferne late umbilicata, olivacea, anfractu ultimo compresso.
a. Testa maiore: Pl. olivaceus SPIX, Tab. XVIII fig. 2.
b. Testa minore: Pl. ferrugineus SPIX, Tab. XVIII, fig. 1.

Testa discoidea, tenuis, pellicula, oblique striata superne plano depressa, inferne late umbilicata, epiderme tenuissima vestita. Anfractus quinque plano-convexi; ultimus maximus versus peripheriam compressus; omnes gyri umbilico latissime visibles. Apertura valvae obliqua; margine acuto. Color epidermis olivaceo-viridis aut olivaceo-lutescens; apertura alba; color testae decorticatae cae-
ruleo-albidus. Lengtudo 3 ½ lin., latitudo 1 poll. 2 ½ lin.

Habitat in rivulis silvestribus ad Ilheos et Almada, provincia bahiensi.

Observatio: Differt haec species a planorbi corneo testa humiliorre, anfractuque ult-
imo compresso."

To judge by the figures given, WAGNER was right in considering the specimen, named ferrugineus by SPIX, as just a small individual of olivaceus. Thus it would be a syno-
nym, as also probably albescens and viridis which WAGNER considered as young spec-
imens of another species (Planorbis lagu-
bris WAGNER), found in the same place.

D’ORBIGNY, who probably never ob-
served the real olivaceus, referred to ferrugi-
neus a rather common species of Rio de Ja-
neiro where the real olivaceus is not found. This same species, which I shall call confus-
sus, was figured in the Conchologia iconica also, with the ame of ferrugineus.

The exact drawings given in plate XV make a detailed description of the shell superfluous. I saw many specimens of the size represented, the largest diameter being 33 to 35 mm., but most of the individuals found are smaller. The height of the whorls, with exception of the last, is rather constant and always small; the last one
shows a greater height, although this is inferior to the width. Considering the shell sinistral, the upper half of the whorl is always narrower than the under one. Generally, the upper face is more concave and the last whorl a little deflected upwards (Pl. XV b), but sometimes the contrary may be seen (Pl. XV e). The opening does not show an angle on top, but in exceptional cases there may be a very narrow curve.

The colour of the shell varies from transparent conchous to light ocreaceous in life; after death it may become more or less opaque, whitish or straw-coloured. The part occupied by the animal always appears dark.

The animal itself is dark blackish; when little pigmented and full of blood, it appears reddish-brown; other specimens are dark olive in colour. The part over the respiratory cavity does not show as dark and velvety black as it may do in the two following species. The specimens from the north did well in captivity, but would not breed in the cooler season. They are easily infected with Schistosomum mansoni and spontaneous infection is pretty frequent.

Planorbis olivaceus was observed by SPIX in Ilheos and Almada, where we could not obtain it now; also by PIRAJÁ in the city of Bahia where it is quite abundant and the only large species. Other specimens were obtained in Aracajú where they were exceedingly common. It often occurs alone and sometimes with other species. As for the subgenus it agrees with Menetus ADAMS, though in size it is larger than the average. Planorbis bahiensis DUNKER, a possible synonym, is considered by VON MARTENS as intermediary between Menetus and Helisoma SWAINSON, 1840.

2. Planorbis confusus n. n. (Plate 15 fig. 2, a, b, c, d.)

This species was referred to by D'ORBIGNY as ferrugineus SPIX, but differs by the shape of the mouth, as described by D’ORBIGNY and figured in REEVE-SOWERBY, where confusus appears a second time with the erroneous name tenagophilus D'ORBIGNY. (For this and other reasons the name of SPIX cannot be used.) I found it in the same place as D'ORBIGNY. Fortunately it does not seem to exist together with the first species, which would make the determination of not very typical specimens rather difficult. The largest specimens, as shown in the figure, never come up to the size of the preceding species and the last whorl is generally bent a little upwards and narrower, but relatively higher, showing, in sinistral position, a rounded keel near the suture. The number of complete whorls does not exceed five, while in the preceding species there may be six. The animal differs little in both species, though that of confusus is a little darker.

The shell occurs in ditches and in pools of standing water, with or without aquatic plants, sometimes in very large numbers, of which only a few have reached full size. It is rarely found alone; in Rio it is often accompanied by the next species. The shell is transparent hony-yellow but looking black when filled by the living animal. It is often attacked by small algae, producing excavations, where the shell appears calcareous and white, becoming very weak and brittle. After death, the whole shell may become opaque and calcareous.

In his “Journey in South America” D'ORBIGNY mentions this species and gives the following description:

“Planorbis ferrugineus SPIX.
Planorbis ferrugineus et P. olivaceus SPIX, pl XVIII, fig 2.


P. corpore nigrentence. Testá discoideo-depressá, subdianpaná, ferrugínea, superne plano-depressá striáta subtus concavá subláevigatá, anfractibus sex, subangulato aperturá semilunari.

Diam. 30 millim. alt. 10 centim.

Cette belle espèce, remarquable par sa partie supérieure peu déprimée, par sa partie inférieure concave mais étroite comparative-
ment aux autres espèces, habite le Brésil, principalement les environs de Rio de Janeiro. Nous l'avons recueilli dans les marais de S. Christophe où elle est assez rare.

Son animal, blessé rend une liqueur rougeâtre sanguinolente.»

The observations of D'ORBIGNY on the Planorbis, referred by him to ferruginus SPIX, can not apply to olivaceus SPIX, as the dimensions would suggest. Not only is olivaceus never found in Rio (where Schistosomum is unknown) but the species still existing in São Christovão is our confusus (unable to transmit the parasite). Its largest specimens, but rarely found in Manguinhos, are very like olivaceus, but do not exceed 25 mm.

3. Planorbis (Menethes) nigricans
SPIX 1827.

(Plate 15 fig, 3 a, b, c, d.)

Syn. lugubris WAGNER 1827
Tenagophillus D'ORBIGNY, 1847
Biangulatus Spec. 25 of REEVE-SORBERY.

By the rules of priority SPIX's name seems to take the precedence; according to WAGNER, he gave it to the two larger of four specimens; the two others, called albicans and viridis, were young and one had lost its epidermis. They were found together with olivaceus. WAGNER, desiring the name of SPIX, gave another collective name and D'ORBIGNY, much later, still augmented the synonymy, without any necessity, as he must have known the work of SPIX and WAGNER. The last name, tenagophilus, is frequently found in literature. There is not much doubt about the identity; only for the species of other American countries one might desire a more exact comparison.

I give drawings of chosen specimens. As is the rule, the majority of specimens is not of the largest size, with a shell of about 18 mm. in diameter. The height of the whorls, forming the principal feature of the species, is rather variable and may attain about 8 mm. At the same time, the width is reduced becoming much less than the height. In sinistral position, the upper part of the whorls is very prominent and has a rounded keel. Below and outside, the whorls have another, less distinct keel. The horny shell shows a reddish brown colour, more pronounced than in other species, and is, sometimes, somewhat opaque, even in the live animal. The pigmentation of the animal is a little variable, but generally very dark; it becomes velvety black over the respiratory cavity. The species was found by SPIX, together with the first one, in the State of Bahia from where I received typical specimens, collected in Caravellas. D'ORBIGNY found it in the Argentine Republic; it also exists in Uruguay (1) and Paraguay; in Rio it is not rare. I got typical specimens from a ditch in Santa Cruz, where it was the only Planorbis. In Manguinhos and other places it is found together with the preceeding species, making the determination of some specimens difficult, because both the species vary and only the typical forms are easily distinguished, while the aberrations are more alike. I give a reproduction of the descriptions of SPIX and WAGNER and D'ORBIGNY.

SPIX et WAGNER, pag. 27.

"Planorbis lugubris WAGN. Tab. XVIII fig. 3, 4, 5, 6.
Pl. testa discoidea, tenui, utrinque profunde umbilicata, ferruginea; anfractibus rotundatis, oblique stratis.

a) Testa adulta maiore.

b) Testa juniores, minores: Planorbis nigricans, albescens et viridis SPIX, Tab. V.XIII Fig. 3, 4, 5, 6.

Chernitz, Conchylieenkabinet, Tom. IX, Tab. 127, Fig. 118.

Testa discoidea, tenui, pellucida, striis obliquis numerosissimis, subtilibus instructa; epidermide tenui vesteita. Anfractus quatuor rotundati; ultimus inflatus, cylindricus; cæteri gyri utrinque aream profunde, excavatam formantes, quae tamen in parte inferiore est

1) Specimens of Concordia in Uruguay, though apparently of the same species, have much larger dimensions (22-23 and 8-9 mm.)
Our specimens agree perfectly with the drawing of SOWERBY and the phototypy of the Venezuelan authors. With a width of about 18 mm. (2) and a height of about 5 mm., it is much larger than centimetrals, but much smaller than olivaceus. It has 5 ½ high and rather narrow whorls, kidney-shaped in section and with somewhat blunt superior keel. The shell is generally clean and polished, very transparent but somewhat yellowish; it contains a very black animal with plenty of red blood; it has a great attraction for the miracidia of Schistosomum and is easily infected by the antennae, as verified by me in specimens from Maranhão.

In REEVE-SOWERBY, Monograph of the Genus Planorbis the following description is found:

"PLANORBIS GUADALOUPENSIS.
Testa sinistrali, compressa, latâ, fulvâ, polita; spirâ concavâ, anfractus senis, convexusculis; ultimo anfractus magno, supra surtura elevatâ, tum declivi, infra latiusculâ; disco inferiori convexo, apertura subtriaugulâ, inferiori ad anfractus productâ.

SOWERBY, Genera of Recent and Fossil Shells.

Hab. Guadaloupe."

5. Planorbis centimetrals n. sp.
(Plate XVII fig. 8, a, b, c, d.)

In the State of Pernambuco, one of the principal centres of intestinal schistosomatis, the largest species of Planorbis are unknown, but a smaller one is widely spread, as well in rivers as in ponds. Trying to determine it, I found considerable difficulty. It looks somewhat like peregrinus D'ORB. of which F. BAKER mentions a specimen from Ceará which may belong to our species; the true peregrinus, however, which I obtained in Montevideo, is larger and differs by the form of the last whorl. BAKER also mentions stramineus DUNKER as a species of Ceará, but its size and form do not agree, if the drawing of REEVE-SOWERBY be correct.

1) This author cites also Nova Granada, Cayenne and Surinam.

2) Von Martens mentions specimens of 24 mm. (Venezuela and Surinam).
Without denying that this species may have been collected before, I do not think that it has been well defined, which obliges me to give it a name. I call it *centimetralis* to indicate the size which, in this case, helps very much to recognize it.

The shell of *centimetralis* has only four complete whorls, or 4 1/2, if the hollow centre is reckoned as half a whorl. Their calibre increases rapidly and the end of the last whorl is bent (see Plate XVII) upwards and dilated at the mouth. Form and direction of the whorls, (fig. 8 b,) are somewhat variable; both surfaces are umbilicated, the upper one being more excavated than the under one, which may be flat outside the navel. The shell shows fine spiral striae and an ocreous or, more commonly, rusty brown colour, being usually covered with opaque scars and often with algae and other organisms, **which may form larger crusts.**

The animal is black, but the pigment, although generally abundant, is absent in some animals, which show a ferrugineous or orange colour, partly due to a large quantity of red blood.

This species is found in smaller and larger brooks, which may even have a swift current; but then it seeks the muddy river-side where the water is more quiet. It feeds mainly on this mud and does not seem to do well in quite limpid water.

The specimens found in ponds often seem smaller and thicker and altogether a little different, but the dimensions are approximate and, there are intermediary forms which do not allow the distinction of two species.

The largest diameter of the shell is about 1 cm., varying 1 mm., to more or less (1).

*Centimetralis* seems wanting in the Capital of Pernambuco and in the river Beberibe, but occurs already in Socorro and-Ja-boaçao. It is common in the rivers Capibari-

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1) The dimensions given by V. MARTENS for *stramineus* agree with our species but not with the original description.
ment over the breathing cavity. The visceral part, while in the shell, appears rusty brown.

The eyes are middle-sized and the antennae rather long and pointed. The foot is short and the shell is carried parallel to the surface on which the animal walks. I refer the reader to the drawings distinctly showing the peculiar characters.

The same species was found in Bahia (Lagoa da Amaralinhá) and in the city of Natal. Specimens of Planorbis from the city of Parahyba (Lagoa de Baixo) appear somewhat larger and a little different; they belong to the following closely related species.

**7 Planorbis melleus LUTZ**
(Plate XVI Fig 5 a, b, c, d).

This little species of the sub-genus *Spi- rulina* does not agree with any found in REEV-SOWERBY, nor with other descriptions in the literature known to me. From *Pl. heloiṣcus D'ORBIGNY*, it is easily distinguished by the colour of the animal, and from *Sementina janeirensis* CLESSIN by the absence of the characters of this genus.

*Pl. melleus* has 5 complete whorls, or 5 1/2 with the hollow central part. Their section is asymmetrical, sub-reniform, without a keel, with acute internal angles only. In sinistral position the whorls have the upper part wider and the upper face of the shell more excavated. The calibre of the whorls increases very slowly. The mouth is oblique, somewhat sinuous and, sometimes, a little dilated but never thickened. Its largest diameter is oblique, about 2 mm, long; the last whorl has only 1 mm. in height; the largest diameter of the shell is 5 to 5 1/2 mm.

The shell is amber or honey coloured; in life the largest specimens appear ferrugious in the part occupied by the animal, which has long antennae. The foot is long and the lanceolate sole ends in an acute point, while the cephalic lobes are angular. The general colour is ochraceous-white with black markings and an orange-yellow stripe between the eyes, which are very large and rimmed with white principally on the outside. The animal is very lively and graceful. It likes to stretch the fore part very much out of the shell, which is carried horizontally.

In Rio de Janeiro I found this species in pools in Manguinhos and Meyer, also at kilometer 22 of the Leopoldina Railway, in a dirty pool without water-plants. In Meyer it was found between green algae in a pool formed by inundation. The species was also discovered in Aracajú and near the salt-works of Parahyba. This snail may resist some time to drought by burrowing in the mud. It is not very rare but easily escapes detection owing to its small size and its tendency to hide.

**8- Planorbis (Taphius) incertus n. sp.**
(Plate XVII, Fig. 9, a, b, c, 10 d).

I was unable to identify this small species, found by me in the Capital of Parahyba (Lagoa de Baixo) and in Limoeiro, state of Pernambuco (Lagoa da Estação). Its greatest width is about 6, its greatest height about 1 1/2 mm. It has four whorls or 4 1/2 with the hollow central part. The last whorl is deflected, the mouth looking upwards but not as much as in *nigritabris*. As shown in fig. 9 a, the mouth is more angular and the lip thinner. No black rim was noticed.

The shell is transparent, corneous yellow, somewhat opaque and whitish. There are spots of black pigment seen in the extent of about one circumvolution, and situated in the pallium of the respiratory cavity.

**9. Planorbis cimex MORICAND 1837**
(Plate XVIII, fig. 14 a, b).

Original description:
"P. testa depressissima, utrinque leviter concava, 6—volva, ultimo anfractu subitus plano, supra semiotundato.

Hab. les eaux douces aux environs de Bahia.

Ce petit planorbe n'a que six millimètres de diamètre, et un millimètre d'épaisseur. Les tours, au nombre de six, sont très serrés, plats en-dessous et convexes en dessus, sans carène saillante; mais le dernier tour paraît caréné, la moitié inférieure étant plate et la supérieure bombée; elles forment na-
turellement un angle à leur jonction. Sa couleur est cornée claire. Les tours s'enroulant dans un même plan, le centre de la spire est légèrement et également enfoncé dessus et dessous.”

The author of the name received the species from Bahia. BAKER observed it in the lake Papary and we found it in the city of Parahyba (Lagoa de Baixo), principally on the roots of *Pistia stratiotes*.

The animal is very much like that of *melleus* LUTZ, showing the same yellow stripe on the head, while the black pigment of the whole skin and the red one of the blood are equally wanting. The colour of the body is opaque, ocreaceous-white, like in many species of *Helix*, with the inner parts almost transparent; the very thin shell is almost hyaline, only slightly yellowish.

*Planorbis cimex, melleus and cultratus* seem to belong to the genus *Spirulina* together with *depressissimus* and a few other small and flat species. In those I found no parasites, nor do they seem to be concerned in the transmission of *Schistosomum*.

10. *Planorbis cultratus* D’ORBIGNY
(Plate XVIII fig. 10 a, b, c, d).

*This species* was described first from Cuba but it occurs also in Martinique and on the American continent. A species, thus determined by VON MARTENS, does not seem to be rare in Venezuela. BAKER found six specimens in the lake of Papary near Natal and considered this as the most southern habitat observed. VON MARTENS, however, mentioned it as living in Paraguay, where I have since found it too.) I collected many specimens in Lagoa de Carro and some in Limoeiro and in Victoria, in the State of Pernambuco, while Dr. PENNA found it in Pau d’Alho. It is easily recognised by its marked characteristics, which place it in the sub-genus *Spirulina* together with *cimex* and *melleus*.

Original description of D’ORBIGNY: “*Planorbis cultratus* D’ORB., Planorbe tranchant Tab. XIV, fig. 5, 8.

*Planorbis testa discoidēa, depressissimā, tenuī, diaphānă, laevigatā, succinēa, superne concavā, subitus complanatā, ad peripheriam carinato-cultratā, marginatā, anfractibus sex angulatis, supra convexis, subitus complanatis, aperturae triangulari depressā.

Dimensions, Diamètre. ........ 9 millim.
Hauteur. ........ 1 millim.

Coquille discoidale très déprimée, mince, fragile, transparente, légèrement concave en dessus, horizontale en dessous, dont le pourtour est fortement caréné, tranchant et marqué d’une bordure linéaire. Spire composée de 6 tours anguleux, convexes et séparés par des sutures marquées en dessus, aplatis en dessous.

Bouche triangulaire, étroite, transversalement déprimée; son angle est aigu et évidé en dessus.

Couleur. Succinée ou verdâtre.

Autant et plus déprimée que le P. compressus, cette espèce est bien plus triangulaire, plus caréné et à tours de spire plus larges. Parmi les espèces américaines, notre *Planorbis* kermaïoides est le seul qu’on puisse lui comparer; néanmoins le P. cultratus s’en distingue par sa plus grande dépression, par sa carène tranchante et bordée.

Nous en devons la connaissance à M. de Candé, mais nous ne la plaçons qu’avec doute parmi les espèces de Cuba, craignant qu’elle ne soit de la Martinique plutôt que de l’île espagnole’’.


In Lagoa de Carro I found *cultratus* sticking to a drifting piece of wood or floating horizontally on the surface of a large excavation, which had been made in a brick-factory and was filled with dirty water without any plants; in other places on *Pistia stratiotes* and *Polygonum hydropiper*. The animal has the same colour and the same orange-yellow stripe as *melleus* and *cultratus*. The shell is also carried horizontally.


Colour of the shell the same as in *melleus* but appearing black where the living animal
is seen through it. Whorls semilunar in section, a little narrower above, each whorl extensively covered by the next, which makes the counting difficult. The number in the largest specimens is 5 or 4 1/2 the breadth little more than 4, the height little more than 1 1/2 mm.

The whorls show a sculpture consisting of longitudinal lines of very small, round or more or less elongated beads, in varying number. On the upper side of the shell they are more numerous and distinct. Of other species only melleus shows signs of a corresponding, though somewhat different and less distinct, sculpture. The mouth of the shell may be somewhat expanded and show a subterminal black ring.

The animal comes near to that of Pl. melleus but is darker. It also has a yellow frontal stripe but the head seems shorter with more rounded mouth lobules. The foot too is shorter and less pointed. The eyes also are large but less distinctly white rimmed. The dark axial thread of the antennae is more distinct and the back of the foot covered with black points, while, the pallium shows inside the shell, a uniform black colour, varying from 2 to 4 mm.

Some twenty specimens were found in the middle of June near Manguinhos in a pool, covered with Lemna and Azolla. The species which has habits similar to those of melleus mihi does not agree with any of the described species. Though this paper was practically printed, I was still able to include the description here.

12. Planorbis (Spirulina) depressissimus MORICAND
(Plate XVIII fig. 15 a, b).

This species may be recognised by the drawing; it was described by the author of the name from specimens sent from Bahia. BAKER quotes an observation from the coast of Ceará, but a specimen sent me as depressissimus by FRANCISCO DA ROCHA belongs to cimex. Personally I have not seen this species, which seems rather rare,

13. Segmentina paparyensis n. sp.
(Plate XVIII, fig 20 a, b).

Original description by F. BAKER.

"Shell dextral, broadly, rather deeply umbilicate, rather solid, planorboid, everywhere sculptured with minute, retractive, sharp costulae, irregularly sized and spaced, the interspaces being broader, and showing under a strong glass, minute spiral striations on the base; they are formed by the crinkling of the radiating costulae; light horn coloured. Whorls 4, regularly increasing, the last subangulate below the periphery, behind the outer lip for about 1/4 turn, scarcely angulate below, descending very sharply at the mouth: apex depressed, only the last two whorls reaching the upper level of the shell. Aperture very oblique, subhorizontal, rounded; lip simple, not thickened nor sharpened, slightly reflected at the lower angle, extremities approaching, and joined by a slight callus in some specimens; aperture lamellae five, two parietal and three (palatal) on the outer wall; upper parietal lamella about central, the lower about midway between this and the columnellar junction and appearing about half the size to external inspection, both showing a nearly triangular section, the lower sides being nearly horizontal, the upper ascending; lower palatal lamella beginning near the suture and extending nearly transversely across the base, and slightly up the outer side, straight and rather evenly arched; remaining palatal lamellae deep within the shell, nearly horizontal, short, the lower one slightly larger.

Greatest diam. 6, least diam. 5,25, alt. 2 mm.

Two specimens were taken near the mouth of the main affluent of Papary Lake. It differs from S. januarensis Clessin by the unusually deep descent of the last whorl at the aperture?.

Neither in Río, nor in the north of Brazil did I observe any species of Segmentina.

14. Planorbis (Gyraulus) anatinus D'ORB.
(Plate XVIII, Fig. 13 a, b).

According to BAKER, this species described from the river Paraná, occurs in an
artificial lake in the city of Pará. Description and figure are reproduced in the appendix and on Plate XVIII (Fig. 13 a, b.)

Besides the species I mentioned, a few more might be found in Brazil; but the number of good species is small, and may not much exceed 15, which represents about the number of known species. In order to help the determination of such species and other new ones which might appear, I give a reproduction made of all the available drawings, published up to now, of south-american species, and a copy of the descriptions. In the Iconographia of REEVESOWERBY, there are many coloured figures of new or already described species, but the latter do not seem to be always well determined. The drawings are not very accurate and the colouring does not help, as it is not very natural. Only new species or those the original drawing of which was wanting, are reproduced, using a technique for the drawings which allowed to compare all the species. This work was done very carefully by a clever artist. I could not obtain all the literature and so a few species may be missed. I also advise comparing the central-american species of which several appear in South America. The distribution of fresh-water shells is altogether rather curious and not always in relation with that of terrestrial animals.

In the "Proceedings of the Academy of natural Sciences of Philadelphia", December 1913, FRED BAKER published a paper on the land and fresh-water mollusks of the Stanford Expedition to Brazil. In this he enumerates the following species:

**Planorbis anatinus** ORBIGNY — 25 specimens in a natural lake in Belém do Pará.

**Pl. cultratus** d’ORBIGNY — Lagoa de Papary near Natal, 6 spec.

**Pl. cimex** MORICAND — 13 spec. with **Pl. cultratus**.

**Pl. guadaloupensis** SOWERBY — Common near the lake of Papary with **cimex** and **cultratus**. Dead speci-

mens were not rare on the margins of lake Estremoz.

**Pl. stramineus** DUNKER — Lake Papary with the preceding species.

**Pl. depressissimus** MORICAND and **peregrinus** d’ORBIGNY — One specimen of each from the coast of Ceará, sent by SR. ROCHA.

**Segmentina paparyensis** n. sp. — 2 spec. from lake Papary.

**Planorbis anatinus** d’ORBIGNY — 25 specimens in an artificial lake in Belém, Pará.

**Pl. cultratus** d’ORBIGNY — Lagoa de Papary near Natal, 6 specimens.

**Pl. cimex** MORICAND — 13 specimens together with the preceding one.

**Pl. guadaloupensis** SOWERBY — Common near the Lagoa de Papary, together with the two preceding ones. Dead specimens were not rare at the border of Lagoa de Estremoz.

**Pl. stramineus** DUNKER — Lagoa de Papary with the preceding. Ceará — Mirim and Ceará.

**Pl. depressissimus** MORICAND and **Pl. peregrinus** d’ORBIGNY 1) — one specimen of each species, from the coast of Ceará, received from ROCHA.

**Segmentina paparyensis**, n. sp. — 2 Specimens from Lagoa de Papary.

List of south american species of Planorbis, mentioned in the literature.

(Fig. on Plate 18).

albicans Pfeiffer. Hab. Lima (Mus. Brit.)
REEVE. Spec. 117, F. 18. a, b. (Cop.).

anatinus D’ORB. Rio Paraná — D’ORB. p. 351 pl. XIV, fig. 17 — 20 F. 13 a, b. (Cop.)

andecolus D’ORB. Lake Titicaca F. 5, copy from the orig. f. 6 REEVE.

biangulatus SOW. (? = nigricans Brazil.)

1) Probably my centimetralis.
**Appendix.**

Copies of descriptions by different authors.

1. **Planorbis peruvianus D’ORB.**

   (Proc. zool. soc. 1882, p. 125.)

   P. testá discoideá, pellucidá, globulosá, albidá, striatá, superne concavá, infundibuliformí, subutus planá; anfractibus quinque, convexís, ultimo subdepresso; suturá profundá; aperturá obliquá, subdilatát. Diam. 10, alt. 8 millim.

   Hab. Trujillo (BRODERICK) e Callao (D’OBRIGNY), Perú.

2. **Planorbis montanus D’ORB.**

   P. testá discoideá, pellucidá, diaphaná, subdepressá, albidá, substriatá, superne subplaná, subutus concavá; anfractibus quatuor subconvexís: suturá profundá, aperturá obliquá; sub-pentagoná. Diam. 16, alt. 6 millim.

   Hab. Lago Titicaca, Bolivia.

3. **Planorbis andecolus D’ORB.**

   P. corpóre brunneo-rubescénte.

   Testá elevatá, subcrassá, minutissíme striatá, griseo-brunnescente, superne plano-convexá, subcarinatá, subus maximé umbílicalatá, carinatá, infundibuliformí, anfractibus tribus subconvexís: suturá profundá; aperturá magná, subdilatátá, pentagoná. Diam. 13, alt. 8 millim.

   Hab. Lago Titicaca.
4. Planorbis peregrinus D'ORB.

P. corpore caeruleo-nigrescoente.
Testa depressa, tenui, exiliissimè striata, corneo-viridescente vel albida, supernè plana, subtus concava, late umbilicata. anfractibus quinque convexis; suturâ profundâ, apertura subrotundâ, obliquâ. Diam. 13. alt. 4 millim.

Hab. Argentine, Bolivia and Ecuador, presenting local variations. It lives in large families specially in rivulets.

5. Planorbis heloicus D'ORB.

P. testa discoideâ, depressa, tenui, sub-laevigata, corneâ, superno subtusque plano-concava; anfractibus quinque rotundis, sub-convexis; suturâ profundâ; apertura rotundâ obliquâ. Diam. 8, alt. 1 1/2 millim.

Hab. Montevideo.

6. Planorbis helophilus D'ORB.

P. testa depressa, crassa, laevigata, albida, superno subtusque concava; anfractibus tribus rotundis, convexis; suturâ profundâ; apertura gibbâ. obliquâ; labro crasso. Diam. 5, alt. 1 1/2 millim.

Hab. Callao, Peru. The same (?) in the "Museu Paulista" labelled "Itatiba".

7. Planorbis kermatoides D'ORBIGNY.

P. corpore coeruleo, nigrescoente.
Testa discoideâ, depressissimà, tenui, laevigatâ, corneâ, superno plano-concava, subtus plano-concava, ad peripheriam carinatâ; anfractibus sex, subplanis; apertura angulatâ, compressâ, obliquâ. Diam. 13, alt. 1 3/4 millim.

Hab. Callao, Peru.

8. Planorbis paropseides D'ORBIGNY.

P. corpore nigrescoente.
Testa discoideâ, depressa, tenui, sub-laevigatâ, corneâ, superno plano-concava, subtus plana, ad peripheriam subcarinatâ; anfractibus quinque, subconvexis; apertura sub-angulatâ. Diam. 6, alt. 1 millim.

Callao, Peru.

9. Planorbis anatinus D'ORBIGNY.

P. testa discoideâ, globulosocompressà, tenui, laevigatâ, lucidâ, corneâ, superno subtusque convexa, centro solum concava, umbilicata, ad peripheriam rotundâ; anfractibus tribus, spiris cunctis amplexantibus; apertura compressissimâ, arcuatâ, semilunari. Diam. 2, alt. 1 millim.

Hab. Bajada, Entre-Rios.

(According to BAKER, this species was also found in Pará by the "STANFORD expedition").

10. Planorbis limayana LESSON.


Ce petit planorbe est commun dans les ruisseaux... entre Callao e Lima, au Pérou. L'animal a les tentacules longs et d'un beau noir, ainsi que ses autres parties. Son test a au plus 4 lignes de diamètre. Il est parfaitement plane, discoide, à cinq enroulements très-réguliers, à enfoncement ombilical, soit dessus, soit dessous, peu marqué. Les tours sont cylindriques, lisses et à peu près égaux, excepté l'externe qui est légèrement plus gros que les autres. Sa couleur est d'un fauve uniforme.

11. Planorbis depressissimus MORL. CAND.

P. testa depressissima, subtus plana, supra leviter concava, 5—volva, ultimo anfractu in medio acuta carinato.

Hab. les eaux douces aux environs de Bahia.

12. Pl. cummingianus DUNKER.

Pl. testa magna, discoidea, crassiuscula, supra cornea, subrufa, infra olivacea, nitida, obsoletissime striata, fere glabra, utrinque concava; anfractibus senis ovatis, sutura profunda divisis; apertura obliqua, ovato-sublunata.

Planorbi olivaceo simillimus, sed colore, testa crassiore, splendidiore, fere glabra,
umbilico latiore, anfractibus convexioribus minus involutis aliisque notis bene distinguendus.

Patria ignota.

13. Pl. stramineus DUNKER.

Pl. tenuistriata, nitida, parum diaphana, straminea, subcornea, supra plano-concava, medio impressa, infra umbilicata; anfractibus quatuor subrotundis; apertura dilatata, fere rotunda. Diam. maximus 6' fere, alt. 2'. Patria America australis.—Cumming.

E. VON MARTENS, Die Binnenmollusken Venezuela’s—p. 198.

14. Planorbis pronus, n. sp.

Testa subinflata, solidula, striata, lineis spiralibus impressis nonnullis exarata, supra profunde umbilicata, infra mediocriter excavata, anfr. 3 1/2, rapide crescentes, rotundati, sutura profunda discreti, ultimus infra inflatus ad excavationem basalem subangulatus, prope aperturam valde descendens; apertura diagonalis, subtriangularis, margine supero subhorizontali, leviter carenato, margine infero stricto, recedenti, columellari perpendiculari, subdilatato, paries aperturalis callo albido tectus.

Diam. maj. 10, mirm. 8, alt. 5, apert. alt. obliq. 5 1/2, diam. 4 millim. Valenciassee.

E. V. MARTENS, loco cit.
List of Literature.

The following books and papers were consulted:


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KOBELT W., Illustriertes Conchylienbuch.—Nuernberg, 1878.


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VON MARTENS, E, Die Binnenmollusken Venezuela.

I have not been able to consult the last paper but, thanks to Prof. CARLOS BRUCH in La Plata, I obtained a copy of the parts referring to Pl. guadalou- pensis, cultratus and pronus.