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NEW SPECIES OF FOSSIL SHELLS FROM PANAMA AND COSTA RICA[1]

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After the appointment of Mr. D. F. MacDonald as geologist to the Canal Commission, the collecting of the Tertiary fossils, so abundant in the Zone, was begun with energy. Amongst the material forwarded was a considerable amount of Pleistocene remains, chiefly from near Toro Point, Monkey Hill (Mt. Hope of some authorities), and the swamps about Limon Bay. All of this deposit was elevated but a few feet above the sea. While mostly composed of common Caribbean recent species there is also an interesting admixture of forms now living only on the Pacific Coast, such as *Northia northiæ* Gray, and *Pecten* (*Plagioctenium*) *ventricosus* Sowerby. Their presence shows that after the complete separation of the two seas a few of the Pacific species lingered on the Atlantic side nearly to the present epoch. The relative proportion of such species was greater in the Pliocene, while in the Oligocene connection between the two oceans was probably intimate, and many of the species are common to both slopes of the present isthmus.

Subsequent collections by Messrs. Vaughan and MacDonald have not greatly increased the list of those found in the earlier Pleistocene collections.

There is a certain number of species not identifiable with known recent species of the Caribbean waters, yet it would be rash to conclude that they are extinct. Almost nothing has been done to explore the waters in the vicinity of Colon for mollusks and it may well happen that when the dredge is used there most of the species described in this paper will be found in a living state. While the final report with illustrations may be somewhat delayed, it was thought best to describe these apparently new forms from the Pleistocene at the present time.

YOLDIA PERPROTRACTA, new species

Shell thin, elongate, inequilateral, rather bluntly pointed at the posterior, and more rounded at the anterior end; beaks depressed,

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inconspicuous, with a very minute prodissoconch, a very elongate narrow lunule and escutcheon present; the beaks about two-fifths of the total length behind the anterior end. Exterior polished, under a glass showing fine regular concentric striæ with wider interspaces; hinge with about 38 anterior and 48 posterior teeth separated by a small, subtriangular pit for the wholly internal resilium; pallial sinus wide, rather deep, extending nearly to the middle of the valve; the total dorsal margin forms nearly a straight line. Length 29, height at the beaks 8, maximum diameter 5 mm. There is a marked anterior and somewhat smaller posterior gape; the greatest height is at or a little in front of the beaks; the shell is as it were slightly constricted behind them.

The type was collected at station 5850, and is No. 214350, U. S. Nat. Mus.

ARCA (SCAPHARCA) LIMONICA, new species

Shell small, white, rounded below, with a straight hinge-line, carrying about sixteen teeth in an apparently unbroken line; beaks low, mesially impressed in a radial sense, situated a little in front of the middle of the shell; general form rounded quadrate, the area narrow, smooth; surface sculpture of twenty-five squarish, flat-topped, narrow radial riblets with much wider interspaces, the latter crossed by little-elevated, concentric, rather distant lamellæ more numerous and conspicuous toward the beaks. Length 4.0, height 3.5, diameter 2.5 mm.

Station, with the last. Type, U. S. Nat. Mus. 214351.

This little shell has the look of an adult or nearly adult. It is, at all events, apparently not identical with the young of any of the other species obtained from the same beds.

PITARIA SUBARESTA, new species

Shell thin, white, somewhat lozenge-shaped, with the prominent beaks at about the anterior fourth; the basal margin produced, anterior and posterior ends attenuated and roundly pointed; lunule cordate, large, nearly smooth, defined by a feeble incised line; escutcheon none; surface sculptured with rather sharp, narrow, concentric wavelets, with narrower valleys between; posterior end a little compressed and tending to rostration. Hinge of the subgenus, the teeth well developed, the hinge-line short; pallial sinus ascending, pointed above; margin of the valve smooth. Length 28, height at the beaks 23, diameter 15 mm.

Station 5868. Type, U. S. Nat. Mus. 214352.

This species has most resemblance to *P. aresta* Dall, of Porto Rico, but is more trapezoid in form, with a relatively larger lunule, the hinge teeth are of a different shape, as is also the pallial sinus; the shell is more nearly equilateral with a shorter, less arcuate posterior dorsal slope.

CORBULA MACDONALDI, new species

Shell large, nearly equivalve, having much the outline of *Macoma balthica;* anterior end longer, rounded; posterior end shorter; dorsal margin descending to a small angulation at the end of the basal margin; from the beak to this angle extends an obscure ridge behind which the surface is less sharply sculptured. There is no analogous anterior radial ridge. Beaks rather low, closely adjacent, the shell-margins evenly apposed with no gape. Surface finely, somewhat irregularly, concentrically striated; right valve with one strong recurved cardinal tooth in front of a pit under the beak which receives the resilium, the anterior and posterior dorsal margins grooved below to receive the margins of the opposite valve. Interior of the valve smooth, with very distinct muscular and pallial impressions and no pallial sinus; left valve with a spatulate process divided into a ligamentary and resiliary area by a mesial ridge, and behind it a pit into which the cardinal tooth of the right valve enters; dorsal margins of the left valve entire. Length of paired valves 19, height 15, max. diameter 10 mm. A larger valve is 23 mm. in length and 18 in height.

Station 5848. Types, U. S. Nat. Mus. 214353.

This is a very remarkable species not only on account of its unusual size, but because of its regular form and nearly equal valves. It is named in honor of the collector.

SPHENIA WALLACEI, new species

Shell small, myaciform, inequilateral, white; the anterior end shorter, wider, rounded; posterior longer, gradually narrowed and attenuated, terminally roundly truncate; pallial sinus coming nearly to the middle of the shell; outer surface rude, with irregular concentric sculpture; hinge of the usual type in the genus; length 9, height at beak 5, diameter (left valve only) 2 mm.

Station 5849. Type, U. S. Nat. Mus. 214354.

No species, except the very distinct *S. antillensis* of Porto Rico, has been reported from this region. It is named in honor of the former chief engineer of the Canal project.

HAMINEA CANALIS, new species

Shell small, short, cylindrical, subequally rounded at both ends, a shallow pit at the apex, a rather callous pillar with a very minute chink behind it, more noticeable in the young shells; outer lip parallel with the body, but little elevated above the summit of the shell; surface polished, entirely and uniformly covered with sharp spiral striæ with wider interspaces. Some of the specimens show a feeble constriction about the middle. Length 4.0; max. diameter 2.0 mm.

Station 5850. Type, U. S. Nat. Mus. 214355.

This species is notable for its short and cylindrical form and close spiral striation; the latter character varies a little in density in different individuals, but always covers the whole shell. *H. papyrus* A. Adams is perhaps nearest to it, but is proportionately longer.

MARINULA COLONIA, new species

Shell small, of about four whorls, brown, with a darker band at the suture and another at the periphery; the spire short and blunt with an obtuse shoulder to the last whorl; outer lip sharp, simple; body smooth with three very prominent lamellæ, the posterior strongest; pillar curving evenly into the outer lip. Height 5.0; max. diameter 3.0 mm.

Station 5868. Type, U. S. Nat. Mus. 214356.

This genus is reported in the recent state to be confined to the West Coast of Middle and South America, Australia and the Mediterranean.

OLIVELLA MYRMECOÖN, new species

Shell very small, stout, solid, short, of about five whorls; the spire about one-third the whole length, the suture narrowly but deeply channelled. Surface smooth, whitish in the fossils; body with a thin coat of callus, pillar excavated, with a single prominent plait on the outer edge; anterior fasciole short, smooth, the posterior edge abrupt. Length 4.0; max. diameter 2.0 mm.

Station 5849. Types, U. S. Nat. Mus. 214357.

This small but apparently adult species occurs in large numbers. It is notable for its robustly oval form. *O. mutica* Say, is allied to it but is much larger and with a much more profuse deposit of callus. The young of *O. mutica* is proportionately more slender and longer.

CERITHIUM (POTAMIDES?) MILIUM, new species

Shell small, solid, compact, whitish with about eight whorls; nucleus minute, smooth, of about two whorls, followed by reticulately

sculptured whorls, the first with one, the second with two, the third with three, the fourth with five, the fifth with seven, and the last with twelve, equal, revolving threads with subequal or wider interspaces, crossing numerous small, rather obscure axial ridges, and more or less nodulous at the intersections; sutures very distinct but not channelled; upper whorls slightly flattened, last whorl rounded; siphonal fasciole obscure; aperture obovate, outer lip heavily thickened; inner lip with a marked callous deposit; both lips smooth inside; canal short, ample, nearly closed in front. Length of shell, 4.2; of last whorl, 2.5; max. diameter 2.2 mm.

Station 5849. Type, U. S. Nat. Mus. 214358.

Though small, this is a very distinct little species, looking on a casual glance much like a cancellate *Rissoina*. The fossils are of a whitish color.

BITTIUM PANAMENSE, new species

Shell small, slender, dark brown, with deep sutures and six or more very rounded whorls; nucleus absent, subsequent whorls with an exclusively spiral sculpture consisting of very fine, spiral, regularly minutely beaded threads separated by wider interspaces which are filled by two or three still finer, simple, closely adjacent threads; there are seven or eight of the beaded threads on the last whorl. Aperture rounded, the outer lip flaring, hardly thickened; inner lip with a wash of enamel, both smooth, with no posterior sinus; canal short, slightly recurved. Length of shell 7.5, of last whorl 3.50; max. diameter 3.0 mm.

Station 5850. Types, U. S. Nat. Mus. 214359.

There is no known recent species of the region with which this can easily be confused.

TEINOSTOMA (PSEUDOROTELLA) GOETHALSI, new species

Shell small, depressed-turbinate, whitish, of about three whorls, with closely appressed suture, nucleus minute, smooth; last whorl spirally sculptured with two strong grooves at the shoulder, between which are two closely adjacent threads which are sometimes condensed into one prominent thread; marginating the base is another conspicuous groove with a prominent thread behind it; the peripheral space between this thread and the anterior groove at the shoulder is cut by five or six sharp, subequally distant striæ; in front of the marginating basal groove are one or two adjacent spiral threads; the space between the suture and the posterior shoulder groove, the peripheral space, and the base outside the umbilical callus, are

sculptured with fine axial or radiating subequal plications, which are strongest on the base and least prominent on the periphery. The umbilical region is covered by a rather thick, smooth callus. The aperture is very oblique, rounded, the outer lip thin, simple, the labrum with a thick layer of enamel. Max. diameter of shell 2.0; minimum diameter 1.6; height 1.0 mm.

Station 5850. Types, U. S. Nat. Mus. 214360.

There are a number of species related to this one from the same region and from the so-called Pliocene (Gabb) of Costa Rica, but the sculpture of *T. goethalsi* is more complex than in either of the others. It is not uncommon in the marl about Limon Bay, Panama.

CADULUS VAUGHANI, new species

Shell small, white, the girdle or maximum swelling at about the anterior fifth or sixth of the shell, behind which it tapers evenly, with a very slight arcuation to the posterior end. The latter in perfect specimens is circular, the margin divided into four, short, triangular teeth or processes by four indentations opposite one another, of which the lateral notches are most conspicuous. The intervening projections are frequently broken or worn away and then the aperture like the anterior aperture appears simple and circular. The latter is slightly oblique with the margin on the concave side more produced. The surface is polished as usual in the genus. Length 6, diameter at girdle 1.0, at anterior end 0.8, at posterior end 0.4 mm.

Station 5850. Types, U. S. Nat. Mus. 214361.

This is perhaps nearest to *C. dentalinus* of Guppy, but has the girdle differently situated and is less attenuated. It occurs in large numbers in the mud of the Pleistocene stratum.

The geological position of the following species is less definitely fixed and they may probably prove to be older than the preceding forms.

EPITONIUM (STHENORYTIS) TOROËNSE, new species

Shell turbinate of somewhat less than five rapidly enlarging whorls; not umbilicate, the suture impressed, the whorls rounded, crossed by nine to thirteen heavy, backwardly appressed, broad varices, which show a tendency to coalesce with one another; the average number in fourteen specimens is ten, and at the shoulder when in perfect condition each is produced into a short but acute spinose process; on the base the varices merge into one another toward the axis of the shell where they form a solid mass; the

aperture is almost or quite circular. Height 30.0; max. diameter of base 21.0; min. diameter of same 17.0; aperture 9.0 mm.

Station 6037, Toro Point, 35 to 50 ft. above the sea. Types, U. S. Nat. Mus. 214340.

This species is most nearly allied to *E.* (*S.*) *nobile* Fischer and Bernardi, now recent in the deep water of the Greater Antilles. The recent species has higher and less solid varices and the interspaces are spirally, obsoletely striated, while *E. toroënse* is destitute of any spiral sculpture.

With this species was found a fragment of what is perhaps a distinct species, with more numerous varices which rise vertically from the surface instead of being backwardly appressed. This has a diameter of some 45 mm. and a more oval aperture with a diameter vertically measured of 15 mm. Until better material is obtained this might stand as *E. toroënse* var. *insigne*. Type, U. S. Nat. Mus. 214346.

MARGINELLA MACDONALDI, new species

Shell large, solid, polished, of about four whorls, the spire, which is more or less covered with callus, rising only some 2.5 mm. above the outer lip, and the maximum diameter of the shell is situated only about 10 mm. in front of the summit. The aperture is nearly as long as the shell and in adults deposits a mass of callus on the two lips which recalls that of the base of *Cypræa;* the aperture is narrow behind but flares at the posterior sinus, above and around which on the back of the shell is a special mass of callus. There are several species of the region which possess this peculiarity, a recent one being *M. cincta* Kiener. The outer lip is heavily loaded with enamel, is flattened on its basal surface and grooved behind outside. The labrum has a thinner but also flattened layer of callus and a small ridge of it near to and parallel with the aperture. The pillar has four strong plaits graduated in their interspaces, and most adjacent anteriorly. The canal is wide but shallow. Length of shell 28; max. diameter of base 15; vertical diameter 11 mm.

Station 5882 *i*, Costa Rica, MacDonald. Types, U. S. Nat. Mus. 214348.

This fine species is very numerous in and characteristic of late Tertiary beds in eastern Costa Rica, of which the age is not yet positively determined.

VOLUTA ALFAROI, new species

Shell about the size of *V. musica,* smooth except for about a dozen rather obscure rounded ribs, most prominent at the shoulder and on the spire. Aperture with the outer lip smooth inside, the inner lip with five major and six or more alternate minor plaits; whorls five exclusive of the nucleus which is minute, smooth, and of about two whorls only slightly more swollen than the succeeding whorl. Near the canal are 7-10 feeble spiral threads with wide interspaces; the canal is deep and the end of the pillar projects in a sharp point beyond it. Length of shell 51, max. diameter 27 mm. Diameter of nucleus 2 mm.

Station 5882 *i,* Costa Rica, MacDonald. Type, U. S. Nat. Mus. 214347.

This species, probably a precursor of *V. musica,* is instantly distinguishable by the different character of its nucleus. From young specimens of *V. virescens* it is known by its rounder form and the absence of the conspicuous spiral sculpture of *V. virescens.* It is an abundant and characteristic species of the same horizon as the preceding. It is named in honor of Don Anastasio Alfaro, Director of the National Museum of Costa Rica at San José.

TURBO PITTIERI, new species

Shell small, smooth, with five or more whorls, the nucleus lost, the subsequent whorls slightly flattened and the suture smoothly appressed; coloration distinctly retained and consisting of spiral bands of red of varying width on a yellowish ground, the bands articulated or interrupted by small loops of lighter color, exactly as in some banded forms of *Turbo petholatus* L.; aperture defective but obviously similar to that of *T. petholatus* except that the pillar lip is elevated and rounded with a narrow arcuate umbilical chink behind it. The operculum was not obtained. Height 19; max. diameter of base 18; min. diameter 14; height of aperture 11; of last whorl 16 mm.

Station: Colline en démolition, Limon, Costa Rica, Prof. H. Pittier. Type, U. S. Nat. Mus. 214349.

The remarkable point about this species is that the group to which it belongs is not represented on either coast of the Americas but is distinctly oriental. It is one of an interesting collection obtained in the vicinity of Limon by Prof. Pittier, some years ago, and presented by him to the National Museum. The species is named in his honor.

ARCA (NOËTIA) MACDONALDI, new species

Shell rather large when fully grown, but mostly represented by half grown specimens, elevated, subtriangular, with very prominent prosocœlous beaks, the anterior end obliquely truncate; posterior end rounded bluntly, anterior end extended into a point near the base. The part of the shell posterior to the truncation sculptured with about twenty-five broad, flat, similar radial ribs with very narrow, shallow, distally channelled interspaces, crossed by fine, equidistant, wavy, concentric lines; carina of the truncation rounded, truncate area with about fourteen squarish, smaller ribs with narrower interspaces which frequently carry one or two fine radial threads. The beaks are much twisted forward, the ligamentary area is entirely behind them and transversely, closely grooved; in front of the beaks, the valve is deeply impressed forming a sort of cavity not sharply bounded; ligamentary area narrow, inclined at a high angle to the hinge-line; posterior teeth with the last 7-9 angular as in *Yoldia,* succeeded by numerous very closely crowded flat teeth, the series divided under the apex of the beak; anterior series shorter, flat, crowded, numbering 9-15 according to the age of the shell. Interior of the shell smooth with well marked muscular impressions, the lateral and basal margins strongly plicate in harmony with the external sculpture. Valves subequal, the beaks nearly medial. Height 45; basal length 54; length of hinge-line 31; max. diameter 48 mm.

Station 5882 *m.* Types, U. S. Nat. Mus. 214344.

This is an abundant and characteristic shell of the Costa Rica beds, collected by Pittier and MacDonald. It belongs to the group of *A. trinitaria* Guppy, and several others of the region.

ARCA (SCAPHARCA) PITTIERI, new species

Shell of small size, inflated, oblique, with prominent, slightly prosocœlous beaks and a wide, short, lozenge-shaped, mostly smooth, amphidetic area between them; anterior end attenuated and produced but not sharply truncate, posterior end much shorter and very bluntly rounded; exterior with about twenty-six radial ribs sculptured with squarish nodules, and separated by shallow, slightly narrower interspaces crossed by fine concentric striations. The valves are nearly equal and similarly sculptured, with the beaks nearly at the posterior fourth of the length. Internal margins strongly, radially channelled in harmony with the external ribs; hinge-line straight, the tooth series divided somewhat in front of the beaks with about 22 anterior and 18 posterior, closely adjacent,

slightly wavy, flat teeth. Height 25; length of shell 25; of hinge-line 14; max. diameter 26 mm.

Station 5882 *h*. Types, U. S. Nat. Mus. 214343.

This is one of the most abundant species in the above mentioned beds, but does not appear to reach a large size. It is the precursor of *A. Chemnitzii* Philippi, of the recent fauna.

There are also a number of Pyramidellidæ which have been submitted to Dr. Paul Bartsch for determination.

PECTEN (LYROPECTEN) PITTIERI, new species

Shell large, nearly equivalve, suborbicular, coarsely sculptured; left valve moderately convex, with ten strong rounded ribs, obsolete distally, with shallow rounded interspaces at first narrower, afterward wider than the ribs; submargins wide, subequal, radially sculptured with coarse, somewhat irregular threads, about ten in number, which when perfect have a fine, concentric, imbricate sculpture; similar radial sculpture covers both valves, the threads coarser and more regular on the right valve; of the major ribs on the left valve, five alternating ones bear on their proximal halves six to ten prominent, thin, evenly spaced, vaulted scales, resembling those of *P. imbricatus* Gmelin; similar scales are wanting in the right valve; ears subequal, with about half a dozen radial threads and dense, concentric sculpture; margin of the valve wavy, not sulcate; interior with ten deeply channelled, wide sulci corresponding to the external ribs, the angles of the interspaces emphasized near the valve margin; hinge with a deep subtriangular pit for the resilium, a strong anterior ridge and two marked posterior grooves with a ridge between them. Adductor scar large, with a rather ragged margin. Right valve with eleven stronger ribs, each carrying five or six riblets, with two or three similar riblets in the interspaces; the proximal halves of the ribs are slightlly undulated but not scaly; ears subequal, rudely imbricate on the dorsal margin and on the four or five radial threads of the anterior ear; ctenolium with about 16 spines, byssal notch narrow, angular; hinge-line grooved reciprocally to that of the left valve. Height 132; length of shell 152; of hinge-line 82; max. diameter omitting spines 46 mm.

Locality, Moin Hill, near Port Limon, Costa Rica, niveau *a*. H. Pittier, 1899.

Type, U. S. Nat. Mus. 214368.

This fine and remarkable species is somewhat intermediate between *Lyropecten* and *Nodipecten,* and when young must have the aspect of a *Chlamys* much like *C. imbricatus.*