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BOLETIN 12

MOLUSCOS DEL TRIASICO SUPERIOR DEL PERU

(UPPER TRIASSIC MOLLUSCA FROM PERU)

POR

L. R. COX, M. A., Sc. D.
Departamento de Geología, British Museum
(Natural History)

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BOLETINES DEL INSTITUTO GEOLOGICO DEL PERU

1.—Mapa Geológico Preliminar Generalizado del Perú, a la escala de 1:8'500,000. J. A. Broggi. — 1945.

2.—Bibliografía Sismológica del Perú. Alfredo Rosenzweig. — 1945.

3.—Datos Sismológicos del Perú, 1944-1945. E. Silgado F. — 1946.

4.—Bibliografía Climatológica del Perú. Angel Indacochea G. — 1946.

5.—Investigaciones Glaciológicas en el Perú. 1944-1945. Víctor Oppenheim y Hans J. Spann. — 1946.

6.—Apuntes sobre la Geología de los alrededores de Huachón. Otto A. Welter. — 1946.

7.—Datos Sismológicos del Perú, 1946. E. Silgado F. — 1947.

8.—Investigaciones Geológicas en el Perú. Arnold Heim. — 1947.

9.—Geología de la Hoja de Arequipa al 200,000. — Geology of the Arequipa Quadrangle of the Carta Nacional del Perú. William F. Jenks. — 1948.

10.—Geología de los ríos Apurimac y Urubamba Arnold Heim. —1948.

11.—Datos Sismológicos del Perú, 1947. E. Silgado F. — 1948.

12.—Moluscos del Triásico Superior del Perú. — Upper Triassic Mollusca from Peru. L. R. Cox. — 1949.

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CONTENIDO

AL LECTOR:

Los originales de este Boletín han sido escritos en inglés por su autor; y en vista de las dificultades de le época, solo se ha traducido la Introducción, pues la parte sistemática es de uso muy limitado a especialistas que dominan el idioma inglés.

Moluscos del Triásico Superior del Perú

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INTRODUCCION

El presente estudio trata de una serie de moluscos triásicos, coleccionados por el Dr. J. V. Harrison en 1945 al norte de Junín, región del Cerro de Pasco. Una colección anterior, de la parte sur de Junín, hecha por el Dr. Harrison en 1939 y de la cual se hizo una breve referencia en su artículo sobre dicha región (1943, pág. 5), contiene algunas especies iguales a las aquí descritas, lo mismo sucede con la colección hecha en su posterior visita de 1947; pero la descripción de las especies obtenidas en las expediciones de 1939 y 1947 la dejamos para una próxima ocasión. Por coincidencia, una pequeña colección procedente de las cercanías de Junín, que consiste principalmente de especímenes grandes de la notable nueva especie **Pascoella peruviana,** completamente fuera de su ganga debido al intemperismo, hasta el punto de parecer de una edad geológica comparativamente reciente, fué presentada últimamente al Departamento de Geología del British Museum (Natural History) por el Sr. R. G. Patton de la Unión Evangélica de Sud América; dichos especímenes han completado el material sobre el cual se basa el género **Pascoella.** También el Dr. Harrison ha depositado sus colecciones en el mismo Museo.

La distribución de los terrenos triásicos conocidos en el Perú se encuentra en la obra de Steinmann (1929, pág. 53) y en la de Koerner (1937). El mapa de la pág. 146 de este último autor, muestra las áreas, de la parte norte del país, descubiertas hasta entonces. La presencia del Triásico Superior en la región del Cerro de Pasco, fué reconocida primeramente por Steinmann (1909), cuyas colecciones fueron descritas por Jaworski (1922). El mismo Steinmann (1929, pp. 55-59) posteriormente, volvió a citar algunas de las especies mas características y dió nuevos nombres a ciertas formas que Jaworski había identificado provisionalmente con especies del Triásico europeo. El artículo de Koerner (1937), sobre el material del Nevado de Acrotambo, a unos 250 Km. al norte del área de Junín, muestra que muchas de las especies son las mismas que las de Junín.

El material del Dr. Harrison, como los de aquellos autores alemanes, consiste principalmente de calizas duras y fracturadas conteniendo conchas silicificadas, las cuales, parcialmente intemperizadas, sobresalen de la superficie de la roca. Debido a la dureza y tenacidad de ésta los fósiles no pueden ser extraidos por los medios mecánicos ordinarios, sino disolviendo la ganga mediante ácido clorhídrico, de este modo se ha aislado completamente un considerable número de conchas. Los detalles mas finos de la escultura han sido a veces obliterados en el proceso de silicificación, pero frecuentemente se conservan con toda claridad. Además de las especies que describimos en este artículo, hay muchas otras, algunas muy pequeñas, que están representadas por ejemplares muy imperfectos para ser descritos. No hay duda de que una fauna muy grande se descubrirá mediante el tratamiento sistemático con ácido de considerables cantidades de rocas. Además de la roca con fósiles silicificados, también hay muestras de caliza dura, fisible y de color gris con impresiones del lamelibranquio de gran tamaño **Entomonotis ochotica** (Keyserling).

EDAD DE LOS FOSILES

A continuación damos la lista de los fósiles descritos en el presente artículo con sus respectivas localidades:

Nucula subaequilatera Schafhaeutl. — Callahuai y La Cima.
Nuculana (Dacryomya) silicea sp. nov. — cerca a La Cima.

Eonavicula inca sp. nov. — cerca a La Cima.

Entomonotis ochotica (Keyserling). — Carhuamayo y Pacpan.

Bakevellia douglasi sp. nov. — Lulicocha, Huaricolca (Colec. 1939) y Jauja (1939).

Leptochondria pascoensis sp. nov. — Hda. Huanca.

Ostrea (Liostrea) cimana sp. nov. — La Cima.

Myophoria paucicostata Jaworski. — Carhuamayo.

Myophoria jaworskii Steinmann. — Carhuamayo.

Myophoria multicostata Koerner. — La Cima.

Myophoria pascoensis Steinmann. — Lago Churcacocha y Hda. Huanca.

Trigonodus cordilleranus sp. nov. — Lulicocha.

Eotrapezium occidentale sp. nov. — Carhuamayo.

Astarte incae Jaworski. — Lago Churcacocha.

Astarte andicola, sp. nov. — Lago Churcacocha.

Tutcheria densestriata (Koerner). — Hda. Huanca y La Cima.

Schafhaeutlia americana sp. nov. — La Cima.

Palaeocardita peruviana sp. nov. — Lago Churcacocha

Pascoella peruviana sp. nov. — Huayre, Churcacocha, Hda. Huanca, La Cima y Callahuai.

Brochidium spinosum Koerner. — Hda. Huanca.

Chartroniella wortheniiformis sp. nov. — Hda. Huanca.

Eucyclus harrisoni sp. nov. — La Cima y Lago Churcacocha

Eucyclus tricarinatus sp. nov. — Carhuamayo.

Hamusina triasica sp, nov. — Cerca a Lulicocha.

Calliostoma interruptum sp. nov. — Hda. Huanca.

Homalopoma cimana sp. nov. — La Cima y Hda. Huanca.

Omphaloptycha lissoni sp. nov. — Cerca a Lulicocha.

Omphaloptycha? subarmata (Jaworski). — Hda. Huanca.

Muchas de estas especies peruanas ya han sido mencionadas, en algunos casos bajo otros nombres, por lo que debemos referirnos a los trabajos anteriores de otros autores en relación con la edad de las formaciones en las cuales fueron encontradas.

Entomonotis ochotica ha sido considerada siempre como un valioso fósil índice de las capas del piso Noriano del Triásico, pues se la encuentra en formaciones de dicha edad en Siberia, Japón, Alaska, California, Nueva Zelandia y otros lugares mas. En el Perú se la ha encontrado en el Salto de Suta (Jaworski, 1922, pág. 173; Steinmann, 1929, pág. 60), a unos 30 - 40 metros mas arriba de las capas con cefalópodos de indiscutible edad noriana **Rhabdoceras y Sagenites** (1) de modo que su horizonte no puede ser mas antiguo que el Noriano. Otras localidades peruanas donde se ha encontrado **E. ochotica** son el valle de Utcubamba (Jaworski, 1922, pág. 179; Steinmann, 1929, pág. 59) y Huairas (Jaworski, 1922, pág. 179; Steinmann, 1929, pág. 62). Otras especies de esta localidad a las que Jaworski y Steinmann atribuyen una edad noriana, son: **Myophoria paucicostata, Astarte incae, Tutcheria densestriata** ("**Cardium heberti** Terquen") y **Eotrapezium occidentale** ("**Anodontophora? elongata**) (Moore), las cuales también están representadas en la colección descrita en este artículo. Las tres primeras también han sido anotadas como procedentes del Cerro Uliachi, Cerro de Pasco, donde se encuentran en la cima del Triásico en fragmentos residuales de caliza negra parcialmente incorporada en un conglomerado terciario. A esta caliza se la ha considerado noriana (Jaworski, 1922, pág. 181; Steinmann, 1929, pág. 63).

Las capas inferiores del Triásico en el Cerro Uliachí, son calizas con fósiles silicificados que comprenden las especies **Myophoria jaworskii** y **Myophoria pascoensis,** las cuales han sido consideradas como de edad carniana, a causa, principalmente, de su posición estratigráfica, y por la ausencia de **Entomonotis ochotica** (Jaworski, 1922, pág. 180; Steinmann 1929 pp. 55-59). Sin embargo se ve claramente por las colecciones del Dr. Harrison que **M. jaworskii** y **M. pascoensis** no caracterizan un horizonte estratigráficamente inferior del que contiene las especies **M. paucicosta, Astarte incae, Tutcheria densestriata** y **Eotrapezium occidentale,** las que, como se dice mas arriba, han sido consideradas norianas. **Myophoria jaworskii** fué encontrada por Harrison en la misma roca que **M. paucicostata** y **Eotrapezium occidentale,** y en la misma localidad de **Entomonotis ochotica,** aunque la relación preci-

(1). — Jaworski, ha identificado a otros ammonites de esta formación como **Nevadites** y **Anolcites;** pero como el Dr. L. F. Spath (1934, pág. 37) lo ha establecido, esos géneros pertenecen al Triásico Medio, por lo que esas determinaciones de Jaworski no pueden ser aceptadas.

sa entre los horizontes de **Entomonotis y Myophoria** no ha sido observada. También en otra localidad el Dr. Harrison encontró **M. Pascoensis** en la misma roca que **Astarte incae** y **Tutcheria densestriata.** Es por eso que consideramos a todos los fósiles de esta colección como procedentes de un solo horizonte estratigráfico de edad noriana. La única especie, además de **Entomonotis ochotica,** que ha sido identificada con ya conocida en otras regiones, es **Nucula subaequilatera,** la cual se presenta en el Ladiniano y Carniano de Europa, pero no parece que esta especie tenga valor como indicadora de un horizonte. Sin embargo, se debe mencionar que Koerner (1937), cuya colección del Nevado de Acrotambo incluía algunas de las mismas especies (**Nucula subaequilatera, Nuculana (Dacryomya) silicea, Myophoria multicostata, Myophoria paucicostata, Paleocardita peruviana, Tutcheria densestriata** y **Brochidium spinosum**), que parecen ser de la misma edad que la colección aquí descrita, concluyó porque el horizonte era aproximadamente Ladiniano o Carniano y equivalente a las formaciones de St. Cassian o Raibl del Triásico alpino europeo, basándose en la ausencia de **Entomonotis ochotica** y en la afinidad de las diversas formas que estudió, con especies del Triásico europeo. En el caso de la serie de fósiles descritos ahora, se podría mencionar igualmente fuertes argumentos basados también en afinidades con especies europeas que indican que se trata de un horizonte posterior al Ladiniano o Carniano.

Así, de los Arcidae liásicos europeos, solo ciertas especies del Rético (**Arca bavarica** Winkler, **A. pumila** Dittmar y **A. lycetti** Moore) son las que mas se asemejan a la nueva especie **Eonavicula inca** y es dudoso que el género **Eonavicula** esté representado en el Triásico de Europa. Esta última afirmación es también aplicable al género **Eotrapezium,** pues entre las especies europeas solo ciertas formas del Rético (**E. elongatum** Moore) y del Liásico Inferior (**"Cypricardia" porrecta** Dumorter, quizás un sinónimo de **E. elongatum**) son estrechamente comparables a la nueva especie **E. occidentale.** También **Astarte andicola** sp. nov. no tiene relacionados cercanos en el Triásico europeo, pero es muy similar a la especie del Liásico Inferior **A. obsoleta** Dunker. El género **Tutcheria** es conocido en Europa solo en el Rético y Liásico, aunque se le ha asignado una edad carniana al representante de Nueva Zelandia **T. parvula** (Trechmann). Entre los gasterópodos, las dos especies de **Eucyclus** no tienen parientes próximos en las rocas preliásicas de Europa, tampoco el género **Hamusina** ha

sido encontrado antes en un horizonte prejurásico. Por eso, aparte de su ocurrencia en horizontes aparentemente próximos al de **Entomonotis ochotica,** consideraciones como las precedentes abonan en favor de que los fósiles silicificados que describimos, son del Triásico mas reciente y muy probablemente norianos.

Upper Triassic Mollusca From Peru

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INTRODUCTION

This paper deals with a series of Triassic mollusca collected by Dr. J. V. Harrison in 1945 from the area north of Junin, in the Cerro de Pasco region of the Central Andes of Peru. An earlier collection, from south of Junin, made by Dr. Harrison in 1939 and briefly referred to in his paper on this area (1943, p. 5), proves to contain some of the same species as are here described, as does also a collection made on a further visit in 1947. Descriptions of species represented only in the 1939 and 1947 collections must, however, be reserved for a later occasion. By a coincidence, a small collection from a locality near Junin, consisting mainly of large specimens of the remarkable new species **Pascoella peruviana,** so completely weathered out from their matrix as to appear to be of comparatively recent geological age, was recently presented to the Geological Department of the British Museum (Natural History) by Mr. R. G. Patton, of the Evangelical Union of South America, and has supplemented the material on which the genus **Pascoella** has been based. Dr. Harrison has also presented his collections to the same museum.

Summaries of our knowledge of the distribution of Triassic rocks in Peru are given by Steinmann (1929, p. 53) and Koerner (1937), and a map facing p. 146 of the latter author's paper shows the areas in the northern half of the country where they have so far been discovered. The presence of the Upper Trias in the Cerro de Pasco region was first recognized by Steinmann (1909), whose collections were described by Jaworski (1922). Steinmann himself (1929, pp. 55-59) subsequently re-figured some of the most characteristic species and assigned new names to certain forms which Jaworski had tentatively identified with species found in the Trias of Europe. Koerner's paper (1937) on material from the Nevado de Acrotambo, some 250 km. north of the Junin area, shows that much the same assemblage is found in that district.

Dr. Harrison's material, like that described by these German workers, consists mainly of hard, splintery limestone containing silicified shells which have partly weathered out and project from the surface of the rock. Owing to the hardness and adhesiveness of the matrix it cannot usually be removed from the fossils by ordinary mechanical means. It is, however, possible to dissolve away the matrix with the aid of dilute hydrochloric acid, and in this way a considerable number of shells have been completely isolated. The finer details of the sculpture have sometimes been obliterated in the process of silification, but are often quite clearly preserved. Besides the species here described several others, some very small, are represented by specimens too imperfect for description. There can be no doubt that a large fauna would be brought to light by systematic treatment of a considerable quantity of the rock with acid. In addition to the rock with silicified fossils there are also specimens of a hard fissile grey limestone with impressions of the large lamellibranch **Entomonotis ochotica** (Keyserling).

AGE OF THE FOSSILS

The following is a list of the fossils described in the present paper.
Nucula subaequilatera Schafhaeutl.
Nuculana (Dacryomya) silicea, sp. nov.
Eonavicula inca sp. nov.
Entomonotis ochotica (Keyserling).
Bakevellia douglasi sp. nov.
Leptochondria pascoensis sp. nov.
Ostrea (Liostrea) cimana sp. nov.
Myophoria paucicostata Jaworski.
Myophoria jaworskii Steinmann.
Myophoria multicostata Koerner.
Myophoria pascoensis Steinmann.
Trigodonus cordilleranus sp. nov.
Eotrapezium occidentale sp. nov.
Astarte incae Jaworski.
Astarte andicola sp. nov.
Tutcheria densestriata (Koerner).
Schafhaeutlia americana sp. nov.
Palaeocardita peruviana sp. nov.
Pascoella peruviana sp. nov.
Brochidium spinosum Koerner.
Chartroniella wortheniiformis sp. nov.
Eucyclus harrisoni sp. nov.
Eucyclus tricarinatus sp. nov.
Hamusina triasica sp. nov.
Calliostoma interruptum sp. nov.
Homalopoma cimana sp. nov.
Omphaloptycha lissoni sp. nov.
Omphaloptycha? subarmata (Jaworski).

Several of these species have already been recorded from Peru (in some cases under other names) and reference must be made to the views of previous workers as to the age of the beds in which they were found.

Entomonotis ochotica has always been recognised as a useful index-fossil of the Norian stage of the Trias, for it occurs in beds of that age in Siberia, Japan, Alaska, California, New Zealand, and else-

where. In Peru it has previously been found in the Salto de Suta (Jaworski, 1922, p. 173; Steinmann, 1929, p. 60), some 30 — 40 meters above a bed containing the unmistakable Norian cephalopods **Rhabdoceras** and **Sagenites,** so that its horizon cannot here be older than Norian (1). Further Peruvian localities for **E. ochotica** are the Utcubamba Valley (Jaworski, 1922, p. 179; Steinmann, 1929, p. 59) and Huairas (Jaworski, 1922, p. 179; Steinmann, 1929, p. 62). Other species recorded from the last locality and assigned by Jaworski and Steinmann to the Norian include **Myophoria paucicostata, Astarte incae, Tutcheria densestriata** ("**Cardium heberti** Terquem"), and **Eotrapezium occidentale** ["**Anodontophora? elongata** (Moore)"], which are also represented in the collection described in the present paper. The first three of these have also been recorded from the Cerro Uliachi, in the Cerro de Pasco region, where they occur at the top of the Trias in residual fragments of a black limestone partly incorporated in a Tertiary conglomerate. A Norian age has been assigned to this limestone (Jaworski, 1922, p. 181; Steinmann, 1929, p. 63).

The underlying beds of the Trias in the Cerro Uliachi are limestones with silicified fossils including the species **Myophoria jaworskii** and **Myophoria pascoensis,** and these have been considered to be of Carnian age mainly on account of their stratigraphical position and of the absence of **Entomonotis ochotica** (Jaworski, 1922, p. 180; Steinmann, 1929, pp. 55-59). It is, however, clear from the collections made by Dr. Harrison that **M. jaworskii** and **M. pascoensis** do not characterise a lower stratigraphical horizon than the species **Myophoria paucicostata, Astarte incae, Tutcheria densestriata** and **Eotrapezium occidentale,** which, as seen above, have been regarded as Norian. **M. jaworskii** was found by him in the same rock as **M. paucicostata** and **Eotrapezium occidentale,** and at the same locality as **Entomonotis ochotica,** although the precise relationship between the **Entomonotis** and **Myophoria** horizons was not observed. Similarly, at another locality **M. pascoensis** was found by Dr. Harrison in the same rock as **Astarte incae** and **Tutcheria densestriata.** It is, therefore, considered that all the fossils now recorded come from much the same stratigraphical horizon and that a Norian age should be assigned to them. The

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Jaworski assigns other ammonites from this bed to **Nevadites** and **Anolcites,** but, as Dr. L. F. Spath (1934, p. 37) has pointed out, these are Middle Triassic genera and Jaworski's determinations cannot be accepted.

only species besides **Entomonotis ochotica** which has been identified with one known from some other region is **Nucula subaequilatera,** which in Europe occurs in the Ladinian and Carnian, but it seems improbable that this is a species of any value as an index of horizon.

It must, however, be mentioned that Koerner (1937), whose assemblage from the Nevado de Acrotambo included several of the same species (**Nucula subaequilatera, Nuculana (Dacryomya) silicea, Myophoria multicostata, Myophoria paucicostata, Palaeocardita peruviana, Tutcheria densestriata, Brochidium spinosum**) and seems to have been of the same age as the collection now described, concluded that the horizon was approximately Ladinian or Carnian and equivalent to that of the St. Cassian or Raibl Beds of the European Alpine Trias. This conclusion was based on a consideration of the affinities of the various forms described with species known from the European Trias, and on the absence of **Entomonotis ochotica**. In the case of the series of fossils now described equally strong arguments, based on affinities with European species, could, however, be put forward in support of a horizon later than Ladinian or Carnian.

Thus, of European Liassic Arcidae, only certain species from the Rhaetic (**Arca bavarica** Winkler, **A. pumila** Dittmar, and **A. lycetti** Moore) are at all closely comparable to the new species **Eonavicula inca,** and it is doubtful if the genus **Eonavicula** is represented in the Trias proper in Europe. The last observation also applies to the genus **Eotrapezium,** among European species of which only certain forms from the Rhaetic [**E. elongatum** (Moore)] and from the Lower Lias (**"Cypricardia" porrecta** Dumortier, perhaps a synonym of **E. elongatum**) is closely comparable with the new species **E. occidentale.** Similarly, **Astarte andicola** sp. nov. has no close allies in the European Trias, but is very similar to the Lower Liassic species **A. obsoleta** Dunker. The genus **Tutcheria** is known in Europe only in the Rhaetic and Lias, although a Carnian age has been assigned to a New Zealand representative, **T. parvula** (Trechmann). Among the gastropods, the two species of **Eucyclus** have no close allies in Europe in pre-Liassic rocks, nor has the genus **Hamusina** been recorded previously from a pre-Jurassic horizon. Apart, therefore, from their occurrence at a horizon apparently close to that of **Entomonotis ochotica,** considerations such as these support the conclusion that the age of the silicified fossils now described must be very high in the Trias and most probably Norian.

Description of the Species

Class LAMELLIBRANCHIA

Family NUCULIDAE

Genus NUCULA Lamarck, 1799

Nucula subaequilatera Schafhaeutl

Pl. I, fig. 1

Nucula subaequilatera Schafhaeutl, 1865, p. 797, pl. VI, fig. 10.
Nucula subaequilatera Woehrmann, 1889, p. 211, pl. VIII, figs. 10-12.
Nucula subaequilatera Bittner, 1895, p. 152, pl. XVII, figs. 41-44.
Nucula subaequilatera Koerner, 1937, p. 174.

Material.—Four specimens.

Remarks.—The largest specimen is about 8.5 mm. long, and rather strongly inequilateral, with the height appreciably less than the lenght. It is closely comparable to the specimen from the Carnian **Cardita**-beds of Austria represented in pl. XVII, figs. 42, of Bittner's monograph. In the shell from the Norian of Suta, Peru, which Jaworski (1922, pl. IV, figs. 6**a,b**) figures under the name **Nucula** aff, **carantana** Bittner the postero-dorsal angle is more prominent.

In smaller specimens, such as the one represented in pl. I, fig. 1 of the present paper, the height of the shell (4 mm.) exceeds the length (3 mm.) and the dorsal margins slope very steeply, the two rows of hinge-teeth meeting at the umbo at an angle slightly less than 90º. The shell is only slightly inequilateral.

The figures published by Bittner and the other authors cited above show that similar variations occur in specimens of **N. subaequilatera** from Europe, where the species is found in both the Ladinian and Carnian stages. A closely comparable form, possibly the same species, has been recorded by Patte (1926, p. 156, pl. X, fig. 17) from the Upper Trias of S. E. Asia under the name **Nucula** cf. **subaequilatera,** while Reed (1927, p. 204, pl. XVII, figs. 15, 15a) has described a **N. subaequilatera** var. tswayensis from the same area.

Localities.—Two miles N. E. of Callahuai, between Junin and Lulicocha. Near La Cima, 3 miles E. of Lake Lulicocha.

Family NUCULANIDAE

Genus NUCULANA Link, 1807

Subgenus DACRYOMYA Agassiz, 1840

Nuculana (Dacryomya) silicea sp. nov.

Pl. I, fig. 2.

Leda (?) sp. cf. aff. **sulcellata** Münst., Jaworski **1922, p. 113.**

Leda aff. **sulcellatae** wissm. sp. (emend. Bittner), Koerner, 1937. p. 178, pl. XII, figs. 1**a-c.**

Specific Characters.—Shell small, well inflated, pyriform, moderately elongate, with a rapidly narrowing posterior rostrum at the origin of which is a shallow sinus of the ventral margin. Umbonal region obtusely angular, prominent; umbones well incurved, rather strongly opisthogyrous, slightly anterior to median in position. Postero-dorsal outline strongly concave. Antero-dorsal outline convex, rather steeply sloping, forming, with the anterior and antero-ventral margins, a rather sharp, parabolic curve. Posterior to the umbones an escutcheon, not much impressed, is delimited by a rounded-off ridge. The main surface of the shell bears fine, closely spaced, concentric riblets, but these are absent from the escutcheon and the antero-dorsal region of

the shell. The dentition is that of a typical **Nucula** and an internal chondrophore is present below the umbo. The pallial line has not been observed.

Material.—The holotype (B. M., L. 78342) and one paratype.

Measurements of Holotype.—Length 6.2 mm., height 4.2 mm.

Remarks.—The specimens described and figured by Koerner included some larger and better preserved than those now available, but I have no information as to where they are now deposited. The maximum lenght quoted by Koerner is 12 mm.

Jaworski and Korner considered this species to be identical with the form from the Carnian of the Dolomites figured by Bittner (1895, pl. XVIII, fig. 8 only) as **Leda** aff. **sulcellata** (Münst.), but in Bittner's specimen the shell is more elongate and the umbonal region is more obtuse in outline and less prominent. Bittner's **"Leda** aff. **sulcellata"** appears, moreover, to be very distinct from his **"Leda sulcellata** Münst. sp. (emend Bittner)", and he appears to have emended Münster's **Nucula sulcellata** by transferring the specific name to a form probably distinct from that to which it was originally applied. It thus seems most desirable to assign a definite, and new, specific name to the Peruvian species now recorded.

Apart from Bittner's **"Leda** aff. **sulcellata",** the most closely comparable species previously described from the Trias is **Leda timorensis Krumbeck** (1924, p. 235, pl. CXCVII, figs. 11 **a-c),** from the Norian of Timor, which similarly differs in its more elongate form and more obtuse umbonal region.

The characters of the subgenus **Dacryomya,** the type-species of which closely resembles the one now described, have been discussed by me elsewhere (1940, p. 28).

Locality.—Near La Cima, 3 miles E. of Lake Lulicocha.

Family ARCIDAE

Genus EONAVICULA Arkell, 1929

Eonavicola inca sp. nov.

Pl. I, figs. 5a, b

Specific Characters.—Shell of small-medium size for the genus, elongate, narrowing towards its anterior extremity, obliquely truncated posteriorly. Umbo (damaged in the only available specimen) apparently obtuse and slightly projecting, placed at about the anterior third of the length. A very sharp carina runs from the umbo to the postero-ventral corner of the shell, delimiting a concave posterior area. The ventral margin of the shell (as shown by the growth-lines) is irregular, and has a broad sinus towards its anterior end, corresponding to a byssal gape. The main surface of the shell bears moderately prominent radial riblets separated by interspaces of equal or slightly greater width. Irregularly spaced growth-laminae, which imbricate rather pronouncedly on the surface of each rib, produce a reticulate ornament. The posterior area bears five strong radial ribs with traces of a sixth, weaker, one above them; these bear conspicuous, evenly spaced, rounded tubercles. The cardinal area is not preserved and the hinge structure is unknown.

Material.—The holotype only (B. M., L. 78345).

Measurements of Holotype.—Length 20 mm. height 8 mm., inflation (single valve) c. 5 mm.

Remarks.—The external characters of this species — the strongly carinate posterior slope, the radially ribbed posterior area, and the irregular sinus at the anterior end of the ventral margin — are those of **Eonavicula** rather than of **Parallelodon**. Two or three apparently related forms have been described from the Upper Trias and Rhaetic, and these, with one exception, are separated from **"Macrodon"** (= **Parallelodon**) in the **Fossilium Catalogus** (Diener, 1923, p. 160) and listed under **Grammatodon.** This, however, is probably a result of indiscriminate indexing, and may be traced to Healey's (1908, p. 11) discussion of these particular species, and their reference to **Gramma-**

todon merely because (following Woods) she placed **Parallelodon** in its synonymy. **Grammatodon** is now regarded as generically distinct from **Parallelodon** (Cox, 1940, p. 40); it is more easily separated from **Eoavicula,** even by external characters, than is that genus, and has no affinity with the group of Triassic species now under discussion.

The species in question, which, like that now described, have the external characters of **Eonavicula,** are **Arca bavarica** Winkler (1861, p. 475, pl. VII, fig. 2). **Arca pumila** Dittmar (1864, p. 170, pl. III, fig. 3), **Arca lycetti** Moore (1861, p. 501, pl. XVI, fig. 7; also Healey, 1908, p. 11, pl. I, figs. 15-19), and **Macrodon mediodepressum** Krumbeck (1913, p. 54, pl. III, fig. 20). Compared with the species now described, these all possess fewer ribs on the posterior area and a more delicate ornament on the main surface of the shell. The first three are from the Rhaetic and the last from the Norian.

Locality.—Near La Cima, 3 miles of Lake Lulicocha.

Family PTERIDAE

Genus **ENTOMONOTIS,** Marwich, 1935

Entomonotis ochotica (Keyserling)

Pseudomonotis ochotica (Keys.), Jaworski, 1922, p. 105, pl. IV, figs. 1-4.

Pseudomonotis ochotica (Keys.), Steinmann, 1929, p. 60, text-fig. 60.

Marwick's generic name (1935, p. 298) for the species of this group should be noted. The genotype is the New Zealand Upper Triassic species, **E. richmondiana** (Zittel), which is closely related to **E. ochotica.** The genotype of **Pseudomonotis** is the Permian species **P. speluncarius** (Schlotheim), which belongs to another group.

E. ochotica has a world-wide distribution, occurring everywhere in beds of uppermost Triassic (Norian) age.

Localities.—1 1/4 miles S. E. of Carhuamayo. Pacpan, a **peak** 9 miles N. of Junin town.

Family ISOGNOMONIDAE

Genus BAKEVELLIA King, 1848

Bakevellia douglasi sp .nov.

Pl. I, figs. 6, 7**a, b.**

Specific Characters.—Shell of medium size, slightly inequivalve, broadly trapeziform, with the length slightly exceeding the height and the obliquity (measured by the angle between the hinge-margin and a line joining the umbo to the most distant point of the postero-ventral margin) about 45°. The posterior wing in each valve is broad and acutely pointed at the tip, the anterior auricle rounded off and almost undeveloped, with the umbo terminal or subterminal. In the left valve the body of the shell and the umbonal region are well inflated, the umbonal region rising slightly above the hinge-margin. The right valve is rather less convex, with its umbo scarcely projecting above the hinge-margin. In both valves the level of the surface falls away gradually to that of the posterior wing and abruptly to the anterior margin, which is straight or broadly sinuate. The cardinal area of each valve is of variable width, according to the thickness of the test of the specimen, and bears about five ligamental pits. The dentition consists of short, blunt, oblique teeth (two in the right valve and one or two in the left valve) just below the umbo, together with weak, elongate lateral teeth, two in the right valve and one in the left, well separated from the cardinals.

Material.—The holotype (B. M., L. 78360) and about six paratypes.

Measurements of Holotype.—Length 19 mm. +, height c. 15 mm., inflation (single left valve) 4.5 mm.

Remarks.—This species was formerly (Harrison, 1943, p. 5) identified as **Gervillia** cf. **bouei** Hauer, but Hauer's species, with ranges from the Carnian to the Rhaetic in the European marine Trias, has an acute anterior auricle and lacks lateral teeth, having for the latter reason been included by Frech (1902, p. 617) in **Odontoperna.** Pa-

rona (1889, pl. VII) figures certain comparable species from the Carnian Raibl Beds of Lombardy, the most similar of which, **Gervillia musculosa** Stoppani, lacks the pointed extremity to its posterior wing and has a slightly larger posterior auricle. Both in shape and dentition the species now described is a typical **Bakevellia** (see Cox, 1940, p. 108).

Localities.—Close to Lulicocha, near S. shore of lake. S. W. of Huaricolca (1939 collection). N. W. of Jauja (1939 collection).

Family PECTINIDAE

Genus LEPTOCHONDRIA Bittner, 1891

Leptochondria pascoensis sp. nov.

Pl. II, fig. 10.

Specific Characters.—Shell small, ovate, slightly inequilateral and oblique, with the height exceeding the length. Left (the only known) valve moderately convex, with the umbo projecting slightly above the hinge-margin. Anterior wing of moderate size, slightly flattened dorsally, delimited from the body of the shell only by a very shallow, scarcely defined sinus of the anterior margin, and with its distal angle, which is slightly obtuse, rounded-off. Posterior wing indistinctly delimited from the body of the shell, more elongate than the anterior, with its distal angle more widely obtuse. The dorsal margins of the wings are not in alignment, but form a very obtuse angle where they meet at the umbo. Surface of shell ornamented with numerous narrow, rounded radial riblets which are present on the anterior wing but fade away towards the margin on the posterior wing; a few irregular concentric puckerings are also present. An internal, triangular ligamental pit is present below the umbo.

Material.—The holotype only (B. M., L. 78317).

Measurements of Holotype.—Length 3.2 mm. +, height 3.7 mm., inflation 1.0 mm.

Remarks.—Leptochondria, founded on a species from the Upper Trias of Asia Minor, has been regarded as a synonym of **Velata** Quenstedt (**Velopecten** Phillippi), the typical species of which are of Jurassic age. The general configuration of the shell and, apparently, the hinge-structure are similar in the two groups, but in the Triassic forms the shell is small, rarely exceeding 15 mm. in height, whereas the typical species of **Velata** are relatively large. It is by no means certain that the Jurassic group was derived from the Triassic group, and **Leptochondria** is, therefore, here treated as a distinct genus.

The essential differences between **Velata** and **Leptochondria** on the one hand and **Pseudomonotis** on the other hand have been enumerated by Philipi (1898, p. 608), when discussing the affinities of the German Muschelkalk species **"Monotis" albertii** Goldfuss (a **Leptochondria**). In the first two groups the anterior wing of the left valve is usually larger than the posterior wing, whereas it is smaller in **Pseudomonotis.** In the first two groups, moreover, the external ligamental area present in **Pseudomonotis** is absent and the triangular ligamental pit below the umbo is internal. These features support the reference of **Velata** and **Leptochondria** to the Pectinidae. As regards the relative sizes of the two wings, however, examination of a large series of specimens of **Velata** has shown that the left posterior wing may occasionally be larger than the anterior wing, while in the Muschelkalk species of **Leptochondria** any differences in the sizes of the two wings may be negligible.

The species now described much resembles these Muschelkalk species [**L. albertii** (Goldfuss) and **L. inaequistriata** (Goldfuss)] in the general characters of the ornament and in the indistinct separation of the wings from the body of the shell. Its more inequilateral and oblique form and the fact that its posterior wing is appreciably the larger serve, however, to distinguish it. That it is not a **Pseudomonotis**, as these characters would suggest, is shown by the absence of an external cardinal area and by the internal position of its ligamental pit, which is clearly visible when the holotype is viewed in a suitable light. It is possible that this specimen may not be full-grown, and it is also broken away postero-ventrally; the essential characters of the species are, however, clearly visible.

Locality.—2 miles S. W. of Hacienda Huanca.

Family OSTREIDAE

Genus OSTREA Linné, 1758

Subgenus LIOSTREA Douvillé, 1904

Ostrea (Liostrea) cimana sp. nov.

Pl. I, figs. 3, 4.

Specific Characters.—Shell small, ovate or subtrigonal, higher than long. Attached (left) valve moderately to strongly convex, with a moderately large attachment-area; surface smooth or with weak, irregular, radial plications. Upper valve unknown.

Material.—The holotype (B. M., L. 78357) and one paratype (with **Homalopoma cimana,** G. 67182). Fragments of the species have also been observed in the residues left after treatment of the limestone with acid.

Measurements of Holotype.—Length 15 mm., height 18 mm., inflation 7 mm.

Remarks.—The holotype is more evenly ovate in outline and more strongly convex than some other specimens of the species, fragments of which have been observed. Smooth specimens like the holotype are scarcely distinguishable, except by their smaller size, from an oyster which is abundant in the basal beds of the European Lias and should bear the name **Ostrea hisingeri** Nilsson (1831, p. 354, pl. IV figs. 2, 3), although it has been more frequently cited (cf. Dumortier, 1864, p. 79, pl. I, figs. 8-12) under the later name **O. sublamellosa** Dunker. The occasional occurrence of weak radial ribbing has not, however, been observed in the Lower Liassic form; similar ribbing is developed in the Bathonian species **O. subrugulosa** Morris and Lycett (1853, p. **4, pl. I.** fgs. 6, 6a), a derivative of the widespread **O. hebridica** Forbes.

Several species of **Liostrea** have previously been described from the Upper Trias particularly from the Bear Islands (Boehm, 1904, pp. 16-17, pl. I, figs. 35-52) and Sicily (Scalia, 1912, pp. 21-23, pl. II, figs. 6-21). These are mostly strongly convex forms intermediate between **Liostrea** and **Gryphaea,** and were, in fact, described under

the latter genus. Of these forms, **G. skuld** Boehm (1904, p. 17. pl. 1, figs. 36, 39, 40, 41) and **G. faba** Scalia (1912, p. 23, pl. II, figs. 20, 21) may be particularly compared with the Peruvian species but the first has a larger attachment-area and the second is more elongate. An unnamed oyster from the Upper Trias of Ceram figured by Krumbeck (1923, p. 207, pl. XIII, figs. 1**a, b**) is comparable in shape to the holotype of the Peruvian species but is much larger.

Localities.—Near La Cima, 3 miles E. of Lake Lulicocha, 2 miles S.W. of Hacienda Huanca.

Family TRIGONIIDAE

Genus MYOPHORIA Bronn, 1834

Myophoria paucicostata Jaworski

Pl. I, fig. 11.

M. paucicostata Jaworski, 1922, p. 126, pl. V, figs. 9-11.
M. multicostata Koerner, 1937, p. 183, pl. XII, figs. 3a. b.

Locality.—1 1/4 miles S. E. of Carhuamayo.

Myophoria jaworskii Steinmann

Pl. I, fig. 16.

M. ex aff. **vestitae** Alb., Jaworski, 1922, p. 124, pl. V. figs. 5-7
M. jaworskii Steinmann, 1929, p. 57, text-figs. 55**a, b.**
Locality.—1¼ miles S. E. of Carhuamayo.

Myophoria multicostata Koerner

M. multicostata Koerner, 1937, p. 183, pl. XII figs. 3**a, b.**

Locality—Near La Cima, 3 miles E. of Lake Lulicocha.

Myophoria pascoensis Steinmann

Pl. I, figs. 8-10.

M. sp. indet. cf. **decussata** Goldf., Jaworski, 1922, p. 125, text-fig. 1; pl. V, figs. 8, 8**a.**

M. pascoensis Steinmann, 1929, p. 57, text-fig. 56.

The specimens now recorded are more complete than those figured by Jaworski and Steinmann. The sharp marginal carina, which delimits a narrow posterior area set almost at right angles to the plane of the commissure, is bordered by a broad depression to which there corresponds a sinus of the ventral margin. Beyond this depression the surface of the shell bears closely spaced, rounded radial riblets croseed by concentric undulations spaced at about the same distance apart, and producing concentrically elongated tubercles at the points of intersection. The depression is smooth in early growth-stages, but later bears narrow, obscure riblets. The marginal carina is delicately denticulate and the posterior area bears delicate transverse ridges decussated by fine radial threads.

This species is very closely related to **M. nathorsti** Dames (J. Boehm, 1904, p. 41, pl. V, figs. 1-3, 7-9, 17, 20, 21, 27), from the Upper Trias of the Bear Isands.

Localities.—½mile N. of Lake Churcacocha about 2 miles S. E. of Hacienda Huanca; 2 miles S. W. of Hacienda Huanca.

Family CARDINIIDAE

Genus TRIGONODUS Sandberger, 1864

Trigonodus cordilleranus sp. nov.

Pl. II, figs. 9 **a, b.**

Specific Characters.—Of meduim size ovate, posteriorly subtruncate, inequilateral, compressed, height about two-thirds of length. Umbo obtusely angular, not at all incurved, level with the postero-dorsal margin, and situated at about the anterior fifth of the length. Dorsal margin feebly convex, meeting the feebly convex, inclined posterior margin in a broad curve. Ventral margin flattened posterior-

ly, where it meets the posterior margin in a rounded-off angle, moderately convex anteriorly. Anterior margin symmetrically convex; below the umbo the outline of the shell is only slightly excavated and slopes steeply. The shell is most inflated along a line from the umbo to the postero-ventral corner but no definite ridge is present. Surface ornamented with fine concentric ridges, somewhat separated in early growth-stages, later closely spaced. Imbricating accentuations of growth-stages may occur at irregular intervals, becoming more frequent near the ventral margin.

Material.—The holotype (B. M., L. 78368) and one incomplete paratype.

Measurements of Holotype.—Length 33.3 mm., height 23.3 mm., inflation 9.9 mm.

Remarks. — This species much resembles **Trigonodus costatus** Woehrmann (In Woehrmann and Koken, 1892, p. 186, pl. VII, figs. 9-12), from the Raibl Beds of the Schlern plateau, in the Dolomites, but differs in the closer spacing of its concentric ridges.

Locality.—Close to **Lulicocha**, near S. shore of lake.

Family CYPRINIDAE

Genus EOTRAPEZIUM Douvillé, 1913

Eotrapezium occidentale sp. nov.

Pl. II, figs. 6**a, b,** 7.

Anodontophora? elongata (Moore), Jaworski, 1922, p. 122, pl. IV, fig. 8 (**non** Moore sp.).

Specific Characters.—Of small-medium size for the genus, elongate-ovate, inequilateral, obliquely subtruncate posteriorly. Umbonal region broadly rounded, projecting slightly above the dorsal margins; umbo slightly incurved and prosogyrous, situated at about the anterior

quarter to two-fifths of the length. No lunule or escutcheon. Postero-dorsal margin gently sloping, meeting the feebly convex, oblique posterior margin in a rounded-off, obtuse angle. Ventral margin almost straight posteriorly, feebly convex anteriorly. Antero-dorsal outline usually slightly concave, the margin sloping to the rather low, evenly rounded anterior extremity. A well-defined, obtuse ridge runs in a slightly sigmoidal curve from the umbo to the postero-ventral corner of the shell, and the area above it is appreciably concave. Hinge-structure unknown.

Material.—Numerous specimens, some partly weathered out on the surface of hard limetsone, others completely extracted by the aid of acid. The original of fig. 7 (B. M., L. 78382) is selected as holotype.

Measurements of Holotype.—Length 15.0 mm., height 8.5 mm., inflation (both valves) 6.0 mm.

Remarks.—This species bears a very close resemblance to the well-known European Rhaetic species **Anixus elongatos Moore** (1861, p. 503, pl. XV, fig. 18), of which **Cypricardia porrecta** Dumortier (1864, p. 36, pl. VI, figs. 1-7), from the basal beds of the Lias, appears to be a synonym. A specimen from Portugal which Boehm (1901, p. 245, pl. X, figs. 10, 10a) figures under the name **Isocyprina porrecta** (Dumortier) seems to be particularly close to those now described. After careful comparison with specimens from the English Rhaetic I am, however, convinced that the Peruvian species is distinct. The posterior ridge is much more pronounced than in the European species and the pallial margin is usually straighter.

The close similarity in shape suggests, nevertheless, that the two forms are congeneric. The hinge-structure of Moore's species has not yet been described, but Boehm (**loc. cit.**) assumed that the species is congeneric with such forms from the basal Lias as **Mesodesma germari** Dunker, which he showed have a hinge-structure similar to that of **Isocyprina.** Douvillé, however (1913, p. 456), founded a genus **Eotrapezium** with **M. germari** as genotype, and elsewhere (1947, p. 14i) I have advocated the adoption of this genus, which differs from **Isocyprina** in external characters. The species now described is, therefore, referred to **Eotrapezium.**

Jaworski is the first author to have referred Moore's species to **Anodontophora** on account of some superficial resemblance to the German Upper Triassic species **A. lettica** (Quenstedt), but in the genus in question the shell is usually more evenly ovate in outline.

Locality.—1 1/4 miles S. E. of Carhuamayo.

Family ASTARTIDAE

Genus ASTARTE J. Sowerby, 1816

Astarte incae Jaworski

A. incae Jaworski, 1922, p. 128, pl. V, figs. 12-14.

Localities.—Near La Cima, 3 miles E. of Lake Lulicocha, 2 miles S. W. of Hacienda Huanca.

Astarte andicola sp. nov.

Pl. II, fig. 3.

Specific Characters.—Shell of medium size, ovate, inequilateral, compressed. Umbonal region flattened; umbo obtusely angular, not at all incurved, placed at about the anterior quarter of the length. Antero-dorsal outline straight, steeply sloping, and coinciding with a ridge which limits a narrow, elongate, scarcely impressed lunule. A similarly narrow escutcheon may have been present but is not clearly observable owing to the imperfect preservation of this part of the specimen. Anterior end of shell broadly convex, ventral margin somewhat flattened. The posterior end is unknown complete, but from the early growth-stages of the shell appears to have been vertically subtruncate. The earlier growth-stages bear rather wide-spaced, obtusely angular, depressed folds which later become weaker and more closely spaced, until near the ventral margin the surface of the shell bears only irregular growth-rugae. The ventral margin appears to have been denticulate internally.

Material.—The holotype only (B. M., L. 78337).

Measurements.—Length (estimated) 24 mm., height 19 mm., inflation (single valve) 4 mm.

Remarks.—Among the few species of Astarte described from the Trias there is none closely comparable to that now described. It is, however, rather similar to the Lower Liassic species **Astarte obsoleta** Dunker (1848, p. 178, pl. XXV, figs. β, 9), which includes as synonyms **A. gueuxii** d'Orbigny, **A. consobrina** Chapuis and Dewalque, **A. psilonoti** Quenstedt, **A. thalassina** Quenstedt, and **A. dentilabrum** Etheridge. The Liassic species is, however, less compressed, particularly in the umbonal region.

Locality.—½ mile N. of Lake Churcacocha, about 2 miles S. E. of Hacienda Huanca.

Genus TUTCHERIA Cox, 1946

Tutcheria densestriata (Koerner)

Pl. II, fig. 8.

Cardium heberti Terq., Jaworski 1,922, p. 135 (**non** Terquem)

Cardium densestriatum Koerner, 1937, p. 196, text-fig. 5; pl. XII, figs. 9 **a-c**.

Remarks.—The hinge-structure is well shown in Koerner's figures and is well preserved in some of the specimens now recorded. This is a typical species of the genus **Tutcheria,** the genotype of which is the Liassic species **Cardium submulticostatum** d'Orbigny (= **C. multicostatum** Phillips **non** Brocchi).

Localities.—2 miles S. W. of Hacienda Huanca. Near La Cima, 3 miles E. of Lake Lulicocha.

Family LUCINIDAE

Genus SCHAFHAEUTLIA Cossmann, 1897

Schafhaeutlia americana sp. nov.

Pl. II, figs. 1**a, b**, 2.

Specific Characters.—Shell large for the genus, suborbicular, very slightly longer than high, gibbose, with a strongly inflated, prominent umbonal region and a well incurved, strongly prosogyrous umbo situated at about the anterior third of the length . Surface bearing prominent, irregular concentric ridges.

Material.—The holotype (figs. 1**a, b**) and one paratype, preserved on the same block of limestone (B. M., L. 78356).

Measurements of Holotype.—Length 52 mm., hight 48 mm., inflation (single valve) 23 mm.

Remarks.—The two most closely comparable species described from the Trias are **Schafhaeutlia cingulata** (Stoppani) (1860, p. 84, pl. XVI, figs. 20-24, **sub Cyprina**), from the Esino Limestone (Ladinian) of Lombardy, and **S. mellingi** (Hauer) (1857, p. 549, pl. III, figs. 1-5, **sub Corbis**), which has been recorded from various horizons of the Upper Trias and from several parts of the world. From both of these species, however, it differs in its greater inflation, in the more prominent umbonal region, and in the more strongly incurved and prosogyrous umbo.

Locality.—Near La Cima, 3 miles E. of Lake Lulicocha.

Family CARDITIDAE

Genus PALAEOCARDITA Conrad, 1867

Palaeocardita peruviana sp. nov.

Pl. II, fig. 4.

Specific Characters.—Shell of medium size for the genus, elongate-ovate, narrowing slightly towards its posterior end, posteriorly truncate,

very inequilateral, of moderate inflation. Hinge-margin elongate, meeting the straight, slightly inclined posterior margin in an obtuse angle. Ventral margin rather strongly and asymmetrically convex, meeting the evenly convex anterior margin in a broad curve. Umbonal region narrow, sharply angular, projecting slightly above the hinge-margin; umbo slightly incurved, opisthogyrous, placed at about the anterior fifth of the length. A ridge, sharp in early growth-stages but later obscure, and corresponding with the most inflated part of the shell, curves round from the umbo to the postero-ventral corner. Ornament consisting of about 21 obtusely angular radial ribs, eight of which are posterior to the diagonal carina, which is formed by one of them. The ribs, which are most wide-spaced near this carina, on either side, are crossed by narrow concentric lamellae, rather unevenly spaced, which swell out slightly at their crests.

Material.—The holotype only (B. M., L. 78336).

Measurements.—Length 23 mm., height 17.5 mm., inflation (single valve) 6.5 mm.

Remarks.—This seems to be the same species as that from the Nevado de Acrotambo (North Peru) figured by Koerner (1937, pl. XII, figs. 7 **a-c**) under the name **Cardita** aff. **beneckei,** Koerner mentions the presence of 29 radial ribs and it is possible that the specimen now described may have had one or two obscure ribs, now eroded away, near the dorsal margins, in adition to the 21 counted.

The St. Cassian species **Palaeocardita beneckei** (Bittner, 1895, p. 38, pl. IV, figs. 18-20) has a greater number of radial costae, which are more closely spaced in the neighbourhood of the diagonal carina. Stoppani (1861, pl. VI) figures certain species from the Rhaetic of Lombardy [**P. austriaca** (Hauer), **P. munita** (Stoppani), **P. talegii** (Stoppani)] which resemble the new species in their elongate-ovate outline, but these lack the diagonal ridge which is one of its caracteristic features.

Locality.—½ mile N. of Lake Churcacocha, about 2 miles S.E. of Hacienda Huanca.

Family CARDIIDAE

PASCOELLA gen. nov.

(Named after the Cerro de Pasco region of Central Peru)

Genotype.—Pascoella peruviana sp. nov.

Generic Characters.—Shell suborbicular gibbose, posteriorly truncate, radially costate, **Cardium**-like; test thick. Umbones strongly incurved, slightly opisthogyrous. Hinge-margin bordered by a somewhat flattened dorsal area which extends on both sides of the umbones and is crossed by weak costae, continuing the ornament of the main surface of the shell. Corresponding to these costae dorsal margins bear a series of crenulations simulating taxodont teeth. The dorsal area is crossed by a short, wide, deep ligamental groove which runs obliquely from beneath the umbo to the margin, and on its posterior side is separated from the costate part of the area by a ridge. On the anterior side of this groove is a short nymph (most clearly observed in the right valve), the extremity of which appears, when the shell is viewed from its interior, to form a tooth-like protuberance from the margin, bordering the notch where the groove meets the margin. In both valves the anterior adductor scar consists of a deep circular cavity which lies just below the extremity of the hinge-margin and is separated from the main cavity of the valve by a shelly partition.

Left valve with a prominent, thick, elongate tooth anterior to the umbo, separated, from the margin by a wide, deep, elongate recess, and extending as far as the edge of the anterior adductor cavity. This tooth is bordered posteriorly by a deep triangular recess for the reception of the strong median tooth of the other valve. On the posterior side of this recess is a ridge which originates below the umbo; the detailed structure of this part of the hinge is not clearly preserved in any of the available left valves, but, from the occurrence of two small, circular depressions in the corresponding part of the hinge of the other valve, it appears to have borne two tubercle-like teeth. On the posterior side of this ridge is the notch where the ligamental groove meets the margin, and a considerable distance beyond this and well separated from the teeth already mentioned, is a prominent, tuberculiform posterior lateral tooth, separated from the margin by a recess.

Right valve with a prominent triangular tooth immediately below the umbo, bordered anteriorly by a large triangular recess for the reception of the main tooth of the other valve, and with its apex touching the dorsal margin. Posterior to this tooth, just beyond the umbo, are the two radially disposed circular depressions already mentioned, then the extremity of the nymph and the notch where the ligamental groove meets the margin, and, well separated from these structures, a deep circular recess for the reception of the lateral tooth of the other valve, with a very small tooth above it, projecting from the shell-margin.

The ventral and posterior margins are strongly crenulated internally.

Remarks.—This peculiar genus is provisionally included in the Cardiidae, but, like several other contemporaneous genera, including **Tutcheria,** it does not fit well into any of the recognised families, based on Tertiary and living species. It differs from normal representatives of the Cardiidae in the presence of the deep cavity for the insertion of the anterior adductor, in the absence of anterior lateral teeth, and in its oblique ligamental groove, crossing a dorsal area of appreciable width. In external characters it much resembles **Pterocardia,** of the Jurassic, but the hinge-characters of that group, described and illustrated by de Loriol (1891, p. 186, pl. XX) differ in many points. In addition to the strongly costate exterior, there are some points of resemblance between **Pascoella** and **Palaeocardita,** the type of which is the Upper Triassic species **Cardita crenata** Goldfuss. **Palaeocardita** (see Bittner, 1895, pl. IV, figs. 11-13) has well-impressed anterior adductor scars, but these are not deep cavities like those of **Pascoella.** It also has well-defined posterior lateral teeth, but these are elongate laminae as distinct from the tuberculiform teeth of the new genus. It has a normal elongated ligament, extending from the umbo along the dorsal margin.

Pascoella peruviana sp. nov.

Pl. I, figs. 9, 12a, b, 13, 14, 15; ? Pl. II, fig. 5.

Specific Characters.—As defined for the genus. The costae number about 20 (apart from the small ones on the dorsal area), are obtusely angular bear small serrations or tubercles at their crests, and are crossed transversely by closely and evenly spaced ridges.

Holotype.—B. M., L. 78245.

Measurements of Holotype.—Length 46 mm., height 46 mm., inflation (single valve) 24 mm.

Remarks.—Numerous specimens of this species, silicified and completely weathered out of their limestone matrix, were collected at the type-locality (see below) by Mr. R. G. Patton and presented to the Geological Department of the British Museum (Natural History). A photograph sent by Mr. Patton shows numerous partly weathered-out specimens projecting from the surface of a large block of limestone. Subsequently, smaller specimens of the same species were extracted by the action of acid from blocks of Triassic limestone collected elsewhere in the district by Dr. J. V. Harrison. The hinge-structure is fairly clearly preserved in several of the weathered-out specimens and is well preserved in a right valve (fig. 15) extracted by the use of acid.

The specimen represented in pl. II, fig. 5, appears, to be a broken right valve of a **Pascoella** in which the cardinal area and the short, oblique ligamental groove are just visible. It differs from all the other specimens which have been examined in the more conspicuous carination of the posterior slope of the shell and in the very irregular distribution of the radial ribs, which, compared with those of typical specimens of **P. peruviana,** are wide-spaced in the neighbourhood of this carina and close spaced on the rest of the surface. This specimen is either a very abnormal representative of **P. peruviana** or belongs to a second species of the genus which cannot be described until further specimens are available.

Localities.—Hill-top overlooking Huayre, 13 miles from Junin (type-locality) . ½ mile north of lake called Churcacocha, 2 miles .

S.E. of Hacienda Huanca. 2 miles S.W. of Hacienda Huanca. Near La Cima, 3 miles E. of Lake Lulicocha, 2 miles N.E. of Callahuai, between Junin and Lulicocha.

Class GASTROPODA

Family EUOMPHALIDAE

Genus BROCHIDIUM Koken, 1889

Brochidium spinosum Koerner

Brochldium spinosum Koerner, 1937, p. 207, pl. XIII, figs. 6**a.-d.**

This peculiar species is represented by a specimen rather less than 3 mm. in diameter with the peripheral spines clearly preserved on the last whorl.

Locality.—2 miles S.W. of Hacienda Huanca.

Family PARATURBINIDAE

Genus CHARTRONIELLA Cossmann, 1902

Chartroniella wortheniiformis sp. nov.

Pl. II, figs. 13-15.

Specific Characters.—Shell of medium size, depressed-trochiform, broader than high, imperforate. Spire whorls with flat, vertical sides, separated by a narrow, projecting carina from a broad, flat shoulder, which slopes up to the suture, making an angle of 35° to 40° with the horizontal. A second carina, narrow and projecting like the first, appears just above the lower suture on the penultimate whorl, and on the last whorl forms the periphery of the short, feebly convex base. The aperture is ovate, with its plane very oblique, the outer lip, when viewed in profile, forming an angle of about 30° with the suture. The outer

lip is thin and the carinae hollowed out where they meet it. The inner lip is short, strongly inclined backwards with respect to the axis, and rather broadly smoothed, with a well-marked ridge forming its outer margin; its inner edge is slightly concave. The surface of the shell bears weak, obscurely granose spiral threads, about 12 of which are present on the shoulder of the last whorl, three between the carinae, and 16 or rather more on the base. The spirals are crossed by growth-threads which are straight and have a pronounced forward inclination both on the whorl-shoulder and between the carinae, producing jags on the edges of the latter.

Material.—The holotype (B. M., G. 67179) and about eight paratypes.

Measurements of Holotype. — Height c. 15 mm., diameter 16.5 mm.

Remarks.—In view of the fact that the growth-lines are straight and forward-sloping between the two carinae, as elsewhere on the surface, and that there is no evidence that a sinus-band coincides with the upper carina, it appears that this species is not a **Worthenia,** as its general shape suggests. It is, therefore, referred to the family Paraturbinidae, in which the genus **Chartroniella,** of those hitherto proposed, seems the most appropriate for its reception. It lacks, however, the callous coating of the base which is characteristic of the more typical representatives of that genus (see Wenz, 1938, p. 262). No closely comparable species has been described previously from the Trias.

Locality.—2 miles S. W. of Hacienda Huanca.

Family EUCYCLIDAE

Genus EUCYCLUS Deslongchamps, 1860

Eucyclus harrisoni sp. nov.

Pl. II, figs. 17, 18

Specific Characters.—Shell of large-medium size and average proportions for the genus, imperforate. Whorls with vertical sides separated by a well-marked carina from a flat shoulder which slopes up to

the suture at an anlge of about 45°. The shoulder-carina bears a row of moderately large tubercles, while a second carina, bearing slightly smaller tubercles, is visible just above the lower suture, and on the last whorl forms the periphery of the feebly convex base. The worhl-shoulder and the concave band between the two rows of tubercles bear rather conspicuous growth-threads, which form an angle of about 45° with the suture, and the shoulder may also bear obscure spiral threads. The base is unornamented except for weak radial ridges which originate at the tubercles on the lower carina but soon die out. The aperture is not preserved intact.

Material.—About eight specimens; the original of fig. 18 (B. M., G. 67195) is selected as holotype.

Measurements of Holotype.—Height c. 43 mm., diameter 30 mm.

Remarks.—This species appears to be distinct from **Eucyclus pacificus** Jaworski (1922, p. 140, pl. IV, fig. 11), which it resembles in the bicarination of the whorls and the general proportions of the shell. The distinction lies in the much more conspicuous tubercles borne by the carinae. The height of Jaworski's type is given as 18 mm. and even on its last whorl the carinae are narrow and bear only delicate crenulations. In the species now described the upper carina at the same stage of growth is broadly rounded and bears conspicuous tubercles.

Localities.—Near La Cima, 3 miles E. of Lake Lulicocha. 1/2 mile N. of Lake Churcacocha, 2 miles S.E. of Hacienda Huanca.

Eucyclus tricarinatus sp. nov.

Pl. II, fig. 16.

Specific Characters.—Shell small, acute, almost twice as high as broad, with the aperture occupying about one-third of the total height. Spire whorls encircled by two narrow, sharp, obscurely granose carinae, the upper of which is slightly the stronger and delimits a broad shoulder which slopes up to the suture so as to form an angle of about 45° with the horizontal. On the last whorl a third carina appears at the level of the suture and delimits a slightly convex base wich bears four narrow concentric ridges. Aperture suborbicular. Columellar lip concave, narrowly reflected.

Material.—The holotype only (B. M., G. 67192).

Measurements of Holotype.—Height 4.5 mm., diameter 2.6 mm.

Remarks.—This is unlike any of the described Triassic species of Eucyclus and, except for its small size, may be compared with a number of Jurassic forms, such as **E. ornatus** (J. Sowerby) and **E. capitaneus** (Münster). Figures of several such species are **given** by Hudleston (1892, pls. XXI, XXII) and by Broesamlen (1909, pl. XX).

Locality.— 1 1/4 miles S. E. of Carhuamayo.

Genus HAMUSINA Gemmellaro, 1878

Hamusina triasica sp. nov.

Pl. II, fig. 12.

Specific Characters.—Shell of medium size, sinistral, very slightly extraconic, rather higher than broad, with the spire whorls flat and separated by well-incised sutures which are sometimes bordered on each side by a spiral cord. The whorls are ornamented with narrow spiral cords crossed by slightly stronger, more or less oblique axial ribs which bear rounded tubercles at the points of intersection. The spirals, which may be obscure on the early whorls, number either four or five on the penultimate and last according to whether the one adjacent to the upper suture is absent or present; if present, this cord is relatively weak and bears transverse crenulations; the cord adjacent to the lower suture is the strongest and the tubercles which it bears are elongeted in a spiral direction. The axial ribs are straight, depressed, usually more or less oblique, and only occasionally in alignment from one whorl to the next; the interspaces are considerably wider than the ribs. The last whorl is of moderate covexity with an evenly convex base the outer part of which bears two or three spiral cords crossed by the lower ends of the axial ribs. The centre of the base is obscured in the available specimens, but an umbilicus appears to be absent. The aperture is orbicular.

Material.—The holotype (B. M., G. 67207) and one paratype.

Measurements of Holotype.—Height 20 mm. +, diameter 15 mm.

Remarks.—If (as appears to be the case) this shell is imperforate, its characters agree with those of **Hamusina**, hitherto unknown from pre-Liassic rocks, rather than of **Cirrus**, which has been recorded from the Upper Trias of Italy and is represented in Dr. Harrison's 1939 collection from Peru by a new species distinct from that now described. In the holotype of the species now described the last whorl has been flattened by pressure, but its outline is clearly visible in the paratype.

Locality.—Close to Lulicocha, near S. shore of lake.

Family TROCHIDAE

Genus CALLIOSTOMA Swainson, 1840

Calliostoma interruptum sp. nov.

Pl. II, figs. 20 **a, b.**

Specific Characters.—Shell small, regularly conical, slightly higher than broad, with flat-sided whorls separated by linear sutures. Last whorl subangular at the periphery, with a feebly convex, imperforate base. Aperture rhomboidal, low and oblique, occupying about one-third of the height of the shell. Inner lip broad and flattened at the foot of the columella, bordered externally by a well-marked ridge, and bearing a conspicuous swelling, almost forming a rounded tubercle. The surface of each whorl has an upper and a lower zone of about equal width, both bearing obscure, rounded costae, separated by a narrow median zone over which the costae either do not extend or are interrupted by a depression. The costae are vertical or inclined forward to a slight extent and are separated by slightly wider interspaces; those of the two zones are usually, but not invariably, in alignment. Spiral ornament is absent and the base is smooth.

Material.—The holotype only (B. M., G. 67178).

Measurements of Holotype.—Height 6.7 mm., diameter 6.0 mm.

Remarks.—This does not seem to be the species of which a fragment is figured by Koerner (1937, p. 210, pl. XIV, figs. 2**a-c**) as **"Trochus (Tectus)** ? n. sp. ind.", as Koerner mentions and figures a narrow,

umbilicus. Its apertural characters, notably the presence of the basal columellar tubercle, are those of **Calliostoma** s. lat., although this genus has not been recognized in the Trias by Cossmann. In **Proconulus** Cossmann, in which the general configuration of the shell is very similar, this tubercle is absent (see Cossmann, 1918, pp. 277, 287).

Locality.—2 miles S.W. of Hacienda Huanca.

Family TURBINIDAE

Genus HOMALOPOMA Carpenter, 1864.

Homalopoma cimana sp. nov.

Pl. II, fgis. 21**a, b,** 22.

Specific Characters.—Shell small, turbinate, evenly convex at the periphery, and consisting of four strongly and evenly convex whorls; base imperforate. Aperture orbicular, occupying about one-half of the total height of the shell, its peristome discontinuous at the parietal wall. Outer lip inclined forward in profile view so as to form an angle of about 60° with the suture. Inner lip smooth, strongly concave, distinctly margined but not at all detached externally. Ornamentation, which extends over the entire surface, consisting of about 14 obscurely granose spiral bands, 4-5 of which are visible on the spire whorls; the bands are most closely spaced near the upper suture and on the base, and on the peripheral region are separated by interspaces of greater width.

Material.—The holotype (B. M., G. 67204) and one paratype.

Measurements of Holotype.—Height 5.3 mm., diameter 5.0 mm.

Remarks.—The generic name **Homalopoma** is here used for the group of shells to which Pilsbry (1888, p. 245) applies the name **Leptothyra.** This latter name dates only from Pease (1869) and the type-species, **L. costata** Pease, has not been figured and is listed by Pilsbry as a form of doubtful affinities. Wenz (1923, p. 340) places **Leptothyra** in the synonymy of **Homalopoma.**

Although **Homalopoma** has not previously been traced back to pre-Tertiary beds, there are no conchological characters by which the

small shell now recorded could be separated from it. The most closely comparable species described previously from the Trias is **Turbo cinctus** Münster, from St. Cassian, which later monographers of Triassic gastropoda (e. g. Kittl, 1891, p. 239, pl. v, figs. 31-33) have referred to **Collonia. Collonia,** however, as typified by the Eocene species **"Delphinula" margirata** Lamarck, has certain peculiar umbilical features possessed neither by **Homalopoma** nor by the Triassic shells now discussed, and has been made the type-genus of a distinct family or subfamily (see Wenz, 1938, p. 343).

In size, shape, and whorl-ornament **T. cinctus** agrees well with the species now described. All published descriptions of it, however, repeat the information that it has a definite umbilicus, and this feature is well illustrated by Haeberle (1908, pl. II, figs. 14**b,** 16**c**). The Peruvian species, which is imperforate, must, therefore, be regarded as new. The paratype differs from the holotype in the rather wider spacing of the spiral bands on the sides of the whorls.

Localities.—Near La Cima, 3 miles E. of Lake Lulicocha, 2 miles S.W. of Hacienda Huanca.

Family COELOSTYLINIDAE

Genus OMPHALOPTYCHA von Ammon, 1892

Omphaloptycha lissoni sp. nov.

Pl. II, figs. 11 **a, b.**

Specific Characters.—Of medium size for the genus, conical-ovate, with the diameter equal to about two-thirds of the height and the aperture occupying well over one-half of the total height. Spire angle about 60°. Whorls about 5½ in number, those forming the spire strongly convex, with a rounded shoulder developing on the penultimate. Last whorl rather flattened laterally, with an evenly convex base which shows no umbilical perforation from the exterior. Aperture ovate, of moderate width, somewhat extended in an anterior direction. Peristome discontinuous in the parietal región; outer lip rather flattened; columellar lip very feebly concave, vertical, somewhat elongated. Suture of shell smooth, but retaining a coleur-ornament of

lines having the shape of asymmetrical V's the angle of each of which points backwards with respect to the direction of growth of the whorls and is located slightly above the level of the suture.

Material.—The holotype only (B. M., G. 67216).

Measurements.—Height 12.0 mm., diameter 8.4 mm.

Remarks.—This shell closely resembles the species from the Trias of the same area which Jaworski (1922, p. 147, pl. v. fig. 19) identifies, probably erroneously, with the much amaller German Muschelkalk species **O. rhenana** (Koken) (1898, p. 38, pl. vi. figs. 1, 2), but it differs in its less elevated spire and more globose last whorl, and in the absense of a clearly visible umbilicus. It also differs in colour-ornamentation, which in **O. "rhenana"** consists, according to Jaworski, of two rows of dark pyriform puncta. The most closely comparable species described from the Alpine Trias of Europe is **Phasianella münsteri** Wissmann, which Kittl (1894, p. 195, pl. vi, fig. 7) refers to **Pseudomelania.** In the species in question, however, the spire is slightly narrower.

It is difficult to decide whether these species are better referred to **Omphaloptycha** or to **Pictavia** Cossmann, which that author (1925, p. 15) regards as its derivative. I have, however, included it in the former genus, for although no umbilicus is visible from the exterior it is possible that an axial section of the shell would reveal a narrow perforation of the columella. Certain comparable species from the Upper Trias of St. Cassian, in the Dolomites, figured by Kittl (1892, pl. viii, figs. 10-18) under the names **Amauropsis paludinaris** (Münster) and **A. sanctae-crucis** Laube, are considered by Cossmann (1925, p. 50) to be early representatives of **Ampullospira.**

Locality.—Close to Lulicocha, near S. shore of lake.

Omphaloptycha? subarmata (Jaworsky)

Pl. II, fig. 19.

Pseudoscalites subarmatus Jaworski, 1922, p. 143, pl. v. figs. 17, 18.

Pseudoscalithes subarmatus Steinmann, 1929, p. 59, fig. 59 B.

A small, conical-ovate shell, the height of which (3.6 mm.) is about twice the diameter, and the whorls of which are flat, but narrowly shelved at the suture, where they bear a row of small tubercles, appears to be an immature specimen of the species described by Jaworski under the above name. The aperture, which was missing in Jaworski's type, is ovate and entire. An umbilicus, if present, must be very narrow.

This species has little in common with the much stouter, lower-spired, **Purpuroidea**-like shells from the European Trias which constitute the genus **Pseudoscalites.** Apart from the coronation of its whorls it more closely resembles shells which have been referred to **Coelostylina** and **Omphaloptycha,** and it is now tentatively referred to the latter genus.

Locality.—2 miles S. W. of Hacienda Huanca.

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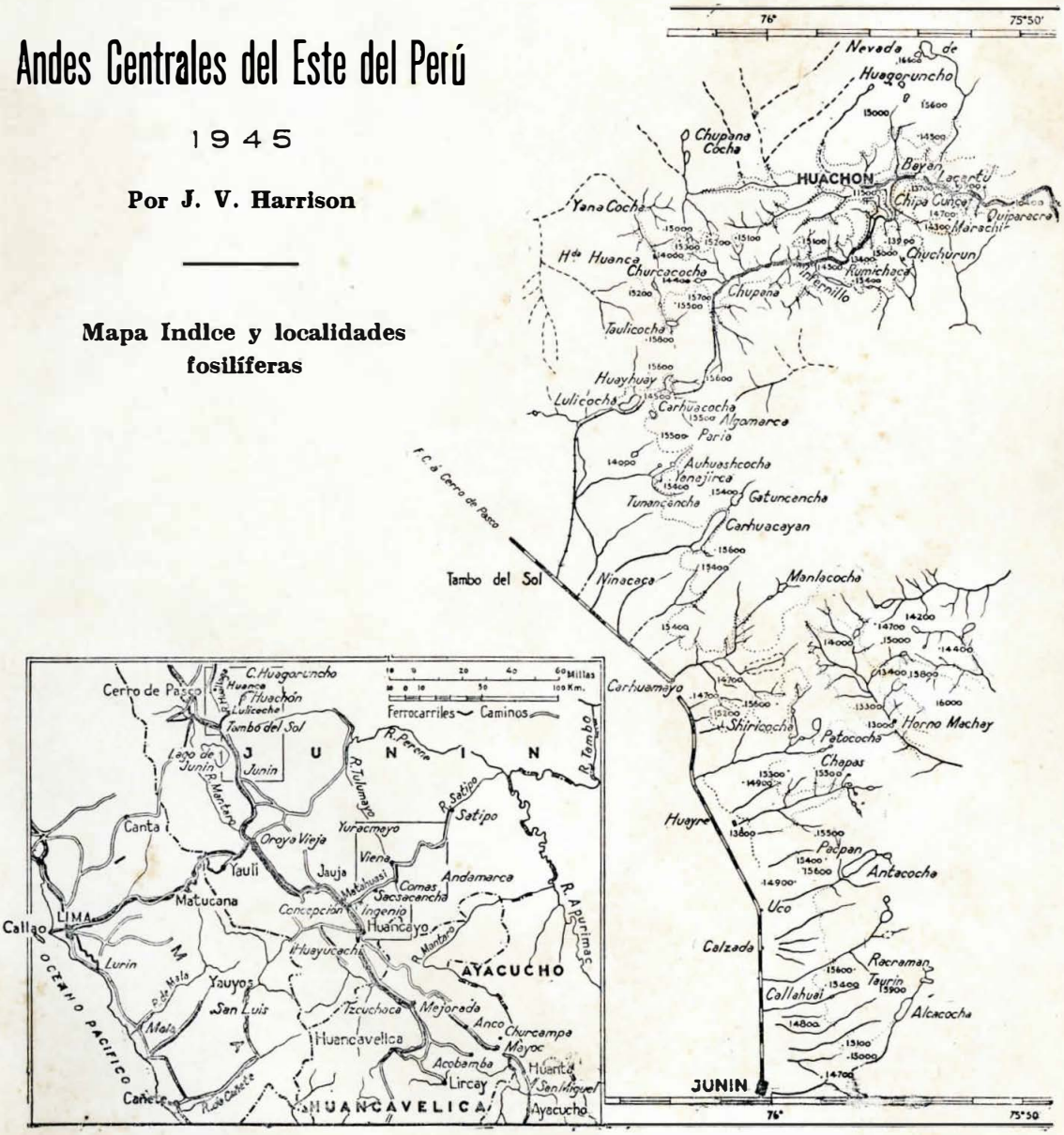
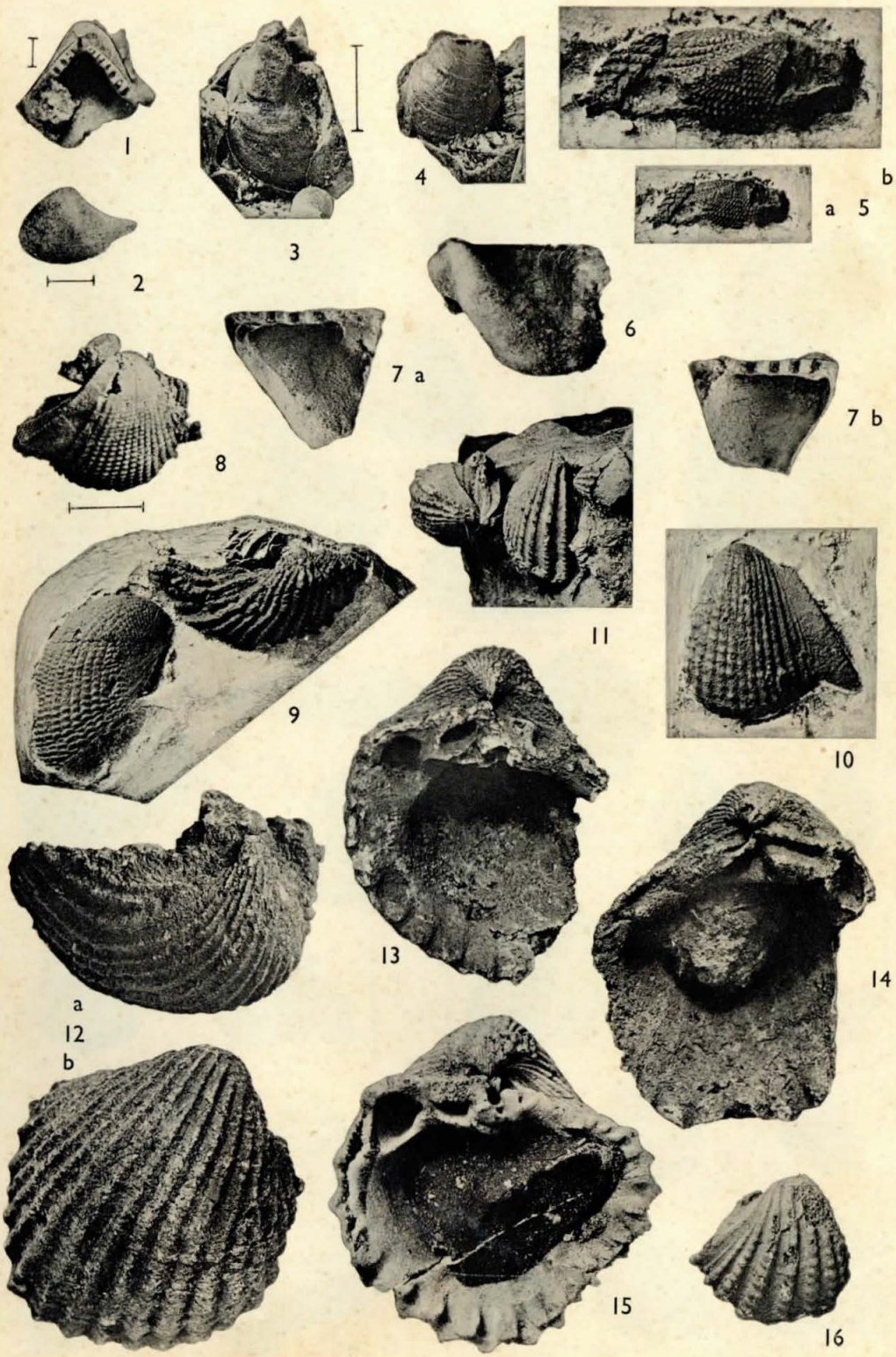
Andes Centrales del Este del Perú

1945

Por J. V. Harrison

Mapa Indice y localidades fosilíferas

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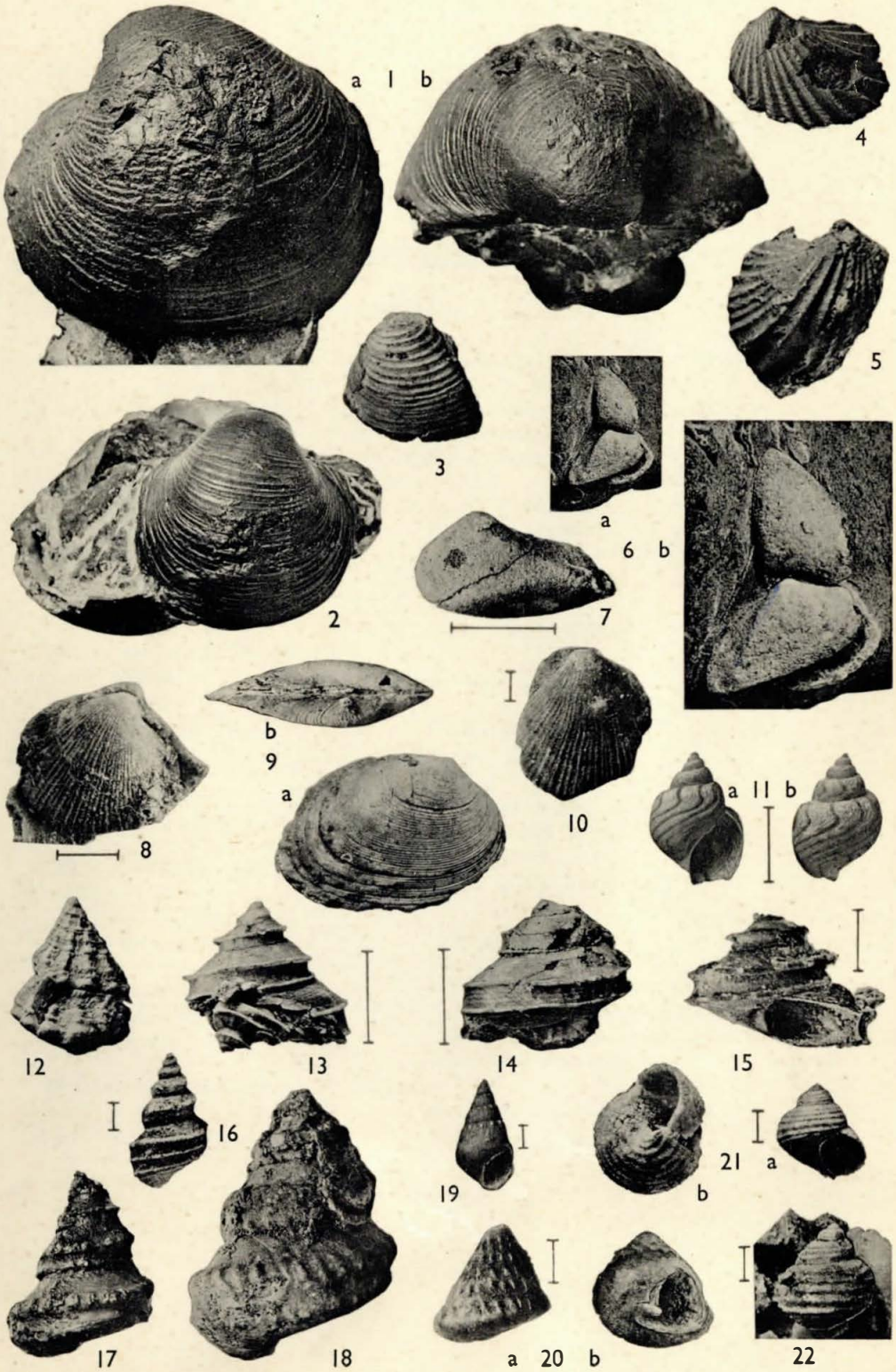
7 b
8
9
11
10
13
14
a
12
b
15
16


a 1 b
4
5
3
a
6 b
2
7
b
9
a
8
10
a 11 b
12
13
14
15
16
19
b
21 a
17
18
a 20 b
22

INDICE ALFABETICO DE ESPECIES