Paleontología Mexicana
Volumen 6, núm. 1, 2020, p. 1 – 9

The Paleontological Collection of the Facultad de Ingeniería of the Universidad Nacional Autónoma de México

Buitrón Sánchez, Blanca Estela[a,*]; Cuadros Mendoza, Iván Manuel[b]; Campos Madrigal, Emiliano[a]; Suárez Noyola, María Elena[a]

[a] Instituto de Geología. Universidad Nacional Autónoma de México. Ciudad Universitaria, Alcaldía Coyoacán, 04510, CDMX, Mexico.
[b] División de Ingeniería en Ciencias de la Tierra, Facultad de Ingeniería, Universidad Nacional Autónoma de México. Ciudad Universitaria, Alcaldía Coyoacán, 04510, CDMX, Mexico.

[*] blancab@unam.mx

Abstract

The Paleontological Collection of the Facultad de Ingeniería of the Universidad Nacional Autónoma de México has 6,347 fossil samples of plants, protists, invertebrates, and vertebrates. Additionally, there are 348 recent samples with the aim to make comparisons between the living world and the geological past. The main purpose of this collection is to support the courses of General Paleontology, Stratigraphy, Paleontology, Micropaleontology, Stratigraphy, and Historical Geology for the Geological Engineer major. The collection is organized by phyla and each sample has a card with systematic, stratigraphic and geographic information. The invertebrate fossils are the most abundant and come from different regions of Mexico such as Baja California, Sonora, Chihuahua, Tamaulipas, Veracruz, Coahuila, Durango, Sinaloa, San Luis Potosí, Querétaro, Estado de México, Puebla, Oaxaca, Hidalgo, Guerrero, and Chiapas. It also has material from Canada, the United States of America, Cuba, England, France, Germany, Italy, Belgium, Sweden, Switzerland, India, Russia, and Australia.

Keywords: Collection, Engineering, Mexico, Paleontology, UNAM.

Resumen

La Colección Paleontológica de la Facultad de Ingeniería de la Universidad Nacional Autónoma de México cuenta con 6,347 ejemplares fósiles de plantas, protistas, invertebrados y vertebrados, además de 348 ejemplares recientes con la finalidad de hacer comparaciones entre el mundo viviente y el del pasado geológico. Esta colección tiene como finalidad principal apoyar con material didáctico a las cátedras de Paleontología General, Paleontología Estratigráfica, Micropaleontología, Estratigrafía y Geología Histórica en la carrera de Ingeniero Geólogo. La colección está organizada por phyla y cada ejemplar tiene una tarjeta con la información sistemática, estratigráfica y geográfica. Los fósiles de invertebrados son los más abundantes y proceden de diferentes regiones de México entre éstas Baja California, Sonora, Chihuahua, Nuevo León, Tamaulipas, Veracruz, Coahuila, Durango, Sinaloa, San Luis Potosí, Querétaro, Estado de México, Puebla, Oaxaca, Hidalgo Guerrero y Chiapas. También se cuenta con material procedente de Canadá, Estados Unidos de América, Cuba, Suecia, Inglaterra, Bélgica, Francia, Alemania, Italia, Suiza, India, Rusia y Australia.

Palabras clave: Colección, Ingeniería, México, Paleontología, UNAM.

1. Historical background

The Real Seminario de Minería was created on January 1, 1792 with being the first technical professional school in America. The Real Seminario de Minería had the assignment of providing formal training in mining engineering to improve the exploitation and production of metals in New Spain. The degrees issued in this school were Proficient in Beneficiary of Metals and Facultative Proficient in Mines (Morelos, 2014; Escamilla and Pineda, 2019). The first establishment of the Real Seminario de Minería was a house rented to the Order of the Discalced Augustinians of the Philippine Islands located in the 19 Hospicio de San Nicolás street, currently 90 República de Guatemala street in the historical center of Mexico City (Otto, 1980; Escamilla, 2013; Escamilla and Pineda, 2019). However, the lack of space and the need to have its own place led to the construction of a new precinct. On March 22, 1797, under the direction of the Valencian sculptor and architect Manuel Tolsá, the construction of the Palacio de Minería on the building lot of *Nilpantongo* begins in what is now 5 Tacuba street in the historical center of Mexico City. Although the works in the Palacio de Minería concluded on April 3, 1813, the Real Seminario de Minería moved to this new building until 1811 (Escamilla and Pineda, 2019).

The first professor of mineralogy in Mexico was the naturalist Andrés Manuel del Río who did an important teaching job in the assignments of Chemistry, Geognosy, and Mine Arts for 51 years (1795-1846). Andrés Manuel del Río is recognized for his work *Elements of Orictognosia* (whose full title is *Elements of Orictognosia or the knowledge of fossils, arranged according to the principles of A.G. Werner, for the use of the Royal Mexican Mining Seminar*) published in 1795 and 1805. *Elements of Orictognosia* became the first treatise of this discipline elaborated in America (Carrera, 1956a; Aguilera, 1986). This work emphasized the importance of theory and practice to have a better knowledge of local minerals as well as the extensive use of mining deposits.

In 1821, when the Mexican independence was recognized with the signing of the Treaty of Córdoba, the Real Seminario de Minería changed its name to Colegio de Minería (Escamilla and Pineda, 2019). Both institutions had collections of rocks, minerals, and fossils, collected by Fausto Elhuyar, Alexander von Humboldt, Andrés Manuel del Río, and Antonio del Castillo, as well as their students. The existing samples formed the collections of the Cabinets of Mineralogy, Geology, and Paleontology to support student practices and promote scientific research. In 1846, the engineer Antonio del Castillo, co-founder and first director of the Geological Institute of Mexico, continued teaching mineralogy and proposed its division into a course of mechanics applied to machinery (later called industrial mechanics) and another course of mineralogy and geology. This course aimed to improve mining exploitation and subsequently, paleontology was included for the determination of geological age through fossils (Morelos, 2014; Morelos and Moncada, 2015). The samples existence and conservation of the Cabinet of the Colegio de Minas is uncertain due to the changes in the historical development of the current Escuela de Ingeniería, which has received different names: Real Seminario de Minería (1792), Colegio de Minería (1821), Establecimiento de Ciencias Físicas y Matemáticas (1883), Instituto de Ciencias Naturales (1861), Escuela Imperial de Minas (1863), Escuela Politécnica (1864), Escuela Especial de Ingenieros (1867), and Escuela Nacional de Ingenieros (1883-1910). On November 28, 1881, during the Porfirio Díaz government, the Engineering and Agriculture schools changed their dependency from the Ministry of Justice and Public Instruction to the Ministry of Development in order to have close control of the country natural resources. This change favored the Escuela Especial de Ingenieros with the acquisition of bibliographic and instrumental material for meteorology, topography, astronomy, building materials, chemistry, physics, and mechanics, among others in the Palacio de Minería (Bazant, 1984; Lara and Saldaña, 2000).

To enrich the mineralogy, geology, and paleontology collections of the Department of Mineralogy of the Palacio de Minería, Antonio del Castillo, then director, commissioned engineer Ricardo Garcia Granados to buy fossils and minerals from differents parts of the world. In 1881, 150 fossil specimens were purchased from the German mineralogist Dr. Adam August Krantz in Germany (Figure 1). In that year, 314 fossils were bought from the French mineralogist Félix Pisani in Paris, France. In 1895, José Guadalupe Aguilera, a Mexican geologist, student of Antonio del Castillo and the first Mexican paleontologist, published the first issue of the Bulletin of the Geological Institute entitled *Fossil Fauna of the Sierra de Catorce, San Luis Potosí* (Carrera, 1956a, b; Rubinovich *et al.*, 1991).

In 1935, the Geological Engineer major at the Universidad Nacional Autónoma de México (UNAM) was created and its classes were taught at the Palacio de Minería. In 1952, the Central Campus of the UNAM was inaugurated in Mexico City and in 1956, the engineering of Mines and Metallurgist, Petroleum and Geologist were added to the campus. In 1959, when the Ph.D. degrees were instituted, the Escuela Nacional de Ingeniería became the Facultad de Ingeniería (Figure 2) (Escamilla and Pineda, 2019). Over several decades, paleontology was taught at the Facultad de Ingeniería of the UNAM by prestigious academics including doctors Felipe Guerra Peña, Baldomero Carrasco Velázquez, Abelardo Cantú Chapa, Sergio Cavazos, Gloria Alencáster Ybarra and Ismael Ferrusquía Villafranca, who enriched the fossil collection. In 1971, the engineer Mariano Ruiz

Vázquez, chief of Department of Geology of the Facultad de Ingeniería, promoted, through Dr. Blanca Estela Buitrón Sánchez, professor of the chair of Paleontology, transfer and, review of the fossils material deposited in the Palacio de Minería to enrich the paleontological heritage of the school. At present, the collection has 6,347 fossil specimens, from which approximately 80% correspond to invertebrates.

2. The importance of scientific collections

Scientific collections have great historical and didactic value (Negrete, 2011). Bautista (2018), in his echinoderms work, emphasizes in a sentence what the director of the Instituto Mexicano de Recursos Renovables, Dr. Enrique Beltrán, said about the importance of scientific collections in

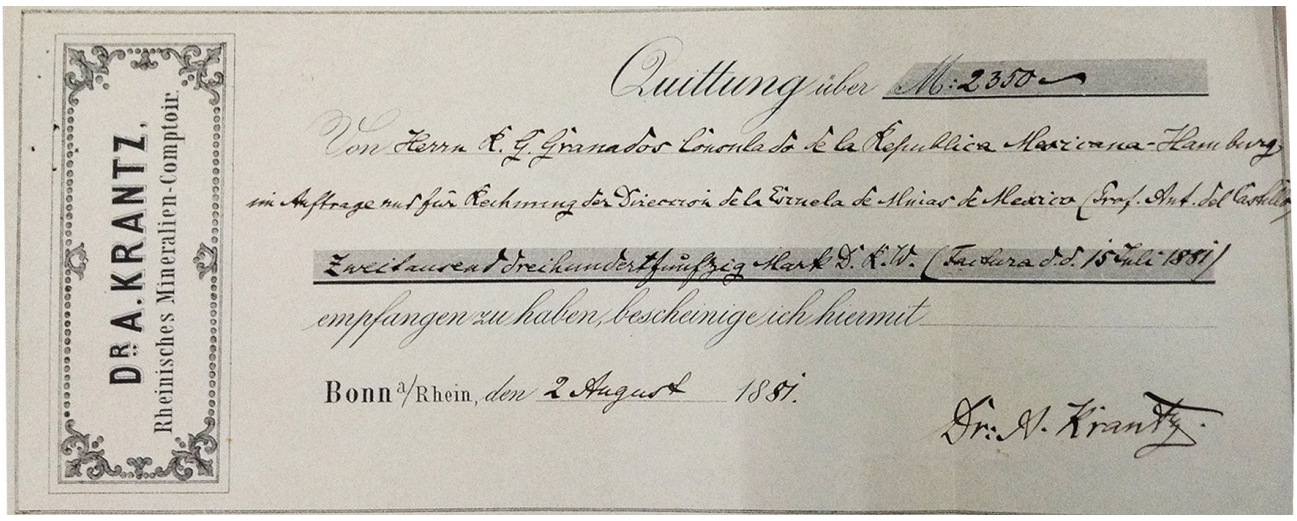

Figure 1. Purchase receipt to Dr. A. Krantz dated on July 15, 1881 (Historical Archive of the Palace of Mines).

Figure 2. Facultad de Ingeniería north set, Central Campus, UNAM (taken from Gaceta UNAM, 2019).

1983, "*... are valuable elements in the educational process: teaching-learning, in addition to providing knowledge about the zoological and botanical collections of the past and present of the Earth that contribute to the stimulus of research.*"

The national territory has outcrops of sedimentary rocks in 75% of its surface. In several locations, fossils of all age groups ranging from Precambrian to Recent are found. Therefore, it is important to protect the paleontological heritage of Mexico, because many times the fossils are collected, for lucrative purposes, by nationals and foreigners, who do not know the scientific value they possess, in addition to being national heritage and invaluable sources for the planet knowledge that we inhabit (Bautista, 2018).

Due to its history in the Palacio de Minería, the Paleontological Collection of the Facultad de Ingeniería is one of the oldest in Mexico. The collection is registered with the National Commission for the Knowledge and Use of Biodiversity (CONABIO, for its initials in Spanish) contributing to the paleontological heritage inventory of the country. This registration in CONABIO allows spreading and sharing the information about the collection.

3. Current organization of the collection

The Paleontological Collection of the Facultad de Ingeniería is located in the Paleontology and Sedimentology laboratory, in the Central Campus of the UNAM. This laboratory also safeguards trace fossils, sedimentary structures and bibliographic material for teachers and students consultation (Figure 3). Currently, the collection consists of 6,347 fossil specimens among plants, invertebrates and vertebrates; and of 348 recent samples with the purpose that students can compare morphological features of the current samples with those of the geological past. In this way, the collection serves as support material for the courses of General Paleontology, Stratigraphic Paleontology, and Historical Geology in the Geological Engineer major at UNAM. The phyla represented in the collection correspond to Porifera, Cnidaria, Annelida, Bryozoa, Brachiopoda, Mollusca, Arthropoda, Echinodermata, Hemichordata and Chordata, in addition to microfossils and fossil plants. Each fossil has a key and a card for its control and registration. The card contains systematic information, location, geological formation, age and collector (Figure 4). Thus, Geological Engineering students can know the location and relative age of the fossil.

Among the Mexican fossils that constitute the collection, there are structures made by Precambrian cyanobacteria from Caborca, Sonora. For the Paleozoic there are trilobites and graptolites of the Tremadocian from Ixtaltepec, Oaxaca; or Pennsylvanian-Permian crinoids of Sonora, Oaxaca, Puebla, and Guerrero. There are also plants of the Late Paleozoic of Matzitzi hill, Puebla. The Mesozoic collection is represented by Triassic ammonites from Sonora, and the Jurassic of Coahuila, San Luis Potosí and Puebla and from the Cretaceous of Baja California, Coahuila, Durango, Puebla and Chiapas. There is a colonial coral (scleractinian) from the Antimonio Formation, northwestern Sonora, of the Triassic of Sonora. Among the cephalopods, there is material from previous belemnites of the Triassic of Sonora and the Cretaceous of Puebla. The bivalve collection is represented by samples of rudists from the Cretaceous of Durango, Tampico, San Luis Potosí, Jalisco, Michoacán, Querétaro, Estado de México, Morelos, Puebla, Guerrero, and Chiapas. Fossils of the Lower Cretaceous, between gastropods, corals and bivalves, represent the region of San Lucas-Huetamo, Michoacán. There are some specimens of mollusks, corals, echinoderms, and ichnofossils from San Juan Raya, Puebla. There is also a collection of gastropods from the Upper Cretaceous of Ocuilapa de la Cruz, Chiapas. There are also fruits with seeds of Nueva Rosita, Coahuila and Mesozoic brachiopods of Real de Catorce in San Luis Potosí. The Paleogene-Neogene collection includes numerous species of bivalves, gastropods, and echinoid-clypeasteroids from Baja California, Tamaulipas and Veracruz. Macro-foraminifers

Figure 3. Part of the collection in the Paleontology and Sedimentology laboratory of the Facultad de Ingeniería, UNAM.

UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO

FACULTAD DE INGENIERÍA
COLECCIÓN PALEONTOLÓGICA

Clave FI-Mb116

Phylum Mollusca

Especie *Trigonia plicatocostata* Nyst y Galeotti

Localidad San Juan Raya, Puebla

Formación San Juan Raya

Edad Aptiano

Figure 4. Card with the data of trigonid sample from San Juan Raya, Puebla.

of the Oligocene from Tamaulipas and Veracruz are also present. There are also mammals fossilized bones found in various locations from the Estado de México. See some examples of different fossil groups and ages in Figures 5 to 8.

The collection also has fossils from other parts of the world such as Canada, the United States of America, Cuba, England, France, Germany, Italy, Belgium, Sweden, Switzerland, Spain, India, Russia, and Australia. Most of these fossils were part of the Palacio de Minería collection. Likewise, the laboratory has received donations from the professors and students of the Facultad de Ingeniería.

4. Purpose

As mentioned, the collection is important as support for the education of geological engineers and especially in the

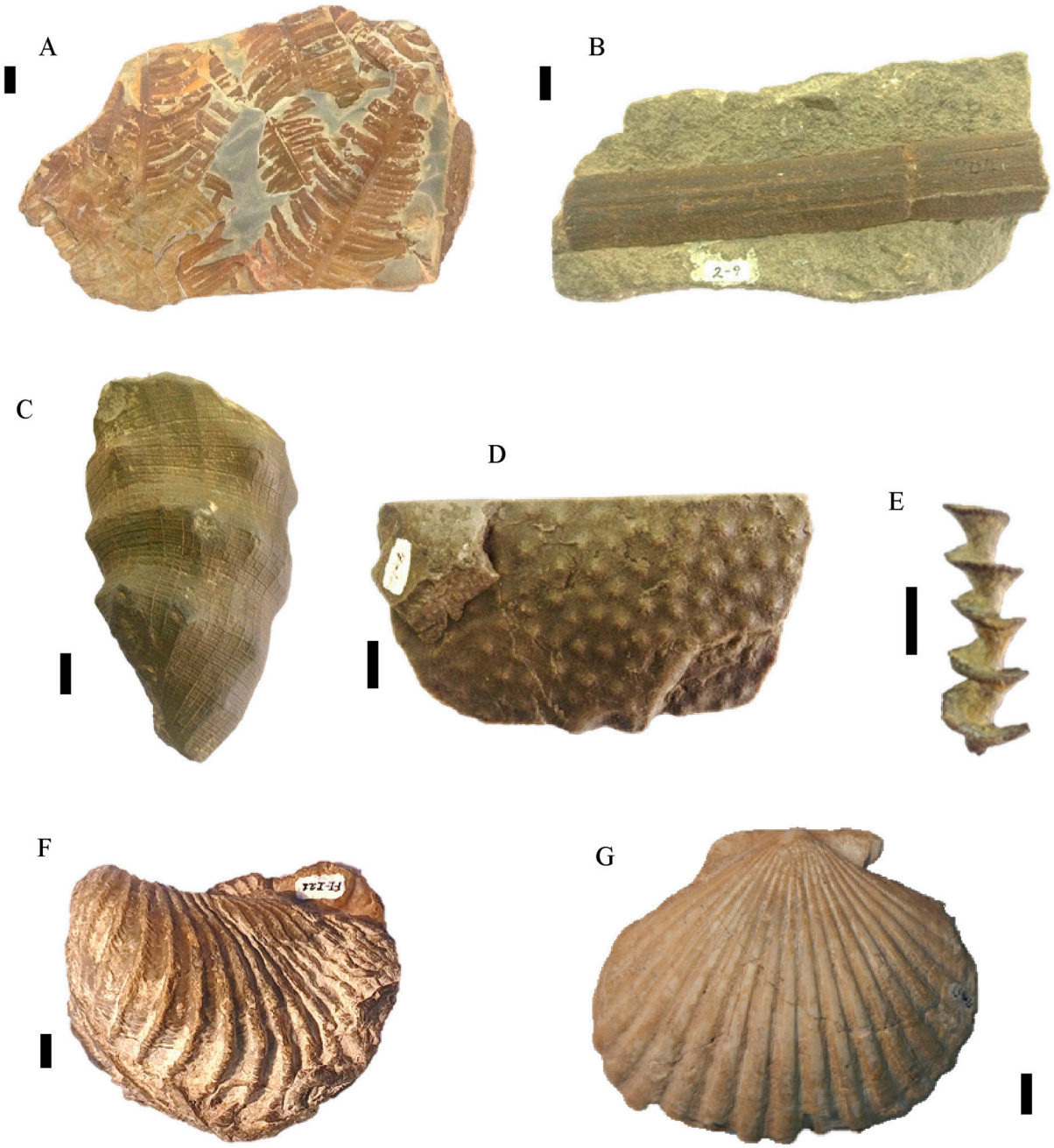

Figure 5. (A) Cycadophyta, fossil plants, Jurassic from Otongo, Hidalgo, Mexico. (B) *Calamites* sp., Pennsylvanian from Tehuacán, Mexico. (C) *Hydnoceras* sp. (Porifera), Devonian from USA. (D) Top view of *Stromatopora* sp., Devonian from Germany. (E) *Archimedes* sp. (Bryozoo), Mississippian from USA. (F) *Ptetrigonia plicatocostata* (Nyst and Galeotti), Lower Cretaceous from San Juan Raya, Puebla, Mexico. (G) *Pecten* (*Lyropecten*) *estrellanus* Conrad from Isla de Cedros, Baja California, Miocene-Pliocene (Cenozoic). Black bar: 1 cm.

laboratory practices of General Paleontology. During this course, twelve practices are carried out covering the topics of fossilization processes, micropaleontology, paleobotany, invertebrates, and vertebrates. The laboratory practices are complemented with fossil molds, recent samples and some books (Buitrón *et al*., 2018); (Figura 9). Fossils from the laboratory have also been used in theses to obtain the degree of geological engineer and social service students have participated in the fossils organization (Negrete, 2011; Bautista, 2018).

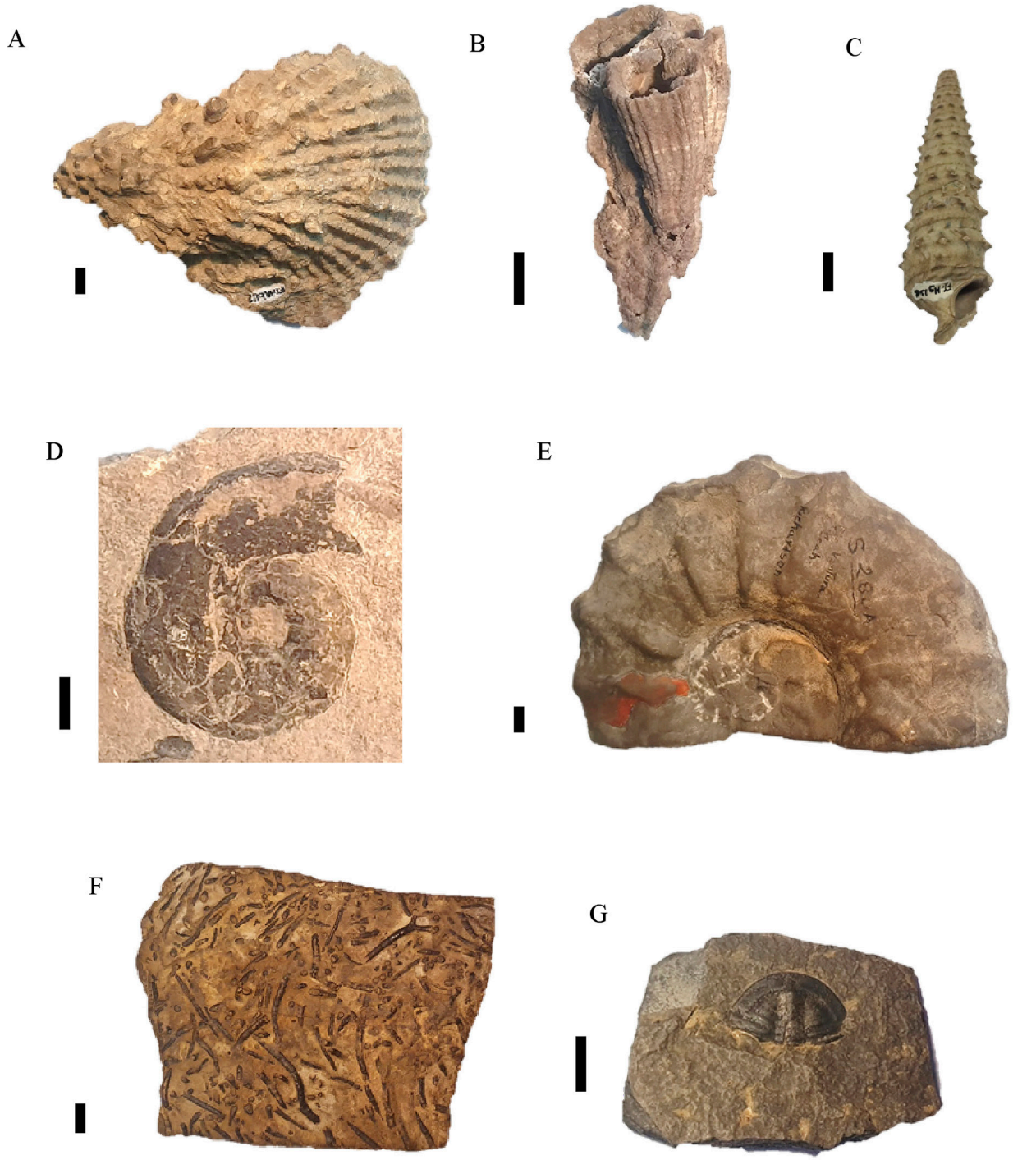

Figure 6. (A) *Ostrea semiarmata* Bose, Cretaceous from Tampico, Tamaulipas, Mexico. (B) Silicified *Hippurites* sp., Cretaceous from Cuautla, Morelos, Mexico. (C) *Cerithium serratum* Lamarck, Cenozoic from Marne, France. (D) *Haploceras* sp., Jurassic from Coahuila, Mexico. (E) *Buchiceras* sp., Upper Cretaceous from Coahuila, Mexico. (F) Trace fossils of Vermes, Lower Cretaceous from San Juan Raya, Puebla, Mexico. (G) *Dalmanites* sp., Silurian from Germany. Black bar: 1 cm.

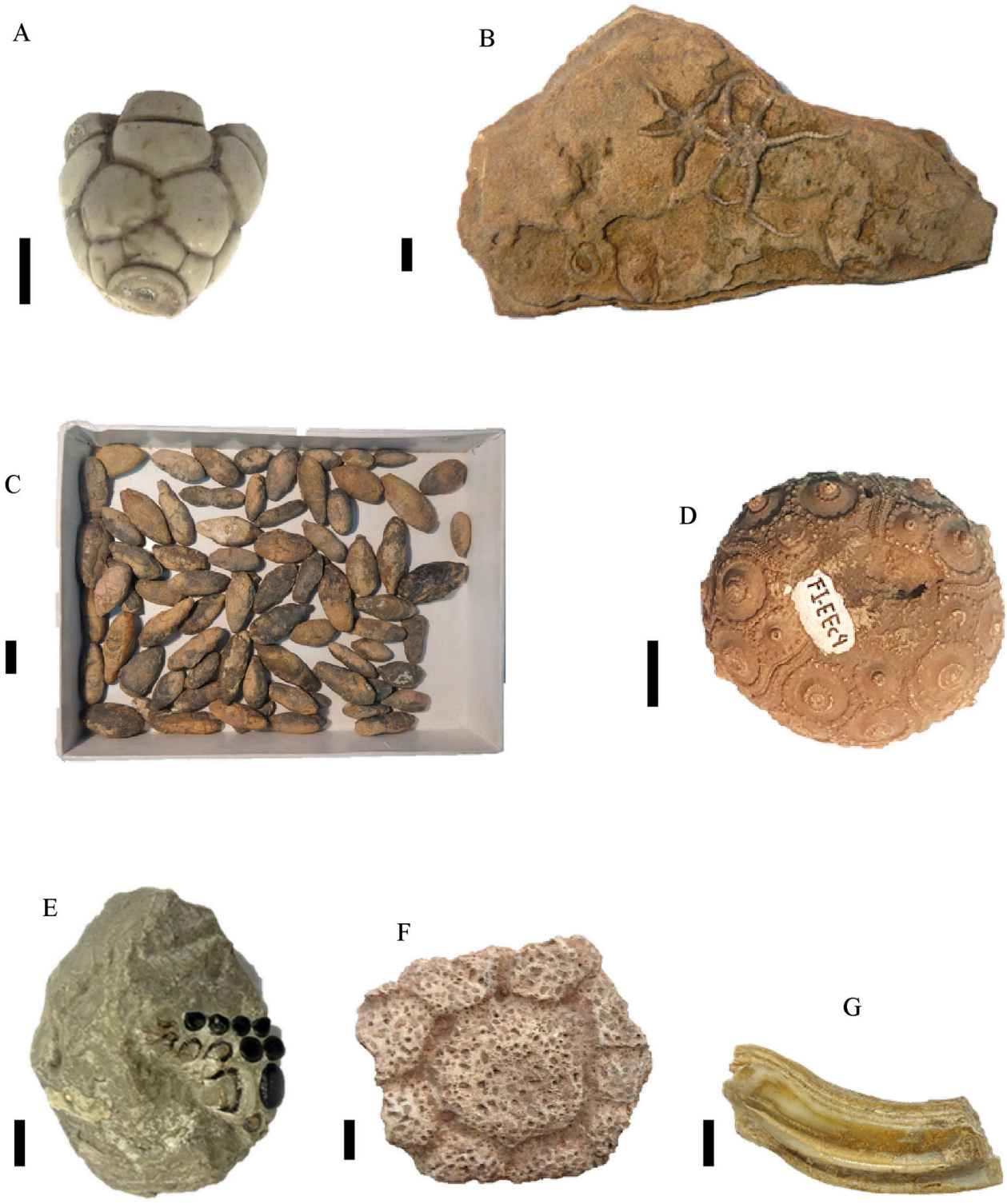

Figure 7 (A) *Poteriocrinus multiplex* Traurschold (Crinoid), Carboniferous from Moscow, Russia. (B) *Ophioderma weymouthiense* Damon, Jurassic from Germany. (C) Box with spines of *Cidaris* sp., Lower Cretaceous from San Juan Raya, Puebla, Mexico. (D) *Cidaris muellerriedi* Lambert, Lower Cretaceous from San Juan Raya, Puebla, Mexico. (E) Dental plaque of *Pycnodus buoklaudi*, Jurassic from Switzerland. (F) Osteoderm of Glyptodont (*Brachyostracon mexicanus* Cuataparo and Ramírez) from Chalchihuites, Zacatecas, Mexico. (G) Tooth of a Pleistocene periodactyl mammal (horse) from Tequixquiac, Estado de México, Mexico. Black bar: 1 cm.

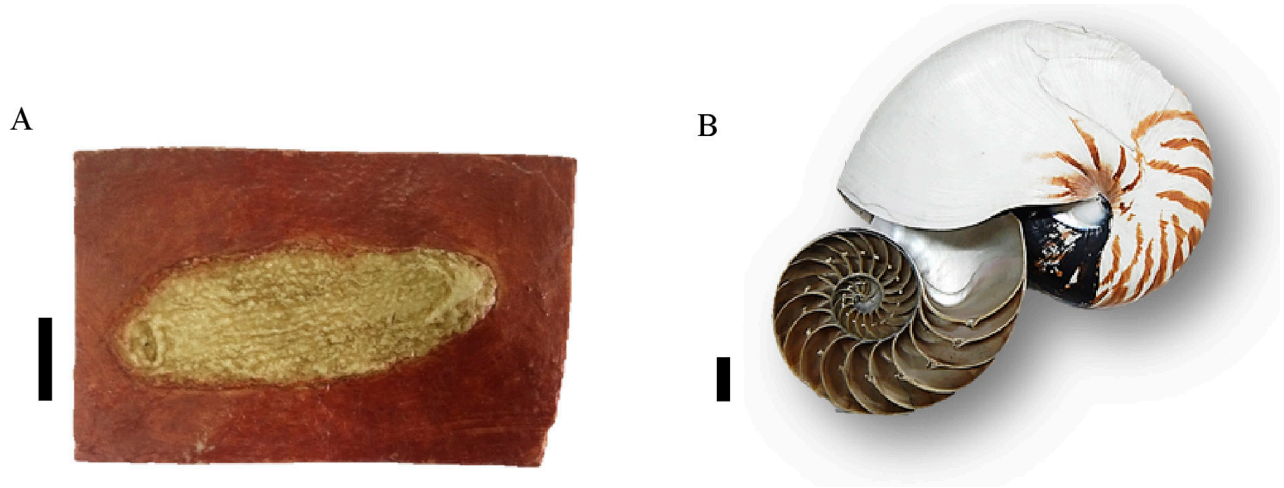

Figure 8. (A) Mold of *Holoturia* sp., Lower Cretaceous from Tepexi de Rodriguez, Puebla, Mexico. (B) *Nautilius pompilius*, Recent. Black bar: 1 cm.

Figure 9. Book of General Paleontology, Invertebrates, edited by Facultad de Ingeniería, UNAM, 2018.

The Engineering Division in Earth Sciences has donated approximately 100 original didactic collections and replicas to universities in Sonora, Guanajuato, San Luis Potosí and to the Facultad de Estudios Superiores Iztacala, UNAM. Fossils were also donated to the Universidad Complutense de Madrid, Spain.

One of the purposes of the academics in this laboratory is to continue enriching the paleontological collection with specimens from Mexico and the world so that future Earth Science professionals continue learning Geology through fossils. At the moment, the laboratory of Paleontology and Sedimentology is in the process of certification at the Council for Accreditation of Engineering Education (CACEI) so that laboratory staff, teachers and students are working to get this goal. In addition to this task, the mission is the curation and classification of fossils.

Acknowledgements

We thank Francisco Omar Escamilla González from the Historical Archive of the Palacio de Minería for the valuable information he provided. We also acknowledge Dolores Rosalva Millan Najera from the Historical Archive of the Palacio de Minería for her very kind attention. The authors thank Francisco Javier Cuén Romero, Griselda Guerrero and an anonymous reviewer for their comments and suggestions in the revision of the article. Our acknowledge to the staff of the Paleontology and Sedimentology laboratory of the Universidad Nacional Autónoma de México for their willingness to let us work with fossils: Nestor Gutiérrez Castrejón, Sergio Durán Avalos and Sergio Santillán Lopez.

References

Aguilera, J.G. *en* Castillo, A. del, Aguilera, J.G., 1895, Fauna fósil de la Sierra de Catorce, San Luis Potosí: Boletín de la Comisión Geológica de México, 1, 1–55

Bautista, L.M., 2018, Actualización y sistematización de los equinodermos (Phylum Echinodermata Klein, 1754) de la Colección Paleontológica de la Facultad de Ingeniería: México, Universidad Nacional Autónoma de México, Tesis de Licenciatura, 51 pp.

Bazant, M., 1984, La enseñanza y la práctica de la Ingeniería durante el Porfiriato: Historia Mexicana, 33(3), 254–297.

Buitrón, B.E., Rivas, G., Gómez-Espinosa, M.C., 2018, Paleontología General de Invertebrados. Universidad Nacional Autónoma de México, Facultad de Ingeniería, División de Ingeniería en Ciencias de la Tierra, Unidad de Apoyo Editorial, 258 pp.

Carrera, M., 1956a, Andrés Manuel Del Río, descubridor del Eritronio (Vanadio) 1764–1846, *en* Congreso Geológico Internacional XX sesión México: Gacetas completas, 3–6.

Carrera, M., 1956b, José Guadalupe Aguilera 1857–1941, *en* Congreso Geológico Internacional XX sesión México: Gacetas completas, 13-16.

Escamilla, F.O., 2013, "Prologo", *en* Escamilla González, F.O. (coord.), 200 años del Palacio de Minería: su historia a partir de fuentes documentales: México, Universidad Nacional Autónoma de México, Facultad de Ingeniería, 404–449.

Escamilla, F.O., Pineda, H., 2019, Historia de la Facultad de Ingeniería (En línea): México, Facultad de Ingeniería. UNAM, Publicado el 13 de diciembre de 2019, *disponible en* [http://www.bienvenidafi.unam.mx/historia.html], *consultado* 14 de enero de 2020.

Gaceta UNAM, 2019, Terna para dirigir la Facultad de Ingeniería, Publicado el 11 de febrero de 2019, *disponible en* [https://www.gaceta.unam.mx/terna-para-dirigir-la-facultad-de-ingenieria/] *consultado* 20 de febrero de 2020.

Lara, M., Saldaña, J.J., 2000, Del Colegio de Minería de México a la Escuela Nacional de Ingenieros: Revista Quipu, 3(1), 105–126.

Morelos, L., 2014, Historia de las ciencias geológicas en México: de entidad gubernamental a instituto universitario (1886–1929): México, Universidad Nacional Autónoma de México, Tesis Doctoral, 327 pp.

Morelos, L., Moncada, J.O., 2015, Orígenes y fundación del Instituto Geológico de México: Asclepios, 67(2), 103 pp.

Negrete, D., 2011, Base de datos de la Colección Paleontológica de la Facultad de Ingeniería, UNAM. Phyla Brachiopoda (Articulata) y Mollusca (Gastropoda). Paleobase FI UNAM: México, Universidad Nacional Autónoma de México, Tesis de Licenciatura, 51 pp.

Otto, G., 1980, El Real Tribunal y el Colegio de Minería en El Palacio de Minería, tercera edición, Sociedad de Ex Alumnos de la Facultad de Ingeniería, Universidad Nacional Autónoma de México, 61–85.

Rubinovich, R., Levy, M., Luna, C., Block, I.C., 1991, José Guadalupe Aguilera Serrano, datos biográficos y bibliografía anotada: México, Universidad Nacional Autónoma de México, Instituto de Geología, Universidad Autónoma de Hidalgo, 116 pp.

Manuscript received: March 13, 2020.
Corrected manuscript received: May 19, 2020.
Manuscript accepted: May 22, 2020.