AIMÉ BONPLAND'S DRAWINGS OF ITÁ PUCÚ, 1834, AND THE HISTORY OF EARLY GEOLOGICAL REPRESENTATIONS IN ARGENTINA

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ABSTRACT

The early geological representations in Argentina dated from the middle of the nineteenth century when Alcide d'Orbigny, Charles Darwin, Bartholomew James Sulivan, Franz Foetterle, Auguste Bravard, Jakob Christen Heusser and Georges Claraz, and Victor Martin de Moussy accompanied their scientific observations with geological maps, stratigraphic sections or sketches of rocky outcrops. Aimé Bonpland (1773–1858), a French naturalist mainly known by his travels with Alexander von Humboldt and by his contributions on tropical botany, settled in southern South America in 1817, and displayed a relevant activity as botanist, zoologist, paleontologist, and geologist. In this last field, Bonpland prepared in 1834 a series of drafts and drawings about the geology of the Itá Pucú that constitute one of the first geological representations to the country and it is the first document providing a detailed description and a schematic graphical representation of a sedimentary outcrop.

INTRODUCTION

The development of a visual language was pivotal in the emergence of geology as a new science during the eighteenth and early nineteenth centuries.[1] Geological maps, stratigraphic cross-sections, schematic drawings of outcrops and landscapes were the result of the intellectual effort of the first geologists and amateurs in trying to represent in a plane a three-dimensional body of rock.

The first naturalistic drawings of Earth's strata were made by the Dutch master Jan Van Eyck (ca. 1385/1390–1441)[2] and by the Italian Renaissance artist and scientist Leonardo da Vinci (1452–1519)[3] in the fifteenth century.

One of the first known geological sections was published in 1719 by John Strachey (1671–1743). Strachey's engraved sections of Mendip coal mines in Somersetshire displayed details of the thickness and angles of dip of strata, together with their lithic characters and structural attitudes.[4] One of the first maps of regional geology was published in France in the middle of the eighteenth century by Jean Etienne Guettard (1715–1786).[5] Guettard's map of southeastern

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[1] Martin J. S. Rudwick, The emergence of a visual language for geological science 1760–1840, *History of Science,* 1976, 14:149–195.

[2] Scott L. Montgomery, The eye and the rock: art, observation and the naturalistic drawing of earth strata, *Earth Sciences History,* 1996, 15:3–24.

[3] Gary D. Rosenberg, An artistic perspective on the continuity of space and the origin of modern geologic thought, *Earth Sciences History,* 2001, 20:127–155.

[4] J. G. C. M. Fuller, The invention and the first use of stratigraphic cross-sections by John Strachey, F.R.S., (1671–1743), *Archives of Natural History,* 1992, 19:69–90.

[5] Guettard's map was published under the title *Carte minéralogique sur la nature du terrain d'une portion de l'Europe dressée pour un Mémoire de M^r Guettard par Philippe Bauche 1746.* See: Patrick De Wever, François Guillocheau, Jean-Yves Reynaud, Emmanuelle Vennin, Cécile Robin, Annie Cornée, and Delphine Rouby, Deux siècles de stratigraphie dans le bassin de Paris, *Comptes Rendus Palevol.,* 2002, 1, 407, figure 7.

England and northern France was merely lithologic and showed the nature and mineralogy of rocks.

The first regional maps including stratigraphic information were made towards the end of the 1790s by William Smith (1769–1839). Smith published in 1801 his first map of England and Wales, at a scale of about 37 miles to one inch, and in 1815, he published at a scale of 5 miles to the inch his great work, *A Delineation of the Strata of England and Wales with parts of Scotland,* the first one of any country at this scale. He also published in 1819 seven detailed geological sections from southeastern England.[6] In 1811, Alexander Brongniart (1770–1847) and Georges Cuvier (1769–1832) published in France a capital work, *Essai sur la géographie minéralogique des environs de Paris.* They mapped the Paris basin and presented several sections of the Tertiary strata around Paris, establishing basic principles of biostratigraphy.[7]

In Britain, geological mapping progressed in the first half of the nineteenth century under the impulse of several academicians such as Dean William Buckland (1784–1856), Professor of Mineralogy and first Reader in Geology at Oxford, who accomplished capital contributions to the geology of the Dorset coast in close relationship with Sir Henry Thomas De la Beche (1796–1855) and Dean William Daniel Conybeare (1787–1857); Adam Sedgwick (1785–1873), Canon at the Cathedral of Norwich and Woodwardian Professor of Geology at Cambridge; and Sir Charles Lyell (1797–1875), Professor of Geology at King's College, London; all of them conspicuous members of the Geological Society of London. Also remarkable was the contribution of Gideon Algernon Mantell (1790–1852), a surgeon of Lewes, author in the 1820s of a series of geological maps and stratigraphic sections used in support of his dinosaur findings from Sussex. South of the English Channel, Jean Baptiste Julien d'Omalius d'Halloy (1783–1875) produced landmark studies in France and Belgium and was one of the geological pioneers in mapping and determining the stratigraphy of several sequences in the Rhine provinces. Geological charting subsequently developed in Germany with Baron Christian Leopold Von Buch (1774–1853), who accomplished several geological maps of his country, but also of Switzerland and Italy, and by the work of Alexander von Humboldt (1769–1859).

In southern South America, the first geological descriptions dated from the sixteenth century and are general reports mainly related with mineral extraction activities.[8] Several topographical maps showing the location of mines or iron meteorites are also known from the latest eighteenth century and the first decade of the nineteenth century.[9]

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[6] William Smith published his famous map of 1815 under the title *A Delineation of the Strata of England and Wales with parts of Scotland; exhibiting the collieries and mines, the marshes and fen lands originally overflowed by the sea, and the varieties of soil according to the variations in the substrata illustrated by the most descriptive names.* See: J. G. C. M. Fuller, *"Strata Smith" and his stratigraphic cross sections, 1819. A review of facts worth knowing about the origin of stratigraphic geology in the mind of William Smith (1769–1839), an English country surveyor and civil engineer* (Tulsa: The American Association of Petroleum Geologists and London: The Geological Society of London, 1995), 1–9; John L. Morton, *Strata. How William Smith drew the first map of the earth in 1801 & inspired the science of geology* (Stroud: Tempus, 2001), 1–160.

[7] Georges Cuvier and Alexander Brongniart, *Essai sur la géographie minéralogique des environs de Paris* (Paris: Institut Imperial de France, Mémoires, 1811), 1–278.

[8] Guillermo Furlong, *Naturalistas argentinos durante la dominación hispánica* (Buenos Aires: Huarpes, 1948), 120–129.

[9] Guillermo Furlong, *Cartografía histórica argentina. Mapas, planos y diseños que se conservan en el Archivo General de la Nación* (Buenos Aires: Ministerio del Interior, 1963), 72, 192; José Torre Revello, Archivo General de Indias. Catálogo de mapas y *planos. Buenos Aires. Tomo II.* Reimpresión (Madrid: Ministerio de Cultura, 1988), 114; and Pedro Torres Lanzas, *Archivo General de*

In Brazil, geological mapping was promoted in the beginning of the nineteenth century with the arrival of German geologists and mining engineers who dealt with the exploitation of iron and coal deposits. The figure of Wilhelm Ludwig von Eschwege (1771–1855) stands out in this context.[10]

The first geological maps of Argentina and Uruguay were published in Paris by Alcides d'Orbigny (1802–1857).[11] D'Orbigny prepared two large-scale maps including northeast and central Argentina, the south of Uruguay, and northeastern Patagonia. The first one, titled *Carte Géologique. Carte d'une partie de la Rép.que Argentine comprenant les provinces de Corrientes et des Missions,* was on display since 1835 at a scale of ca. 40 kilometers to the centimeter (not quoted in the original). The second one, at a scale of 5 French leagues (20 kms) to the centimeter, was known in 1838 as *Carte Géologique d'une partie de la République Argentine comprenant les Provinces de Santa Fe, d'Entre Rios, de Buenos-Aires, et la partie Septentrionale de la Patagonie.* In 1842, eight stratigraphic sections at different spots of the country and two schematic lithic sections of the Tertiary basins of northeastern Argentina and northern Patagonia accompanied the third volume of his monumental *Voyage dans l'Amérique méridionale*; the stratigraphic sections were made at a scale of ca. 1 French league (4 kms) to the centimeter for the distances and 20 meters to the centimeter for the height.[12] Geological maps and stratigraphic sections were lastly reunited by d'Orbigny[13] in the eighth volume (and first Atlas) of the *Voyage dans l'Amérique méridionale.*

While d'Orbigny published his Atlas in Paris, Charles Darwin (1809–1882)[14] published his *Geological observations on South America* in London.[15] The book

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Indias. Catálogo de mapas y planos. Buenos Aires. Tomo I. Reimpresión (Madrid: Ministerio de Cultura,1988), 132–133.

[10] Wilhelm Ludwig von Eschwege was born in Hesse, Nassau. He worked for the Portuguese Crown in Brazil, especially, at the iron mines of the Minas Gerais province from 1821 to 1829. He was author of *Pluto Brasiliensis,* published in Berlin in 1833 and also of a famous chart, *Orographische und Petrographische Charte* whose original is housed at the Deutsche Staatsbibliothek of Berlin. See: Silvia F. de Mendonça Figueirôa, German-Brazilian relations in the field of geological sciences during the 19th century, *Earth Sciences History,* 1990, 9:134–135; and Ana M. de Moraes Belluzzo, *O Brasil dos viajantes.* 3º Edição (São Paulo: Metalivros and Río de Janeiro: Objetiva, 2000), 155.

[11] Alcide d'Obigny visited South America from 1826 to 1833 as naturalist-explorer of the Muséum National d'Histoire Naturelle of Paris. He stayed in Argentina from 1827 to 1829, when he left the country by ship to Chile, and then, to Bolivia, where he also did important geological studies. He published the result of his researches in seven volumes, most of them divided in different parts, accompanied by two atlases.

[12] Alcide d'Orbigny, *Voyage dans l'Amérique méridionale (le Brésil, la République Orientale de l'Uruguay, la République Argentine, la Patagonie, la République du Chili, la République de Bolivia, la République du Pérou), exécuté pendant les années 1826, 1827, 1828, 1829, 1830, 1831, 1832 et 1833). Tome Troisième. 3e Partie: Géologie* (Paris: P. Bertrand and Strasbourg: V. Levrault, 1842), 1–289.

[13] Alcide d'Orbigny, *Voyage dans l'Amérique méridionale (le Brésil, la République Orientale de l'Uruguay, la République Argentine, la Patagonie, la République du Chili, la République de Bolivia, la République du Pérou), exécuté pendant les années 1826, 1827, 1828, 1829, 1830, 1831, 1832 et 1833, Tome Huitième. Atlas historique, géographique, paléontologique et botanique* (Paris: P. Bertrand and Strasbourg: V. Levrault, 1846).

[14] Charles Darwin circumnavigated the world with the *HMS Beagle* under the command of Captain Robert Fitz Roy (1805–1865) from 1831 to 1836. He arrived in Argentina in 1833 and abandoned definitively the country in 1835. He partially followed in his trips the steps of Alcide d'Orbigny, but also could visit new localities on the Atlantic coast and southern margin of Patagonia and Tierra del Fuego, and succeeded to pass across the Cordillera de los Andes in two opportunities.

[15] Charles Darwin, *Geological observations on South America. Being the third part of the geology of the voyage of the Beagle, under the command of Capt. FitzRoy, R. N. during the years 1832 to 1836* (London: Smith, Elder and Co, 1846), i–vii, 1–279.

included three main stratigraphic sections of the Cordillera de los Andes at a scale of ⅓ of an inch to a mile for the horizontal, and 1 inch to a mile for the vertical, as well as several cross-sections without scale, however, like most of Darwin's geological publications, it lacked geological maps.[16]

The work of Bartholomew James Sulivan (1810–1890) also deserves a mention. In 1854, Sulivan sent Darwin part of his collections of Tertiary fossil mammals from Patagonia accompanied by a letter that enclosed sketch drawings of the stratigraphic section at Gallegos River cliffs.[17] This document remained unpublished up to the late twentieth century.[18]

In 1856, the Austrian geologist Franz Foetterle (1823–1876) published a schematic, large-scale geological map of South America. The information on Argentine geology was principally compiled from previous authors, such as d'Orbigny and Darwin.[19]

The first geological map of Argentina edited in the country was accomplished by Auguste Bravard (1803–1861).[20] Bravard published in Buenos Aires, in 1857, the *Mapa geologico y topográfico de los alrededores de Bahía Blanca* at a scale of ca. 2.3 kilometers to the centimetre (not cited in the original). The chart also included eight cross-sections where the author only stated the vertical scale.[21]

In 1865, the Swiss scientists Jakob Christen Heusser (?–1909) and Georges Claraz (1832–1930)[22] published at Zürich a geological description of the Buenos Aires province that included several schematic geological sections of the Sierra de Tandil.[23]

By the end of the 1860s, and as a complement to his great book *Description géographique et statistique de la Confédération Argentine,* Victor Martin de Moussy (1810–1869)[24] published at Paris, in the year of his death, an atlas in-

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[16] David R. Stoddart, Darwin and the Seeing Eye, *Earth Sciences History,* 1995, 14:3–22.

[17] Bartolomew James Sulivan served as naval officer in both *Beagle* expeditions to South America and became a friend of Darwin during the second *Beagle* survey. In 1845, as commander of the brig *Philomel,* he discovered fossil mammals on the north bank of the Gallegos River in Patagonia. Sulivan attained the rank of Admiral of the Royal Navy before his retirement. See: Paul Brinkman, Bartolomew James Sulivan's discovery of fossil vertebrates in the Tertiary beds of Patagonia, *Archives of Natural History,* 2003, 30:56–74.

[18] Frederick Burkhardt and Sydney Smith, eds., *The correspondence of Charles Darwin. Volume 3. 1844–1846* (Cambridge: Cambridge University Press, 1987), 109–126.

[19] Franz Foetterle, Die Geologie von Süd-Amerika, in *Mittheilungen aus Justus Perthes' Geographischer Anstalt über wichtige neue Erforschungen auf dem Gesammtgebiete der Geogrphie von Dr. A. Petermann* (Gotha: Justus Perthes, Band 2, 1856), 187–192.

[20] Auguste Bravard was a French mining engineer who arrived to Argentina in 1853. He worked as geologist mainly in Buenos Aires and Entre Ríos provinces. He collected a great deal of fossil vertebrates which were re-located after his death, following an earthquake in the city of Mendoza, to the Museo Público de Buenos Aires. He published a catalogue of fossil vertebrates, works on the geology of the Pampas, and, in 1858, his *Monografía de los terrenos marinos terciarios de las cercanías del Paraná.*

[21] Auguste Bravard, *Mapa geologico y topográfico de los alrededores de Bahía Blanca.* Lithography (Buenos Aires: Julio Beer, 1857).

[22] The Swiss arrived in Entre Ríos province in 1859 and settled then near the city of Bahía Blanca, Buenos Aires province in 1863. They published several articles on geology, geography, meteorology, meat production, and European emigration to Argentina. They also worked in the diamond mines of Mina Geraes, Brazil. Claraz left the country in 1882, while Heusser died in Argentina.

[23] Jakob Ch. Heusser and Georges Claraz, Beiträge zur geognostischen und physikalischen Kenntniss der Provinz Buenos Aires. I. Der Gebirgszung zwischen dem Cap Corrientes und Tapalquen, *Neue Denkschriften der allgemeine schweizerische Gesellschaft für die gesammten Naturwissenschaften,* 1865, 21, figures 1–8.

[24] Victor Martin de Moussy was a French physician and geographer who lived in Argentina between 1841 and 1859. He published at Paris the three volumes and one atlas of *Description géographique*

Figure 1. Aimé Bonpland (1773–1858).

cluding several charts, and, among them, a large-scale geological map of the country.[25]

The attempts at geological mapping of the Argentine territory received then a great impulse after the 1870s when several German geologists arrived in the country to work principally at the Academia de Ciencias in Córdoba.[26]

Aimé Bonpland (Figure 1) was by training a physician, but his research interest and activities shifted soon, after his graduation in Paris, to systematic and applied botany, and also to zoology, paleontology, and geology. In this last field he accomplished in 1834 the geological reconnaissance of the Itá Pucú. The unpublished drafts and drawings resulting from his observations are remarkable because they constitute one of the first geological representations of Argentina and are also the first detailed graphical representations of a sedimentary outcrop in the country.

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et statistique de la Confédération Argentine. The book was intended to promote the country as a suitable place for European investments.

[25] Victor M. de Moussy, *Description géographique et statistique de la Confédération Argentine. Atlas* (Paris: Firmin Didot Frères, Fils et Cie, 1869).

[26] Telasco García Castellanos, *Exposición de cartas geológicas. Resultado y estudio crítico e histórico sobre cartografía geológica* (Córdoba: Academia Nacional de Ciencias, Miscelánea 35, 1958), 1–51; and Telasco García Castellanos, Historia de la enseñanza de la ciencia geológica en la Universidad Nacional de Córdoba, Argentina, *Boletín de la Academia Nacional de Ciencias,* 2000, 64: 10–13.

THE NATURALIST AIMÉ BONPLAND

Aimé Bonpland (1773–1858) was born in La Rochelle, France, and died in Santa Ana, Corrientes province, Argentina. He studied at the Muséum National d'Histoire Naturelle of Paris with Jean Baptiste Pierre Antoine de Monet Chevalier de Lamarck (1744–1829), who managed the invertebrate zoology section in 1793 and with Antoine Laurent de Jussieu (1748–1826), head of the botanical section in 1795. He may have met also Georges Léopold Chrétien Fréderic Dagobert Baron Cuvier (1769–1832), who joined the museum in 1795. Bonpland acquired a solid scientific education, in an institution that, in the dawn of the eighteenth century, was leading natural science research.

Bonpland apparently never studied geology in a systematic way in Paris, his geological knowledge was, by large, the result of his years with Alexander von Humboldt, his partner of travels. Humboldt had a strong background in the earth sciences; he studied in the School of Mines in Freiberg, worked as mineralogist in Berlin, and then, in his maturity, generated valuable works on geology resulting of his field observations in several countries of America, Asia, and Europe.[27] Bonpland met Humboldt circa 1797 and his life radically changed. Humboldt, a rich Prussian intellectual, became his friend and involved him in preparing a long scientific travel across northern South America and Central America. They visited different countries from 1799 to 1804. They observed nature, hunted and stuffed animals, dried plants for their herbaria, and collected all sort of rocks, minerals, fossils, and archeological artefacts they took with them to Europe. Humboldt accomplished his geological work, including maps and profiles, as in *Geognostische Durchschnitt der Küstenkette von Venezuela,*[28] in the company of Bonpland, and evidently influenced him. About fifteen books, each of them in different volumes, on the botany, zoology, geology, astronomy, history, and ethnography of the expedition were published in France and Germany by Humboldt, Bonpland, and collaborators under the chief title of *Voyage de Humboldt et Bonpland.* Bonpland produced two volumes of general botany, and, also in two volumes, a monograph on the Melastomaceae.[29] Bonpland so became a prestigious man, highly recognized in France and in the European scientific forum. In 1809, he was appointed botanist and general manager of the Empress Joséphine Castle and in 1817 correspondent of the Académie des Sciences of Paris. In this period, his last years in France, he published the two volumes of *Description des plantes rares et cultivées à Malmaison et à Navarre,* with descriptions and illustrations of plants from Joséphine's properties.

The defeat of Napoleon and the collapse of the French Empire in 1815 put Bonpland in an inconvenient position in his country, so, influenced by Bernardino Rivadavia and Mariano Sarratea, representatives of the Buenos Aires government in Europe, in 1817 he accepted an appointment as Profesor de Historia Natural

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[27] Alexander von Humboldt, *Voyage de Humboldt et Bonpland. Première Partie. Rélation Historique. Voyage aux régions équinoxiales du nouveau continent, fait en 1799, 1800, 1801, 1802, 1803 et 1804, par Al. de Humboldt et A. Bonpland. Tome Prèmier* (Paris: F. Schoell, 1814), 332–333; and Alexander von Humboldt, *Essai géognostique sur les gisements des roches dans les deux hémisphères* (Paris and Strasbourg: F. G. Levrault, 1823), i–viii, 1–380.

[28] Alexander von Humboldt, Schichtung der Gebirgsarten am südlichen Abfall der Küstenkette von Venezuela gegen das grosse Becken der Ebenen (Llanos). Aus einem Briefe des Herrn Alexander v. Humboldt an Herrn Ewald, *Zeitschrift der Deutschen Geologischen Gesellschaft,* 1853, 5:18–20.

[29] The complete list of Bonpland's publications can be checked in: Eduardo G. Ottone, The French botanist Aimé Bonpland and paleontology at Cuenca del Plata, *Earth Sciences History,* 2002, 21: 150–165. Ottone's article also contains a sketchy biography and references of previous biographies of Bonpland.

de las Provincias Unidas. Bonpland moved to Buenos Aires but never occupied his promised place.

Troubled times were the 1810s in the Río de la Plata; the country fought against Spain for its independence and also against the Brazilian Empire. Science was not a priority for the government. Political problems convinced Bonpland to quit the city and try his luck with a farm in Misiones to produce yerba maté (*Ilex paraguariensis* Saint Hilaire), a type of tea. Misiones was occupied only by groups of Guarany Indians after 1767, when the Jesuits, by order of King Carlos III of Spain, abandoned their missionary villages. The Buenos Aires authorities claimed this province for their own, but Paraguay did, too. Then, in December 1821, troops of José Gaspar Rodríguez de Francia, Perpetual Dictator of Paraguay, invaded Bonpland's state and snached him away by force to Paraguay, where he was obliged to stay until 1831.

After his liberation, Bonpland lived as a farmer in São Borja, Rio Grande do Sul, Brazil, and finally in Santa Ana, Argentina, however, his curiosity and admiration of nature never ceased. He collected and described in this time a lot of plants, animals, rocks, and fossils, which he sent, mostly, to the Muséum National d'Histoire Naturelle of Paris.

Bonpland published a few scientific papers in the last period of his life. A great deal of his botanical descriptions were published after his death, and, in the same way, his paleontological contributions remained unpublished and only were recently highlighted.[30] Several drafts on different subjects so diverse as zoology, pharmacology, or the production of staining substances are still unpublished.

Constituting one of the most interesting geological contributions of Bonpland, the study of the Itá Pucú is not his only geological work. Bonpland quoted in several documents his geological observations. One of them, published originally in a journal[31] and, after Bonpland's death, reproduced in a book by one of his friends,[32] referred to the alleged presence of quicksilver near La Cruz, Corrientes province, and to the importance of exploiting a metal "so much valuable in the amalgam of gold and silver." In other documents, Bonpland commented on Alexander Brongniart and Georges Cuvier's landmark geological studies in the Paris basin,[33] as well as Alcide d'Orbigny's[34] and Félix de Azara's[35] investigations at the Cuenca del Plata.

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[30] Eduardo G. Ottone, Aimé Bonpland and paleontology, 2002. See also on this subject a letter that Bonpland sent to a clergyman and naturalist of Montevideo named Dámaso Antonio Larrañaga (1771–1848), a reference on Bonpland and paleontology at Cuenca del Plata omitted in Ottone, 2002: Aimé Bonpland, Correspondencia. De M.r Bonpland a Larrañaga, in *Escritos de Don Dámaso Antonio Larrañaga. Tomo III,* Edición Nacional (Montevideo: Instituto Histórico y Geográfico del Uruguay, 1923), 271.

[31] Aimé Bonpland, Documentos Oficiales. Santa Ana, Octubre 27 de 1854. Al Exmo. Gobernador y Capitan Jeneral de la Provincia Dr. Juan Pujol. *El Comercio,* 1855, año 3, 165 (4 March 1855).

[32] Adolphe Brunel, *Biographie d'Aimé Bonpland,* seconde édition, considérablement augmentée (Toulon: E. Aurel, 1864), 1–75.

[33] Aimé Bonpland, June 1832 (?). Manuscript titled *Journal Scientifique.* Archivo Bonpland, Facultad de Farmacia y Bioquímica, Universidad de Buenos Aires (Bonpland Papers of Buenos Aires, FFB-UBA). Document 1697.

[34] Aimé Bonpland to Monsieur Cordier, Membre de l'Institut, Professeur au Jardin du Roi, 5 January 1837. Draft for letter. Bonpland Papers of Buenos Aires, FFB-UBA. Document 276 (partially reproduced in: Ottone, Aimé Bonpland and paleontology, 2002).

[35] Félix de Azara (1746–1821) was a Spanish officer and naturalist who stayed in South America during 1781–1801. He worked in the delimitation of Spanish and Portuguese territories in the northeastern frontier of the Viceroyalty of the Río de la Plata, actually Paraguay, south of Brazil, northeastern Argentina, and Uruguay. He did precise geographical, biological, and ethnographical observations that constituted the corpus of his books, *Apuntamientos para la historia natural de*

THE GEOLOGY OF THE ITÁ PUCÚ

Itá Pucú, which means "big rock," is the Guarany name for a club-shaped outcrop of sandstone located in central Corrientes province, northeastern Argentina. The Itá Pucú is a relict of erosion from a unit that geologists know as the Solari Formation, a succession of cross-bedded quartzites interpreted as deposited through a complex aeolian dune system during the Mesozoic era.[36] The Itá Pucú constitutes a relatively small outcrop placed nearby two pillars of similar composition and its height does not exeed 9 meters. However, in a relatively flat countryside such as the Corrientes province, it stands out from the landscape as a noticeable feature. Bonpland visited the Itá Pucú and was evidently impressed by it.[37]

Bonpland prepared a little booklet including drawings of the outcrops and an explanatory text titled *Géologie Itapucu.*[38] He worked lacking any kind of optical implement and he complained to his Europeans correspondents about his situation.[39] He evidently lacked a compass also; a tape-measure was probably the only instrument used by him in performing the geological sketches of the *Géologie Itapucu.* Bonpland recovered also several samples of the Itá Pucú sandstones which he sent in December 1836 to the Muséum National d'Histoire Naturelle of Paris, together with other lithic samples from different localities. He also sent to the Muséum a manuscript with sketchy descriptions of rocks and fossils, titled *Catalogue pour servir à la Géologie des Côtes de L'uruguay, du Parana et de la plata; d'une partie de Paraguay; de toutes les missions; de la Province de Corrientes et d'une grande partie de la Province de l'Entre-ríos par Aimé Bonpland. Buenos Aires, Xbre 1936.*[40] This work includes the description of the Itá Pucú samples. Bonpland's shipment was registered with the geological collection of the Muséum in the *Catalogue 6.0. Roches, Minéraux et Fossiles du Paraguay, de l'Uruguay Septentrional (Missions), des provinces de Corrientes, d'Entre-Ríos. Donnés Par Monsieur Aimé Bonpland 1837.*[41]

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los quadrúpedos del Paragüay y Río de la Plata, published in Madrid (1802), *Apuntamientos para la historia natural de los páxaros del Paraguay y Río de la Plata,* published in Madrid (1805), and *Voyages dans l'Amérique méridionale,* published in Paris (1809), with notes by George Cuvier. Aimé Bonpland commented and criticized in one of his drafts Félix de Azara's opinion on the origin of petrified wood: Aimé Bonpland, undated, Manuscript titled *Roches & Mineraux de l'Uruguay*: Bonpland Papers of Buenos Aires, FFB-UBA. Document 1267 (partially reproduced in: Ottone, Aimé Bonpland and paleontology, 2002).

[36] Guillermo A. Jalfin, Litofacies y paleocorrientes de la Formación Solari, provincia de Corrientes. *Revista de la Asociación Geológica Argentina,* 1987, 42:101–111.

[37] The Itá Pucú is located at about 29° 21′ 20″ S latitude, 58° 04′ 55″ W longitude, 15 km south of Mercedes, formerly Paiubre, a grazier settlement founded by the 1830s. In this epoch, Bonpland owned an estate in Santa Ana, near Paso de los Libres, formerly Restauración (ca. 100 kilometers south-east of Mercedes), where he farmed and traded in cattle, and, in this way, he often went over on horseback the muddy tracks that linked Santa Ana with the neighbouring of Mercedes. The Itá Pucú with the Sun above and flanked by a cow and a ship constitutes the actual coat of arms emblem of the city of Mercedes.

[38] Aimé Bonpland, 23 November 1834, manuscript titled *Géologie Itapucu.* Bonpland Papers of Buenos Aires, FFB-UBA. Document 1273.

[39] Aimé Bonpland to Monsieur Mirbel, Professeur de Culture au Jardin des Plantes, Montevideo, 1840, draft for letter. Bonpland Papers of Buenos Aires, FFB-UBA. Document 381.

[40] The *Catalogue* is housed at the Laboratoire de Géologie, Muséum National d'Histoire Naturelle of Paris. This document contains many interesting geological and paleontological observations from Argentina, Brazil, and Uruguay (partially reproduced in: Ottone, Aimé Bonpland and paleontology, 2002).

[41] Bonpland's collection at the Laboratoire de Géologie, Muséum National d'Histoire Naturelle of Paris was probably registered by Pierre Louis Antoine Cordier (1777–1861), who headed geology,

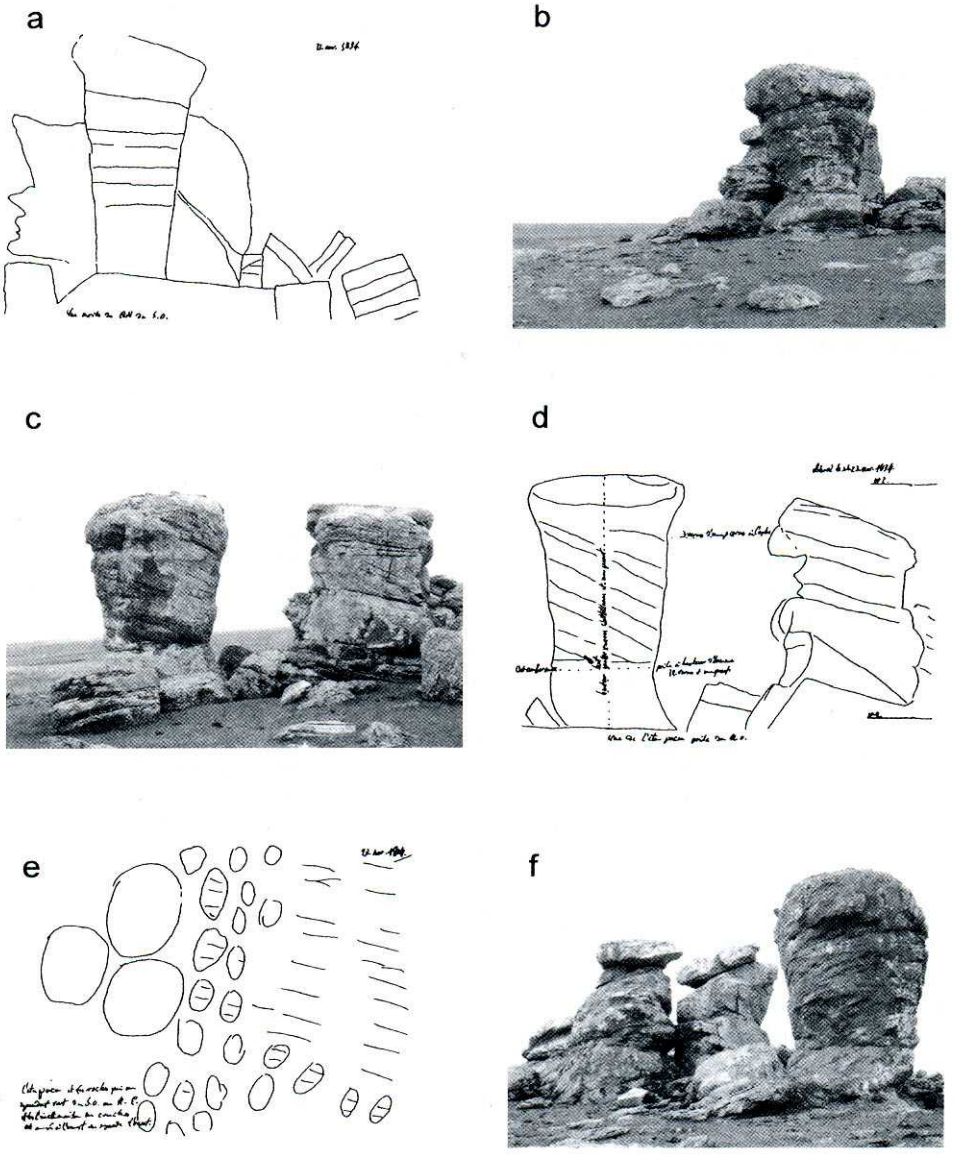

Figure 2. Itá Pucú, from modern photographs and from sketches made by Bonpland in 1834.

The *Géologie Itapucu* geological schemata are dated on 23 November 1834. The *Géologie Itapucu* includes four sheets of ca. 21 × 30 millimeters. The sketches are drawn in pencil with annotations in black ink. Two of them are plane views of the outcrops and the other ones represent lateral views. The first plane view shows Itá Pucú flanked by two pillars of rock and the rest of outcrops to the east (Figure 2e and 2f); the scale is of ca. 0.9 meters to the centimetre.[42] It is note-

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or by one of his collaborators. It includes 830 samples of rocks, minerals, and fossils that are mostly from Argentina, Brazil, and Uruguay, as well as a few recovered in his travels with Humboldt from Colombia, Cuba, Ecuador, Mexico, and the Canary Islands.

[42] The original of Bonpland lacks any scale or reference. The scale was checked in the field by the author.

worthy that although Bonpland noted in the legend to this sheet that he was indicating on it the dip of strata, which, as he pointed out, is to the north-east (to the upper-right corner of the sheet), he only marked on his map a series of straight lines, perpendicular to this direction. The scheme lacks also a symbol for the north as well as any lithological reference. The second plane view is not registered herein because it is more difficult to interpret. Bonpland's lateral views of the Itá Pucú are at a scale of ca. 0.4 meters to the centimetre.[43] Bonpland drew one lateral view from the south-east to the north-west (Figures 2c and 2d), and the other one from the south-west to the north-east (Figures 2a and 2b). He took care through them to depict the tabular form of strata and the changing dip of stratification in different planes. Bonpland's drawings of the Itá Pucú stratification are important because they constitute one of the first representations that show, in clear detail, a cross-bedding structure.

The *Géologie Itapucu* explanatory text, written in French (as are most of Bonpland's documents) is a mixture of geological report with a bit of gossip column.[44] The geological part of the text is merely descriptive; it lacks chronostratigraphic references or any comment on the genesis of the sandstones. Bonpland described the rocks as whitish to greyish fine-grained sandstones and quoted the presence of horizontal and, mostly, north-easterly dipped strata. He also cited reddish quartzite outcrops in the surroundings, and mentioned the presence of white sand, together with rounded gravels of quartzite and angular basalt gravels on the ground nearby to Itá Pucú. He noted that the basalt fragments were "similar to those of Misiones"; these basalts would be named by geologists as Basalts of Serra Geral a century later.[45] Bonpland, following "the opinion of geologists," criticized them as ludicrous, a peculiar thought of country folks who believed that the Itá Pucú was permanently growing up. He remained sceptical of this odd belief and compared it with the existence of myths about amazing animals such as two-headed snakes or with the popular guess on the allegedly efficacy of tobacco in preventing the electrical discharges of gymnotus, a tropical eel.

In the *Catalogue pour servir à la Géologie des Côtes de L'Uruguay,* Bonpland gave descriptions of samples from Itá Pucú, accompanied by geographical references of findings and a bit of gossip also. He referred to the "pyramid of Ita-pucu" and said about the story of its increased height "in which I do not believe." He commented, "reasonable men affirmed that, when young, they could touch the top of the Itá Pucú from the saddle of their horse." In order to prove that, definitively, the Itá Pucú did not grow up, he concluded, "I measured it three years ago in front of witnesses and I hope to realize a new measurement during

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[43] The scale is not quoted in the original but could be easily inferred because Bonpland stated that the height of the Itá Pucú is of "huit (eight) vares castillanes et un quart," so ca. 7 meters, and its perimeter, taken at "human height" is of "12 vares et un quart," so ca. 10 meters (1 vara castellana: 83.6 centimetres).

[44] It is interesting to observe that Bonpland's drafts often bear notes in the margin. These notes may or may not be related with the main text, and as a matter of fact, could be, or not, contemporaneously written. In the original of the *Géologie Itapucu,* we can see in the upper-left margin of the first page, in Spanish, the following annotations that picture Bonpland as a skilled farmer, or better, as an expert in horse breeds: "6 colorados, 1 yegua, 1 pangaré (Mariano), 2 yeguas rosillas, 1 picazo, 1 colorado, 1 petiso rosillo, 1 cav de Mariano." It is a list of different kind of horses to buy, sell, or loan (who knows!) to or from Mariano; colorado = bay, yegua = mare, pangaré = mealy, yegua rosilla = roan mare, picazo = black with white blaze, petiso rosillo = small roan, cav, could be the abbreviation for caballo = horse. Bonpland often substituted by mistake b for v in his Spanish texts.

[45] Rafael Herbst, Esquema estratigráfico de la provincia de Corrientes, República Argentina. *Revista de la Asociación Geológica Argentina,* 1971, 26:225–228.

1837."[46] The *Catalogue 6.0* has summary descriptions of Bonpland's samples. The original copyist, following Bonpland, noted about Itá Pucú "It is a little hill situated at Corrientes province which, by folk tradition, appears to be gradually growing up." This last sentence was later crossed out from the text.

CONCLUSION

Documentary drawings or geological landscapes displayed an important cognitive function in the development of visual language in geology during the eighteenth and early nineteenth centuries. They served that function before geological maps and stratigraphic cross-sections became the highly theoretical constructs of the present time.[47]

Aimé Bonpland's drawings of the Itá Pucú constitute, in this way, one of the earliest attempts in representing a geological outcrop at a detailed scale in Argentina and southern South America. It is a paradox that the author, who was a man with a limited geological knowledge but with an open mind and a solid education in other branches of natural sciences such as botany and zoology, could draw, in a so literal a manner, the form and thorough internal structure of the Itá Pucú outcrop. The descriptions of Bonpland, mixing bits of strictly scientific information with a few gleanings of folk tradition, could also appear as lighthearted for readers of the twenty-first century, but they are comprehensible in a text of the 1830s, an epoch when natural history narratives and fictional stories were not so strongly or definitively separated as they are nowadays.

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[46] Bonpland wrote his "*Catalogue*" on "Xbre (December) 1936."

[47] Martin J. S. Rudwick, A Visual Language for Geological Science, 1976, 172–177.

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