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Author(s): Alfred Sherwood Romer

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THE FOSSILIFEROUS TRIASSIC DEPOSITS OF ISCHIGUALASTO, ARGENTINA, AND PRELIMINARY DESCRIPTION OF *ISCHIGUALASTIA*, A NEW GENUS OF DICYNODONT

BY ALFRED SHERWOOD ROMER and C. BARRY COX

THE FOSSILIFEROUS TRIASSIC DEPOSITS OF ISCHIGUALASTO, ARGENTINA

BY ALFRED SHERWOOD ROMER

Early in 1958, a joint expedition of the Museo Argentino de Ciencias Naturales of Buenos Aires and the Museum of Comparative Zoology, Harvard University, was organized to explore continental deposits in the western Argentine in search of fossil vertebrates. The personnel included, for the Buenos Aires Museum, Dr. Guillermo del Corro, geologist, and Mr. Orlando Gutiérrez, assistant; from Harvard, Professor Bryan Patterson, preparators Arnold C. Lewis and James Jensen, Mrs. Romer and the writer. The earlier part of the trip was spent in the general region of Mendoza. In late April it was decided to move our base northward and explore the valley of Ischigualasto.

This region lies some 300 miles to the northeast of Mendoza, in eastern San Juan Province, close to the border of La Rioja, in the department of Valle Fértil, at a latitude and longitude of approximately 68°W, 30°5'S. No adequate maps of this area exist; Ischigualasto is shown on the San Juan sheet (no. 37) of the 1/500,000 map of Argentina, but the details are highly inaccurate. Frenguelli (1948, fig. 1, pls. 1, 2) gives sketch maps showing the general topography of the valley and its relation to adjacent regions. The name derives from an Indian village once

present at the margin of the valley. This, however, disappeared long since and the valley is completely uninhabited. In 1874 Stelzner (1885, pp. xii, 74-75) rapidly traversed the valley on mule-back, presumably following a trail which runs from Jachal, in San Juan Province, through the valley and on eastward to Patquia in La Rioja. Bodenbender (1911, pp. 94-113) similarly crossed by this trail several decades later. A small coal seam had been discovered in the hills west of the valley at a locality named los Rastros because of dinosaur-like footprints discovered there; Huene (1931) was taken, in 1927, on a hasty trip to see these footprints; he traversed the valley but was unable to stop there. Until recent years nothing was known of the geology of the region except for such observations as Stelzner and Bodenbender could make as they crossed it, and nothing of fauna and flora except the footprints just mentioned and a few plants collected by Bodenbender.

The reason for this former paucity of knowledge is obvious. The valley is extremely arid, and in the days of mule travel, a stay there was impossible because of the almost complete lack of water and fodder.¹ With the coming of automobile transportation and, particularly, of vehicles with four-wheel drive, the situation has changed radically, and in 1948 Frenguelli was able to publish a rather comprehensive account of the stratigraphy of Ischigualasto as the result of exploration of the area in 1943, primarily in the interests of paleobotany.

During the course of his work there, three fragments of cynodont skulls and jaws were recovered, and were described by Cabrera (1943). These were of interest as indicating the presence in Argentina of Triassic beds similar in fauna and presumed age to those of southern Brasil. But since so little reptile material was collected during Frenguelli's survey of the region, it seemed unlikely that work there would be profitable for the vertebrate paleontologist.

My attention was first called to Ischigualasto by Professor Huene before the results of Frenguelli's work became known. As noted above, Huene had crossed the valley on mule-back during his inspection of the los Rastros footprint site and, although unable to stop and prospect, had been struck by the

¹ Bodenbender (1911, p. 96) breaks off in the middle of his description of the region to insert a paragraph of emphatic and italicized warning: "*NOTA — A los futuros exploradores hago presente que no se puede contar . . . con suficiente pasto para los animales,*" etc.

seemingly favorable nature of the beds for vertebrate exploration. Like our Argentinian colleagues, I had failed to be impressed as to prospects by the few materials obtained by Frenguelli. A different light, however, was shed upon the possibilities by a publication by Heim (1949). He had been commissioned in 1944 to report on the los Rastros coal mine, but in crossing the Ischigualasto valley had become so interested in the region that a considerable part of his report is devoted to the Ischigualasto beds and, incidentally, to the fossils found there. He photographed a cynodont skull *in situ* (pl. VIII, fig. 2) and says (p. 22): "El señor de la Vega me llamó la atención sobre los restos de vertebrados que se han hallado frecuentemente en el suelo de las arcillas, especialmente en la parte media de la formación. Se presentan como acumulaciones de fragmentos de huesos, de color pardo oscuro. A veces aún se distingue la forma del cráneo y de la dentadura con restos de dientes negros, pero sin que se pueda restaurar esqueletos."

This report indicated that investigation of the Ischigualasto region might prove profitable, and our expedition moved to that region. A road of passable quality runs to Valle Fertil, a village south of the valley, which serves as departmental capital. Beyond this, settlement is sparse and presently ceases altogether, the roads deteriorate into a confusing series of trails, and it was necessary to hire a local guide to reach our destination.² At Cerro Morado, about 50 km. north of Valle Fertil, there is reached the southern edge of the valley which extends some 20 km. to the north-northwest. At its southern end its width is about 7 km.; it narrows to 2½-3 km. at the north. Its western boundary is a range of rugged sandstone hills, the eastern boundary an unbroken cliff of red sandstone, "los Colorados," striking in appearance, with a height, for much of its length, of 150 to 200 meters. The valley itself, almost bare of vegetation except for scattered thorn bushes, exhibits an expanse of shales of varied pastel colors and occasional sandstones. It is drained by a series of broad sandy arroyos which converge at about the center of its western margin where, at Agua de la Peña, there is a small stream of water (non-potable, according to our guide). From this point the deep gorge of the Rio de la Peña runs westward through the hills to the Rio Bermejo. Northwestward from

² Since our work there, a new highway has been constructed that links Patquia with Pagancilla and Chilecito. This passes a little to the northeast of the Ischigualasto basin, rendering it comparatively accessible.

the main valley extends the narrower valley of the Rio de la Chilca, which turns westward to join the Bermejo.

We made camp near Agua de la Peña, began exploration of the valley — and were immediately astounded by the abundance of vertebrate remains which it contained. Every vertebrate paleontologist dreams of finding, someday, a virgin territory strewn with fossil skulls and skeletons. Almost never does this dream come true. To our amazement and delight, it did come true for us at Ischigualasto. All about us, in the clays of the valley, were exposed specimen after specimen of fossil reptiles. In most instances the greater part of the time of a field party is taken up in prospecting for specimens. Here little of this sort of work needed to be done, and our energies could be devoted to excavating the better specimens chosen from the wealth of materials readily available. Approximately six weeks were spent here. Our work was hampered by the shortness of the daylight hours at this season of the year, and by the fact that a number of trips to Valle Fértil, each taking a full day, were necessary to carry out fossil blocks and obtain food supplies, gasoline and water. Nevertheless, well over 100 specimens, mainly plaster blocks containing skeletons, partial skeletons or skulls, were recovered.

The geology of the region has been described by Frenguelli and by Heim, and discussed by Groeber and Stipanovic (1952, pp. 87-99). Apart from faults of a minor nature, the geologic structure is simple, the sediments uniformly dipping gently to the east-northeast with, in consequence, a regular succession of beds from west to east. Toward the Bermejo, in the western hills (an area not visited by us), are beds thought to be of Carboniferous and Permian age — the Paganzo beds of Bodenbender — followed by the Estratos de Ischichuca.³ Farther east, the hills bordering the Ischigualasto valley are formed by the Estratos de los Rastros, dominantly sandstones, which conformably overlie the Ischichuca and include the coal seam and footprint locality mentioned. The shales occupying the valley constitute the Estratos de Ischigualasto, with a thickness estimated at 400 to 500 meters; it is in this formation that nearly all the vertebrate fossils of the region have been found. The steep cliffs at the east side of the valley constitute the lower part of the Estratos de Gualo of Frenguelli, for which Groeber and Stipanovic prefer the designation of Estratos de los Colorados. The four upper

³ The beds beneath Cerro Morado may be the Ischichuca.

formations, at least, of the series — the Estratos de Ischichuca, de los Rastros, de Ischigualasto, de los Colorados — are obviously parts of a single sedimentary cycle, without evidence of any disconformity. In the region of Agua de la Peña a local fault (Frenguelli, 1948, pl. II, profile A) obscures the transition between los Rastros and Ischigualasto formations. But elsewhere (as Frenguelli's profiles B-D, pl. IV) deposition can be seen to have been uninterrupted, and (apart from a conglomerate bed which is taken as the upper boundary of the los Rastros formation) the transition is marked mainly by a diminution in importance of the sandstones which are so prominent in the los Rastros. The uppermost beds of the los Rastros yielded fragmentary vertebrate remains which appear comparable to those of the Ischigualasto formation. The typical beds of the Estratos de los Colorados contrast strongly with those of the Estratos de Ischigualasto in color, predominance of sandstones, and resistance to erosion; but as Frenguelli notes, a zone of transition is apparent at the base of the cliffs.

Stelzner "lumped" the entire series of beds found in this region as "Rhaetic" (in the broad sense in which that term has frequently been used in Argentinian geology). Bodenbender believed the "Gualo" beds to be Cretaceous, the Ischigualasto Jurassic, the los Rastros "Rhaetic." Frenguelli, more correctly, considers the series as a whole to be older, the "Gualo" to be Rhaetic or lower Liassic, the Ischigualasto to be upper Keuper, the los Rastros to be lower Keuper. Groeber and Stipanovic (table I) believe the spread in time of deposition of these beds to be rather narrower; the los Colorados are assigned with doubt to the Rhaetic, and both Ischigualasto and los Rastros to the upper Norian — i.e., the uppermost Keuper. The vertebrate remains suggest a lower position (Romer 1960a, pp. 1291-1292; 1960b, pp. 86-87) although full discussion should be postponed until the fauna has been more thoroughly studied. The Norian stage is one in which is found the typical Upper Triassic dinosaurian fauna; the Ischigualasto fauna is, on the contrary, one in which there is little evidence of dinosaurs and in which gomphodont cynodonts and rhynchosaurs are dominant. The Ischigualasto formation is essentially comparable to the Santa Maria beds of Brasil and the Manda beds of Tanganyika. It is surely pre-Norian and not improbably pre-Carnian; the gomphodont-rhynchosaur faunas would appear to be essentially Middle Triassic in age.

By agreement, the entire collection was shipped to Cambridge, where it is being prepared. All types and representative specimens of all forms found will be deposited in the National Museum in Buenos Aires. Complete preparation, however, will be a lengthy process, not only because of the considerable quantity of material but also because of the refractory nature of the matrix enclosing a large proportion of the specimens. In general, publication of the scientific results will not appear for some time, since we do not wish to publish before preparation has proceeded to the point at which all material of a given form has become available for study. In the case of the dicynodonts, however, the material included only a few specimens of a single large form; these have been prepared, and have been studied by Dr. Barry Cox, of King's College, University of London. A preliminary description is appended; it is hoped that a full account may be published within the year.

It is gratifying to us to have been instrumental in opening up a new Argentinian area for exploration by vertebrate workers. Since our trip, several further expeditions to the region have been made by the University of Tucuman, under the direction of Dr. Oswaldo Reig, with successful results; certain materials collected on these later expeditions have already been described (Reig 1958, Casamiguela 1960). There are vast areas of late Paleozoic and early Mesozoic deposits in the western Argentine which have never been visited by vertebrate paleontologists. Although the chances of finding beds as unusually productive as those of Ischigualasto are not great, it is highly probable that other faunas which will aid in rounding out the early history of vertebrates in Argentina await discovery.

I have elsewhere (Romer 1960a) expressed our thanks to a number of friends who aided us in the Mendoza region. We are further deeply grateful to various other persons who aided the general work of the expedition and our exploration of Ischigualasto. The cordial cooperation of Dr. Adolfo D. Holmberg, then Interventor, and members of the staff of the Buenos Aires Museum, was much appreciated. Professor Rosendo Pascual of the La Plata Museum accompanied us during the early portion of the trip. Much valuable scientific information was given us by the geologists of the Yacimientos Petrolíferos Fiscales, Comisión Nacional de Energía Atómica and the Dirección Nacional de Minería, including, among others, Drs. Pablo Groeber, Pedro N. Stipanovic, Martínez Cal, Héctor de la Mota, Luis A. Barriónuevo, and Vicente Ferreiro. The Comisión Nacional de Energía

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