

isolated in the mountains of the higher portions of the Isthmus, and some others, we find that northern forms found in Central America are specifically identical with northern species, and that their presence is due in a great measure to migration during the winter season. As regards numbers, we find a gradual diminution as we recede from North America. These migrants are everywhere present, some few passing still further south into the equatorial provinces of the southern continent. Costa Rica and Veragua, with Panama, possess these characteristics of the Central American fauna in the highest degree. It is here we find the greatest number of South American genera represented; but the species are to a considerable extent not the same as the continental species. If we endeavour to account for the facts as we find them, by changes in past times in the physical features of the Isthmus, we seem to require:— 1st. A union between Costa Rica, Veragua, and Panama with the southern continent, when those united lands possessed in common a much larger number of species specifically the same as at present, during which time the oceans may have been united north of Costa Rica. 2nd. The long duration of Costa Rica and Veragua as a ‘continental’ island, when the union of the two oceans has been of greater extent. This period must be long enough to have established specific differences much as we now find them. 3rd. The emergence of the whole Isthmus in its present form. These requirements seem to fall in fairly with what has been demanded in other branches of natural science. Dr. Duncan requires a union in Miocene times between the oceans to account for the specific identity of certain corals. The union here demanded will suit my first and second requirements, I only regulate the amount; and as for the period when it took place, fixing it to Miocene times would seem to answer to the requirements of the birds. That all the peculiar features of so varied a fauna can be accounted for by this theory I do not pretend to say. The changes in the physical features of the Isthmus, indicated by the numerous minor modifications of existing species, belong to the most recent events in geological history. To account for the greater differences observable we must go deeper into the abyss of geological time, where light is at present barely perceptible.”

In his first paper on this subject (P.Z.S. 1867, pp. 129–161), based upon less extensive material, Salvin stated that there was a closer affinity between the birds of Veragua and those of Costa Rica than between those of Veragua and of the Isthmus of Panama, but this proved not to be the case when Arcé’s later collections were examined. He then remarked that it was evident that Costa Rica and Panama had for a long period occupied the position of one or more islands between the two continents at a time when the two oceans were united by two or more channels; and that an obvious division separating Costa Rica, Veragua, and Panama from the southern continent was a line drawn from the Atlantic Bay of San Blas to the mouth of the Bayano on the Pacific.