Ruddy Seedeater. *Sporophila minuta.* This species, known from Middle America only on the Pacific slope, and from Costa Rica only in the upper Térraba valley, was observed by us at Los Chiles on 29 August 1966. The bird, a male, flew ahead of us in a marshy area and acted like a wandering individual.

Slaty Finch. *Spodiornis rusticus.* We observed this rare species in two localities on the south slope of Volcán Barba. A young male was collected from a flock of six, 5 mi. N of San Rafael, Heredia Province, at 6000 ft on 6 August 1966; a flock of 20 was seen north of San José de la Montaña at 6400 ft on 3 November 1966.

Peg-billed Finch. *Acanthidops bairdi.* This aberrant and rarely observed finch was seen twice on Volcán Poás, single birds on 27 March and 23 April 1967.

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ON THE NATURE OF "COTINGIN"

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The violet color of the contour feathers of certain members of the Cotingidae was once ascribed to the presence of a pigment called "cotingin" (Görnitz and Rensch 1924). The presence of violet pigments in birds is questionable, thus the origin and nature of such colors is of interest. The violet coloration in certain species (e.g., *Cotinga cotinga*) is considered to be produced structurally and is not a true pigment. On the other hand, pigments were isolated from other species of this family (e.g., *Xipholena pompadora*) as early as 1890. The carotenoid nature of these pigments was demonstrated by Görnitz and Rensch (loc. cit.). This observation is significant because violet carotenoids are not generally common in vertebrates and none seem to have been described from avian material. Aside from establishing the nature of the cotinga pigment as a zooerythrin (= a red carotenoid), Görnitz and Rensch did not attempt to characterize these pigments further.

Völker (1952:122–124) worked with a variety of Cotingidae and suggested that the pigment of *Xipholena punicea* and *X. lamellipennis* was similar to that of certain Ciconiiformes. That is, extracts of feather carotenoids had spectral characteristics which resemble the spectra of extracts from various Threskiornithidae and Phoenicopteridae. It is now known that the major feather carotenoid of the six flamingo species, the Roseate Spoonbill, and the Scarlet Ibis is canthaxanthin (4-4′-diketo-β-carotene), although other oxygen-containing carotenoids are present (for recent review see Fox et al. 1967). However, because of the similarity in the chromophoric groups of these pigments, they are not easily distinguished spectrally. Differentiation cannot be considered complete without further treatment and chromatographic separation.

A number of carotenoids have been identified in the brightly colored feathers of various species of the Cotingidae. These include zeaxanthin (3-3′-dihydroxy-β-carotene), astaxanthin (3-3′-dihydroxy-canthaxanthin), and perhaps canthaxanthin (Völker 1961). However, there are a number of species about whose pigments very little is known. Included in this category are most members of the genus *Xipholena* (Völker, loc. cit.).

Through the generosity of Dr. Pierce Brodkorb of the University of Florida I was able to obtain small amounts of body feathers from a cotinga, *Xipholena punicea,* and a manakin (Pipridae), *Pipra aureola.* Both specimens were taken in Surinam. The *Xipholena* feathers were intensely violet in color, although proximal parts of individual feathers were totally without pigmentation and appeared white. Feathers taken from the head of *Pipra* were red. The pigmented area of the barbs of these feathers was flattened and lacked barbules. This structural modification appears to be typical of small carotenoid-containing

feathers, regardless of taxonomic affinities (Brush and Seifried 1968).

The pigment from *X. punicea* was easily extractable in alkaline ethanol and the extract produced was brick red. Partitioning with petrol ether or *n*-hexane produced an ambiphasic distribution of the pigments. The pigment in the epiphase had an absorption curve with a single peak at 468 mμ. The curve had the typical symmetrical shape of a keto-carotenoid. The crude pyridine extract had a maximum absorbance at 480 mμ.

Treatment of the crude extract with sodium borohydride converted the color from red to yellow and changed the keto-carotenoid curve to one typical of hydroxy-carotenoids. The shape of the spectrum of the borohydride reduction product strongly supports the presence of the β-carotene chromophore. Reduction also decreased chromatographic mobility. These data indicate the presence of keto groups in these molecules.

Thin-layer chromatography on prepared silica plates (Eastman chromatograms) separated the crude mixture into four fractions (solvent = benzene:ethyl acetate, 2:1). The four fractions were isolated by preparative thin-layer chromatography.

The farthest migrating fraction was present in extremely small amounts. No spectral or partitioning data on the isolate were available, but it co-chromatographed ($R_f = 83$) with a known sample of canthaxanthin. The spectrum of the crude extract agrees with that of canthaxanthin. Reduction with sodium borohydride greatly reduced the mobility of this fraction ($R_f = 54$).

The second fraction was identified as astaxanthin. This was confirmed by spectral data, partitioning coefficients, and co-chromatography with a known sample.

The third fraction, one of the more abundant, had spectral characteristics and partitioning behavior typical of hydroxy-carotenes. This fraction co-chromatographed with a known sample of isozeaxanthin (4-4′-dihydroxy-β-carotene). The fourth, slowest band had an absorption peak at 466 mμ in methanol and was strongly hypophasic in partitioning tests. It is still unidentified.

The extract of the red feathers from the head of *P. aureola* contained only two pigments. These were identified spectrally and chromatographically as canthaxanthin and astaxanthin.

The evidence presented here indicates that the violet pigmentation of *X. punicea* is due to a combination of blue structural colors (schemochrome) and a mixture of red carotenoid pigments (Mattern and Völker 1955). The pigments present are mainly canthaxanthin, astaxanthin, isozeaxanthin, and minor amounts of oxidative products of β-carotene. The first two were also found in red feathers from *Pipra aureola*. No structural coloration was observed in this species. The small amounts of material available for this study did not allow complete recovery of all the pigments from the original extract. This means that further identification tests and crystallization was not possible. We could not, for example, eliminate completely the possibility of the occurrence of rhodoxanthin (3-3′-diketo-β-carotene) in either species. This pigment has been reported in the Cotingidae by Völker (1955).

It is possible now to extend Völker's (1952, 1961) listing of the species of Cotingidae about whose pigmentation something is known. It appears that even though the production of color in the two species considered here is complex, they do not possess any unusual pigments. The purple of *X. punicea* is certainly the result of a combination of structural blues and red carotenoids. On this basis, I would suggest that any special name given to this pigment is superfluous and the term "cotingin" should be abandoned.

The mixture of pigments present in these species is perhaps significant from another aspect; that is, in regard to the evolution of the biochemical pathways for the metabolism of the carotenoids. It is now becoming apparent that the complex mixtures of pigments found in many organisms actually form a sequential pathway going from completely unsubstituted carotenoids to those with all possible substitutions (see Krinsky 1965 for brachiopods and other crustaceans; Lee 1966 for isopods; and Fox et al. 1967 for flamingos). Recently an even more direct relationship between pigmentation and its genetic control has been described in an estrildine finch (Brush and Seifried 1968). In all these cases particular sequences are built on either α- or β-carotenoids. Animals are able to oxidize or reduce functional groups on these chains, but not to convert one backbone to another (Williams et al. 1967). This condition is clearly demonstrated in the Cotingidae. Here β-carotene, a molecule undoubtedly obtained in food, presumably represents the starting material. The subsequent products probably are derived from this precursor by a series of oxidative enzymes, but always have the β-configuration.

Among the vertebrates, the integumentary display of carotenoids reaches an evolutionary peak in the birds. This may be associated in large part with their dependence on the visual senses for communication. Based on the information presently available, there does not seem to be any phylogenetic sequence in the metabolism of carotenoids in the class Aves. While the ability to deposit carotenoids in the feathers is not present throughout the class, in those orders where it has appeared, the ability to modify the carotenoid precursors seems to be developed approximately to the same degree. The evolution of similar biochemical pathways in taxonomically diverse groups indicates the conservative nature of these pathways and the molecules themselves. Exploitation of these metabolic pathways and the resultant species differences must have involved the production of enzymes for further oxygenation of the ingested unsubstituted carotenes, production of distinctive display patterns of carotenoids in the plumage (Brush 1967) and, as is the case in *Xipholena punicea*, combining carotenoids with structural colors.

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SOME ADDITIONAL RECORDS OF BIRDS IN CALIFORNIA

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The following records of birds from various parts of California seem to be worthy of publication.

Pigeon Hawk. *Falco columbarius richardsonii.* A male immature of this race was collected five miles SW of Gonzales, Monterey County, on 31 October 1937. Another male immature was collected near Adin, Modoc County, on 31 December 1937.

American Golden Plover. *Pluvialis dominica fulva.* A female adult of this subspecies was collected at the south end of Tulare Lake, King's County, on 26 October 1940. This appears to be the first inland record of this race for this state. It was with two other birds that resembled *P. d. dominica* rather than *P. d. fulva.*

Costa's Hummingbird. *Calypte costae.* During April 1959 I noted a relatively small female hummingbird in my back yard in San Jose, Santa Clara County. I presumed it to be a small female Anna's, until one day when the bird fed on a cluster of lemon blossoms within about 2 ft of my face. I instantly realized it was a Costa's when it gave the peculiar twittering call of this species, which is totally unlike that given by any other local species. She came regularly to feed and departed southeastward over the back fence. I did not see her after the first week of October.

On 4 April 1960, she, or another female, was noted in the yard feeding on various flowers. On 6 June of that year, a neighbor girl brought me a partially decomposed nestling hummingbird killed in falling from the nest to the concrete in her back yard about 150 ft SE of our yard. I prepared the specimen as best I could considering its condition, compared it with young *costae* of comparable age, and found it to be typical. The female brought one young into our yard until about the middle of July.

The nearest nesting site of recent times known to me was about 3 miles SW of the town of San Benito, San Benito County, about 75 miles SE of San Jose.

Eastern Kingbird. *Tyrannus tyrannus.* An immature female of this species was collected about 1 mile NE of Gaviota, Santa Barbara County, on 14 September 1937. It was taken within less than a mile of where I saw one in September 1931.

Wied's Crested Flycatcher. *Myiarchus tyrannulus magister.* As I was driving up the Colorado River north of Needles, San Bernardino County, on a two-wheel track road through the riverside growth on 23 May 1949 I heard a bird call that I had not heard for nearly 30 years. Somehow I remembered it as the call of this species. The bird, an adult male, was sighted about 30 ft away on a lower limb of a willow tree. I collected it, and at the shot another flew out of a hole in the same tree. I drove off the road, stood on one of the fenders, and looked into the hole. Four young flew out and disappeared into the willows toward the river.

Northern Shrike. *Lanius excubitor invictus.* A female of this form was collected in Round Valley, Inyo County, about 30 ft S of the Mono County line on 27 February 1935. It was eating a junco when taken. Two others were noted the same day, one on the University of Nevada campus in Reno, Nevada, and the other in the town of Bridgeport, in northern Mono County.

Black-headed Grosbeak. *Pheucticus melanocephalus maculatus.* An adult male of this form entered the banding trap in my back yard along with some *Zonotrichia* on 7 January 1962. It was prepared as a specimen and was found to be in excellent condition except for one missing outer tail feather.

Rosy Finch. *Leucosticte* spp. On 19 November 1947, as I came out of the canyon on the SW side of Deep Springs Valley in eastern Inyo County, I noted that the road ahead was almost covered with birds for at least 100 yards. They proved to be rosy finches and the flock was estimated to contain at least 10,000 birds. I fired two shots and picked up six specimens of *L. tephrocotis tephrocotis*, two of *L. t. wallowa*, and two of *L. atrata.* The birds were feeding on the seeds of Russian thistle (*Salsola kali*) which were being blown about by rather strong gusts of wind. During my three days stay in the valley, this great flock of brids shifted back and forth over the valley floor and the surrounding lower slopes. At one time, when taking motion pictures of some of them, I actually had birds walk between my legs as I stood behind the tripod.

Another specimen of *L. t. tephrocotis* was collected at the same place on 2 November 1952 from a flock of about 80 birds. Another of the same race was collected on 3 November 1953 at Panamint Springs in southern Inyo County. I was surprised that no *L. t. dawsoni* were collected even though this subspecies nests within 20 miles of Deep Springs Valley in the higher parts of the White Mountains.

Tree Sparrow. *Spizella arborea ochracea.* On 13 November 1948, as I was checking Buckhorn Spring in the southeastern corner of Deep Springs Valley in order to find out how many bighorn sheep and other species of birds and mammals were making use of this water supply, I noticed an adult male Tree Sparrow hopping through the loose rocks a few feet away. I took motion pictures of the bird and then collected it.

Harris' Sparrow. *Zonotrichia querula.* A female adult was collected on 14 November 1948 at Laws, Inyo County. It was with a flock of 9 or 10 of the