and is apt also to suffer mitigation in the course of subsequent study.

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Hopi Songs. By BENJAMIN IVES GILMAN, Secretary of the Museum of Fine Arts, Boston, Mass. Hemenway Southwestern Expedition. A Journal of American Ethnology and Archæology. Fifth and Concluding Volume. Pp. xi + 235. Boston and New York, Houghton, Mifflin Company. 1908.

The text of the volume is divided into three sections: I., The Rote Song of the Hopi; II., The Phonographic Method; III., Notation, Diagrams and Comments. Seventeen Hopi songs are included in section III. A brief account of The Hemenway Southwest Expedition closes the volume.

The author opens his treatise by saying:

The study of Hopi, or Moqui, singing, to which this volume is devoted, completes an inquiry into Pueblo music begun in 1891 with a study of Zuni melodies. The records upon which both investigations have been based were obtained in Arizona by Dr. J. Walter Fewkes, now of the Bureau of Ethnology, Washington, at the time in charge of the Hemenway Southwestern Expedition, who first applied the phonograph to the preservation and study of aboriginal folk-lore.

Of his previous study the author writes (p. 11):

The major thesis of the "Zuni Melodies"—that Pueblo music is without scale—is strongly confirmed by this cumulative evidence. The diatonic form of the Hopi songs is (*a*) harmonic necessity or (*b*) apperceptive illusion. In large measure their adiatonic features are at once (*c*) intentional and (*d*) inexplicable by interpolation and transposition. The minor thesis of the "Zuni Melodies"—that "In this archaic stage of the art the scales are not formed but forming"—is rather weakened than corroborated by a closer study of Pueblo music. Its bent toward change inspires a doubt whether, unless by outward compulsion, it would ever submit to the trammels of a system. It appears an unhistoric rather than a prehistoric art.

Under the head Scales an Instrumental Product; the Voice Determining their General Form, the Ear, the Hand and the Eye their Varieties, the author skillfully proceeded to show that "Although the voice provides the raw material for scale building," the instruments have rendered service, so that

It would appear that while still disembodied music tends to remain adiatonic, though always of necessity diatonoid. Only when incarnate by instrumental constraint does it chose, because it must, the best of all possible yokes.

Other factors have influenced scale development so that

Scales may result with which the voice has had little to do, giving back to music, at the convenience and pleasure of ear and hand and eye, a semblance of the liberty of its vocal stage.

Under the head of Freedom, a characteristic of Pueblo music, the author writes:

Apart from the tendency to consonant intervals no metes and bounds to invention manifest themselves in these melodies, and they may apparently be altered by every performer.

In this connection a footnote calls attention to a fact presented at Berlin in 1888 before the International Congress of Americanists that

The anatomists of the Hemenway Southwestern Expedition found the hyoid bone of the ancient skeletons exhumed on the Rio Salado exceptionally elastic in structure. The position of this bone at the base of the tongue makes it an important factor both in speech and song.

This fact should not be forgotten when considering the data presented in this volume as of wide application. Nor can the statement that songs "may apparently be altered by every performer" be accepted as true of Indian songs in general. Accuracy in the rendition of a song, particularly of one that was a part of a religious ceremony, was insisted upon. In some of the tribes a mistake, or variation, in singing a song, constituted so grave a matter that it put a stop to the ceremony, until after a rite of contrition had been performed; that being finished the ceremony had to begin afresh. That there were slight variations in pitch and intonations was true, but they were such as occur among ordinary singers and did not affect the movement and flow of the melody, which the

singers were careful not to disturb, as the song in all religious rites was regarded as a message to the supernatural.

Section II. deals with The Phonographic Method. The author says of the phonograph: It "makes possible a hitherto unheard-of thing, the detailed study of an individual performance of music. It opens a field of investigation, that of the actual events of which music consists, which has hitherto been accessible to observation in only a very limited way—while a performance lasts, and in so far as it can afterward be recalled by memory." From the premise that "Music is an art of interval and measure primarily, and one of timbre secondarily" the author proceeded to a phonographic study of interval in Hopi singing. He says:

With a series of tests not psychological but physical I endeavored both to find the principal limitations of the instrument by the trial of various conditions of inscription and reproduction, and to determine the degree of exactness of its best performance. The method consisted mainly in noting the amount of variation in the rapidity of pulsations of sound called beats produced between a phonographic reproduction of a note held continuously and another note known to be of constant pitch.

Then follows a lengthy account of his work upon these tests and the conclusion:

As an apparatus for the reproduction of textures of interval the phonograph may fairly be called an instrument of precision.

Of the "method and symbolism of the notation" we read:

Like the records of Zuni music these . . . are the result of an attempt to judge the tones delivered by the phonograph by means of the sense for difference of pitch alone, without aid from the sense of interval. My aim has been to make a separate estimate of the pitch of each individual note of each performance, through its comparison with one or more of the series of tones at intervals of a tempered semi-tone, or 100 cents, given in the notes of an ordinary harmonium. This comparison was made, as before, by silencing the phonograph the moment the note to be judged had been reached, and immediately thereafter sounding a harmonium note. . . .

For the expression of "the minute scale of fourteenths of a tone made the basis" of his records the author adopted modifications of the historical notation by which he says:

There is thus afforded for each of the fourteenths of a tone assumed as the steps in the scale of these notations a gradation of position easily distinguishable from every other.

He further remarks:

The attempt to follow the musical practise of non-European peoples with such minuteness must justify itself, either on the ground that accuracy of observation is a thing worthy to be aimed at for its own sake, or on the ground that in this branch of research such a degree of it has veritable value for purposes of theory.

Section III. is composed of the presentation of each of the seventeen Hopi songs; given first on the usual clef, next the phonographic record according to his plan of notation, then a chart showing the "Course of Tone," followed by more or less elaborate "Comments." In some of these latter the author shows a fine appreciation of "these wild flowers of fancy, the wanton yield of naïve delight in the vocal production of interval," as in connection with "Snake Song No. 4" where he says:

The interest of the song lies in its stately rhythm, occasionally delicately varied; and in this deliberate ascent, as if from level to level of the singers native mesa, with a pause midway in each to rally loiterers.

The volume represents much careful work and is a valuable contribution to the study of the phonetics of some kinds of Indian singing. The quality of tone is not touched upon and unfortunately the songs under consideration do not present a wide range of rhythms so that that interesting aspect is not dwelt upon. All the records under examination are from single singers. The Indian solo singer is apt to waver more in pitch than when he sings with a group. A number of voices not only strengthens the tone but steadies the interval. Moreover, comparatively few Indian songs are intended to be sung by one voice only, so that such records as those presented in the volume can hardly be regarded as representative of Indian music. They do not picture the songs as they appeal to the Indians, nor does the dissection of tones, as here so ably given, assist our race to dis-

cern the beauty that lurks in a vast number of the songs of the American Indian.

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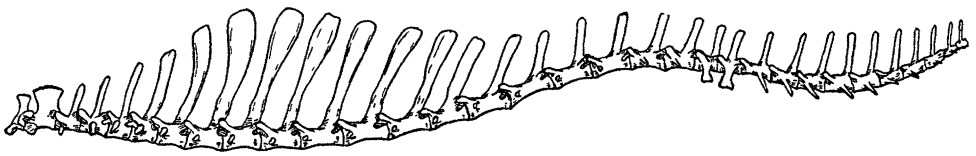
SPECIAL ARTICLES

THE DORSAL SPINES OF CHAMELEO CRISTATUS, STUCH

SINCE the discovery of the long-spined Pelycosauria, in Texas, no similar condition has been reported in any living form. Cope referred to the dermal spines of *Iguana* and *Basiliscus* as the nearest condition to that of the fossil forms. Baur noted one or two lizards in which one or two spines were a little longer than the others. Through the kindness of Dr. A. G. Ruthven, curator of the Museum in the University of Michigan, I have been enabled to examine a specimen of *Chameleo cristatus* from Efulen Kribi in the Cameroon district, sent to the museum of the university by the Rev. Geo. Schwab, a missionary. The accompanying figure shows the condition of the spines of the vertebræ. The elevated neural spines beginning with the axis extended to the tenth caudal and then rapidly diminish in size on the long and slender tail. At the base of the larger spines there is a very slight enlargement indicating the attachment of the dorsal muscles which reached to that point. The upper ends of the spines were attached by a strong thread of connective tissue and the interspaces between the spines were filled by a very thin membrane of the same tissue. A few scattering threads of muscle were dispersed over the membrane. The condition of this specimen is of great interest as it shows almost exactly the conditions which have been imagined to exist in the Pelycosauria. In the literature of this group I find the presence of the elevated neural spines mentioned but they have not been figured and have never been referred to in explanation of the Permian forms.

Unfortunately this gives us no hint of the use of the elongated spines in the ancient forms. Only two species of the genus, *cristatus* and *montium*, have the elevated spines; the others have a crest supported by dermal rods. The habits of the forms are not sufficiently well known to make any suggestion as to the use of the crest or spines. It is perhaps significant that the chameleons are a highly specialized and decadent group just as the Pelycosauria were and that there is a decided tendency to develop seemingly useless horns and spines in other parts of the body just as there was in the Pelycosauria. It leaves one with the same impression of some sort of physiological excess of growth.



Vertebral column of *Chameleo cristatus* Stuch, from Efulen Kribi, Cameroon, showing elevated neural spines.

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ON THE CHEMISTRY AND DEVELOPMENT OF THE YOLK PLATELETS IN THE EGG OF THE FROG (RANA PIPIENS)

THE yolk platelets in the frog's egg contain 6 per cent. of lecithin and 94 per cent. of a proteid having the following composition: 1.21 per cent. of phosphorus, 1.32 per cent. of sulphur and 15.14 per cent. of nitrogen. I used gravimetric methods in determining phosphorus and sulphur and the Kjeldahl method in determining nitrogen. This composition and the precipitation reactions of the proteid indicate it to be a nucleoalbumin related to the vitellins and ichthulins of the yolk of the eggs of birds and fish, hence I will call it batrachiolin.

In the germinal vesicles of the ovarian eggs nucleoli arise from the chromatin. These nucleoli grow and multiply by fission and budding, and during the fall of the year migrate