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NOTES ON THE SURFACE FEATURES OF THE COLORADO OR FRONT RANGE OF THE ROCKY MOUNTAINS.

By F. V. Hayden.

The geological structure of the eastern base of the Rocky Mountains, from Cheyenne to Pueblo in Colorado, has been so carefully studied that but little more can be said that will have the air of novelty. It remains now to present to the eye a more connected view of the topographical features of this region, thus rendering much clearer many points in the geology. The beautiful and accurate illustrations of Mr. Holmes which accompany these notes will convey a clearer conception to the minds of geologists, of the topographical forms, as well as the geological features, of this interesting portion of Colorado, than pages of mere description. With these views before the reader the detailed investigations of Mr. Marvine, Dr. Peale, and Dr. Endlich, as well as those of the writer, in the annual reports for 1873 and 1869, will be far better understood. Therefore, it will not be necessary to repeat in this connection the details of the geology of this region, but the reader is referred to the series of annual reports. Plate IX represents the great Colorado or Front range of mountains, as seen from a point near Denver, commencing north just beyond the northern boundary of Colorado and extending south to Pike's Peak, a distance of about eighty miles in a straight line. In the foreground we see what are termed the plains, a broad rolling surface, gradually sloping from the base of the mountains eastward. The dotted line marks the boundary between the sedimentary strata and the Archæan or Metamorphic rocks which form the nucleus of the range. At different points the uplifted ridges, which are termed in the West "Hogbacks," can be distinctly seen. This view was taken twenty miles or more to the eastward of the immediate base of the mountains, and therefore only the higher ridges were visible to the eye of the artist, but their character can be well understood from these sketches. North of the North Boulder Creek, at *l*, *l*, the ridges of red sandstone with Cretaceous No. 1 are well exposed near the base of the range, but are not shown in the sketch; between the North and South Boulder Creeks at *l*, *l*, and *h*, are some of the most conspicuous ridges of sandstone that are known to occur along the foot of the Rocky Mountains, from latitude 49° south to Santa Fé. They rise to a height of 1,500 feet above the plains at their base. It is difficult to account for the manner in which they have been protected from erosion. It is quite possible, however, that it is due to the fact that they have been partially metamorphosed by heat, and hence their greater hardness renders them less amenable to the influence of the atmospheric forces. That these ridges, all along the base of the mountains, were originally much higher and may have even extended far up the mountain-sides, but have been removed by erosion, there is ample evidence. In many instances they seem to have been almost entirely removed for considerable distances, and again they rise 200 to 500 feet, seldom more,

except in this instance. The inclination of these sandstone ridges varies much in different localities. Sometimes they stand nearly vertical. They may be said to incline at all angles from 5° to 80° from the granitic mass. It will be seen that these sketches illustrate a very important point, which has been often repeated in my former reports, the rising of the great mountain-ranges suddenly or abruptly out of the plains. In the foreground we have the Lignitic beds inclining at a very small angle, within a short distance from the granites, varying from a half mile to two miles in width, seldom more. We may infer, therefore, that the force that elevated the mountain-range acted nearly or quite vertically. Whenever the inner ridges stand at a high angle, the beds have been undoubtedly broken off abruptly close to the granite foot-hills, as is well shown at Boulder Creek, and at Pike's Peak in the "Garden of the Gods." The illustration of this vertical uplift of the sedimentary beds, by which they seem to have been broken off abruptly, forming a right angle, as it were, is very common along the base of either side of the eastern range of the Rocky Mountains. In some instances a nucleus of granite will be surrounded with a narrow belt of nearly vertical beds of sedimentary rock, and within a few hundred feet the same vertical strata will lie in a nearly horizontal position. Some of the most important coal-beds in Colorado are opened within a mile east of the granite nucleus in the drainage of the Boulder Creeks, the strata of the coal group inclining at angles of not more than 10° to 15°, and very soon flattening down to a nearly or quite horizontal position still farther to the eastward.

Let us examine the sketch from Denver. To the west, about ten miles, are two quite remarkable table-mountains capped with basalt. Underneath their basaltic caps there is a great thickness of the Lignitic beds, evidently protected from erosion by the hard bed of basalt over them. The valley of Clear Creek separates the two. That they originally formed one bed and spread over a much larger area than at present, seems probable. Between these table-mountains and the granites, the distance is not over a mile in a straight line, and yet there is a thickness of 1,500 feet or more of Lignitic beds, with an important coal-seam, with a series of Cretaceous, Jurassic, and red sandstones, or Triassic, in regular order to the granites. These mountains, with the geology in the vicinity, were described by me in the third annual report of the survey, 1869, and much more in detail, with illustrations by Mr. Marvine, in the seventh annual report of the survey for 1873. From Denver, southward of the Platte Cañon, the ridges are well shown in the sketch just under the dotted line. At a distance, there would appear to be not more than one main ridge, but there are usually several of them, with beautiful valleys between. There are many fine farms among these ridges, and the settlers are very numerous at this time. South of the Platte Cañon there is a narrow belt of the red sandstones extending for about five miles that have been worn into most remarkable picturesque forms, presenting as great a variety, even, as the celebrated "Garden of the Gods," at Colorado Springs. The red sandstones are protected from the plains by a continuous ridge of the Cretaceous sandstones of the Dakota group, while, between that ridge and the granites, there is a belt between a fourth and half a mile in width, in which the red sandstones present a confusion of broken ridges, with their sharp edges projecting above the level, grassy surface, from a few feet to 150 feet in height, with an inclination from the granite mass of 45° to 50° to the east. For this entire distance the Red beds, or Triassic, (?) as they have been usually termed, rest on the granitic rocks. The rolling plains in the

foreground are underlaid with Lignitic strata, oftentimes covered with a great thickness of drift composed of sands and rounded boulders, varying in size from a small pebble to 10 feet in diameter. The rounded masses are usually quite small. The city of Denver is built on the Lignitic beds, lying nearly or quite horizontal.

¶ This pictorial section, as well as the one shown on Plate X may be studied with great advantage from several points of view. They present to the eye the relations of the plains with the great mountain-ranges. We can see how the mountains appear to the traveler, approaching them from the eastward, to rise abruptly out of the plains. Denver is 5,197 feet above sea-level, and yet many of the peaks of this great front range, which rises up like a vast massive wall, send their summits above 14,000 feet. The simplicity of the structure of the eastern range, in a general way, is well presented in these sketches. The upturned ridges along the immediate base on the east side, and in some instances on the west side, inclining in opposite directions, show the simple action of a vertical force with very slight tangential movement. In the case of the Laramie range, west of Cheyenne and the Black Hills of Dakota, the full series of sedimentary strata present their uplifted edges on either side of the granite nucleus, so that we cannot resist the conclusion that, prior to the elevation, the sedimentary beds extended in unbroken continuity across the area now occupied by the metamorphic central mass; the missing portions having been removed by erosion during the slow, long-continued process of elevation.

Although there is apparently so much simplicity in the dynamics of these eastern ranges, the details of structure are very complicated and varied. Perhaps the most important lesson taught by these sketches is the great variety of forms resulting from erosion. The glacial period in the Rocky Mountain region has passed away, but it has left everywhere most wonderful exhibitions of its power. Even the highest peaks have suffered more or less degradation, and it is hardly possible to estimate the amount of material which has been worn from the great central granitic mass. Water and ice are still at work diminishing the height of the loftiest ranges, and yet the forces now in operation are very feeble compared with those which performed the work during the glacial period. Indeed, we may presume that the work of degradation commenced as soon as the area now occupied by the mountain ranges arose above the sea; and, therefore, the work of destruction of the original forms has been going on for an almost unlimited period of time, dating back nearly or quite to the Carboniferous period. We may therefore conclude that the present remarkable forms which Mr. Holmes has so accurately and beautifully depicted, are the later results of the handiwork of nature, in her task of earth-sculpture. All through these ranges of mountains are myriads of deep gorges, the channels of the many small streams that, uniting in the plains, form our large rivers. All of these show conclusively that they have been carved out to a greater or less extent by erosion. On either side of the mountain crests are huge amphitheaters, filled with vast quantities of *débris* of broken rocks, the wearing back, toward the crest, of these channels by the combined action of water and ice. There are also numerous oval areas, usually called parks, varying in size from a few acres to many square miles, which have also been worn out to a great extent by glacial action. Vast quantities of drift, morainal deposits, terminal and lateral, are in most cases found in these mountain valleys, detailed descriptions of which appear in our reports, from time to time. All along the base of the mountains this local deposit is most

abundant, and it extends far out into the plains. To show its local character we may state that the materials become gradually finer as we recede from the place of their origin. Toward the mountain crest or divide, the local drift is very coarse, made up of blocks scarcely worn; these diminish in size and become more and more rounded by attrition as we move from the crest. Pike's Peak, which towers so loftily over all the other summits in the vicinity, is covered on its top and sides with broken masses. High above timber-line, the sides of the peak are covered with a heavy thickness of glacial drift, forming a fine earth, upon which a thick matting of grass and other herbaceous vegetation is growing. Small lakes surrounded with morainal ridges occur above as well as below timber-line.

The sedimentary ridges along the foot of the mountains, as is shown in the sketch, are cut through at right angles, at short distances, by the numerous little streams that flow down from the mountains into the plains. Most of these channels are dry the greater part of the year. These also show that the erosive action has greatly decreased in modern times. We may therefore infer that, so far as surface forms are concerned, there has been nothing permanent but change; that the process of degradation has gone on from the beginning with varied degrees of power, and that it is going on now continually, but with greatly diminished force.

In describing briefly Plate X, we may commence at the right hand or north end; we see in the distance the source of Monument Creek in the divide which separates the drainage of the Arkansas River from that of the South Platte. The coarse sediments of the Monument Creek group usually jut up against the granite foot-hills with very little inclination, as if the elevation had been very slight since the deposition of the Monument Creek beds. In the foreground near the pine tree, are the bluffs of Lignitic sandstones, which overlook the valley of Monument Creek, and once extended across to the foot-hills of the mountains. At *n* is West Monument Creek, which, with its numerous branches, has carved out broad valleys, as they came down from the mountains, leaving, either in groups or isolated columns, those singular forms figured in the annual report for 1873, opposite page 32, and on this account have suggested the name of Monument Park. At *v* we have the isolated castellated columns seen in the heliotype Plate VII, in Bulletin No. 3. About midway in the profile at *p*, are Austin's Bluffs, a part of the coal or Lignitic series, dipping northeast at an angle of about 8°, and extending off to the northwest, so as to lap on to the granite foot-hills. At the left-hand corner, a portion of the same sandstones seen at the right-hand corner and in the center of the foreground, are shown, with something of the peculiar style of weathering of the Monument Park sandstones. The layer which caps the column, is an iron-rust colored sandstone, harder and less yielding than the portions below. The oxide of iron seems to have cemented the grains of sand and small worn pebbles into a hard rock. Here we have the lowest beds of the Lignitic group, and nine miles east of Colorado Springs, underneath these sandstones, are thick beds of coal, amounting in the aggregate to 20 feet or more. In the valley of Monument Creek, *t*, *t*, the Cretaceous clays are exposed by the denudation of the Lignitic beds, and numerous species of *Ammonites*, *Scaphites*, *Inocerami*, &c., are found. These coal or Lignitic beds once extended uninterruptedly across to a point very near the base of the mountains, and in all probability were connected with the coal-beds at Cañon City, on the Arkansas, a distance of thirty miles in an air line, southwest. The mesa, *k*, *k*, separates Monument Creek from Foun-

tain Creek, and is underlaid with Upper Cretaceous beds, Nos. 4 and 5, with a thick covering of rather coarse drift. This is a most beautiful plateau, overlooking the plain country in every direction. At the point of the mesa, at the left hand, the two creeks unite; only Cretaceous clays of Nos. 4. and 5 are seen.

The Lignitic beds pass very soon beneath a more modern group of rocks, which in the annual report of the survey for 1869 I called the Monument Creek group. North and west of Colorado Springs are a number of extensive coal-beds, and in the sandstones above and below a considerable variety of the peculiar fossil plants have been observed. We know that a great thickness of the Lignitic group is here represented, and in following the valley of the Monument Creek up to the northward no want of conformity between the Lignitic and the Monument Creek groups could be observed. I do not doubt, however, that on the "divide" between the drainage of the Arkansas and the South Platte Rivers there is a group of beds of quite modern date entirely distinct from the Lignitic group, which must bear the name of Monument Creek group. I desire here to correct a statement in Bulletin No. 3, page 210, that the two groups, could possibly be identical; also to correct the description of Plate VII, which is an illustration of the more modern group.

In all cases where I have observed the Lignitic strata near the base of a mountain range, they have partaken fully of the uplift, and incline at high angles usually from the range, but it is not an uncommon thing for the modern Tertiaries to jut up against the granites, or to incline at small angles, from 5° to 15°. It was on this account that I pronounced the Monument Creek group, in 1869, Middle Tertiary or Miocene, and, although differing in lithological character, probably contemporaneous with the White River group farther to the northward, and holding the same relations to the mountain ranges. Professor Cope, in the annual report for 1873, page 430, says that the few vertebrate remains which he discovered in this group show conclusively that it is newer than the Eocene. We know but little of this modern group as yet, and we hope hereafter to secure more definite evidence of its age as well as its relations to the South Park basin and other lake-basins in the West.

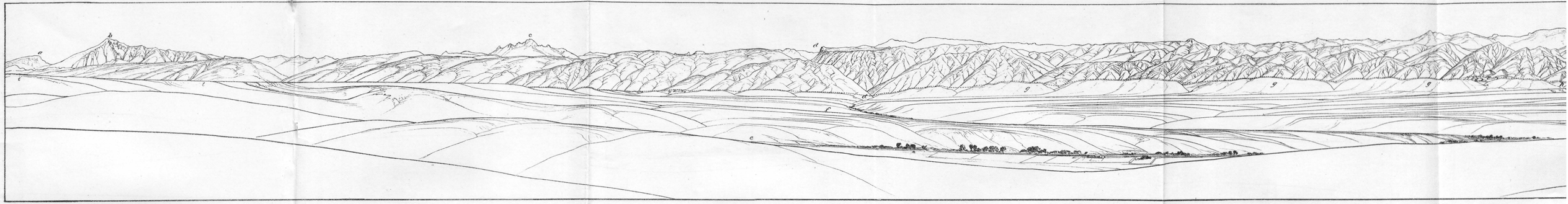
If we look closely under the mountains, about the middle of the profile, we shall see the upturned edges of the sandstones that form a portion of the celebrated "Garden of the Gods." The brick-red sandstones are probably better shown here than at any other locality, and the unique forms which they have received from atmospheric erosion have earned for them their peculiar appellation. In the annual report for 1873, opposite page 200, is a pictorial and anatomical section, which strikingly illustrates the position of the rocks in this region. It will aid the reader much in understanding this profile to read this report. To the left of *y* there is a ridge, lapping on to the side of the mountain, elevated at a high angle, with four cone-shaped points; these are Silurian limestones, which are well exposed in the vicinity of Manitou, near the source of Fountain Creek. Above this point the Monument Creek group juts up against the granites, concealing all the formations of older date. The lessons taught by this profile are much the same as those so well shown in the preceding plate, IX. The mountains seem to rise abruptly out of the plains, as if the vast granitic masses had pushed their way up vertically through the overlying crust, or sedimentary group of beds. At the very base of the mountains, for a portion of the distance, the entire group of sedimentary beds is tipped up at various angles, but in a very short distance eastward from the range only the coal group is seen in a horizontal position. The peculiar forms, both in the mountains and the

plains, have been represented by Mr. Holmes with wonderful accuracy and fidelity, and in among the high peaks are the usual gorges or cañons, and all the proofs of terrific erosion in past times.

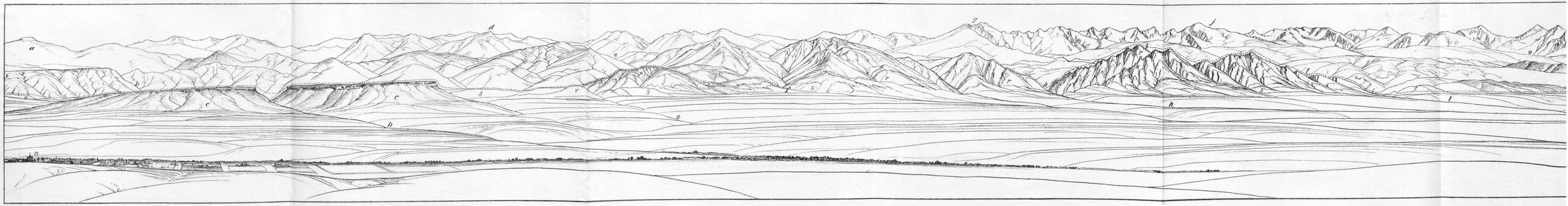
An important fact, however, is illustrated by the profile, which, so far as I know, was first observed by me in 1869 and published in the annual report of that year—that is, the dying out of the mountain-ridges in the plains. The great ranges are usually composite in their character, that is, are made up of a number of smaller ranges. These minor divisions may be continuous for long distances or may break off suddenly, and form some other ridge. The general trend of the aggregate mass of the eastern Rocky Mountain group is slightly west of north, and in many cases, and perhaps in the majority of instances, the minor ranges have an axial trend about northwest and southeast. The consequence is, that all along the eastern side of the great range, the smaller ranges tend to die out in the plains. So that, to one traveling along the eastern base, the ends of these smaller ranges or ridges present a sort of "*en echelon*" appearance. This feature is much more clearly exposed on the Big Thompson Creek about forty miles north of Denver. Section 1, opposite page 20 in the annual report of the survey for 1873, illustrates the manner in which these ridges die out in the plains more clearly. Cheyenne Mountain, at *h*, is an example of a short mountain-range ending abruptly. There is still another point of interest which I believe to be capable of demonstration, though I have not accumulated a sufficient number of observations to express it with confidence. It seems to me that these great composite ranges of mountains have gradually grown to their present size by additions on either side; that, for instance, the single ridge appeared first, as a nucleus, and that, at different periods of time, minor ridges were elevated on either side of the main ridge. This seems to be quite evident, from the different mineral characters which compose the Pike's Peak group. This seems probable, also, from the fact that at one point the red beds, which are at least as old as the Jurassic, appear to have been deposited on the granites after they had been elevated nearly to their present position, while in many other instances the ridges have been lifted up after the deposition of the Lignitic strata. On the south side of the Fountain Creek, Mr. Holmes made some very interesting sketches and studies, which tended to show that these red beds were made up of materials taken from the granites in the immediate vicinity; that the red beds in immediate contact with the granites are made of rather large rounded granitic masses, cemented with sand, that the coarse conglomerate soon became a fine pudding-stone, and fine sandstones, as we gradually move eastward, from the base of the granitic ridge. It is possible that the great Rocky Mountain range was outlined in form, far back in the past, perhaps, even during the Carboniferous period, though it received vast additions during the Cretaceous and Tertiary epochs.

PLATE IX.

View of the Colorado or Front Range, taken from a point near Denver. The two profiles on this plate are continuous; the right-hand end of the upper one joining on to the left-hand end of the lower one.



a, Cheyenne Mt. b, Pikes Pk.-14147. c, Platte Mt.-9203. d d, Platte Cañon. e, Cherry Cr. f, Plum Cr. g g g, Hog Backs Cret. Nal. r, Red Beds h, Turkey Cr.

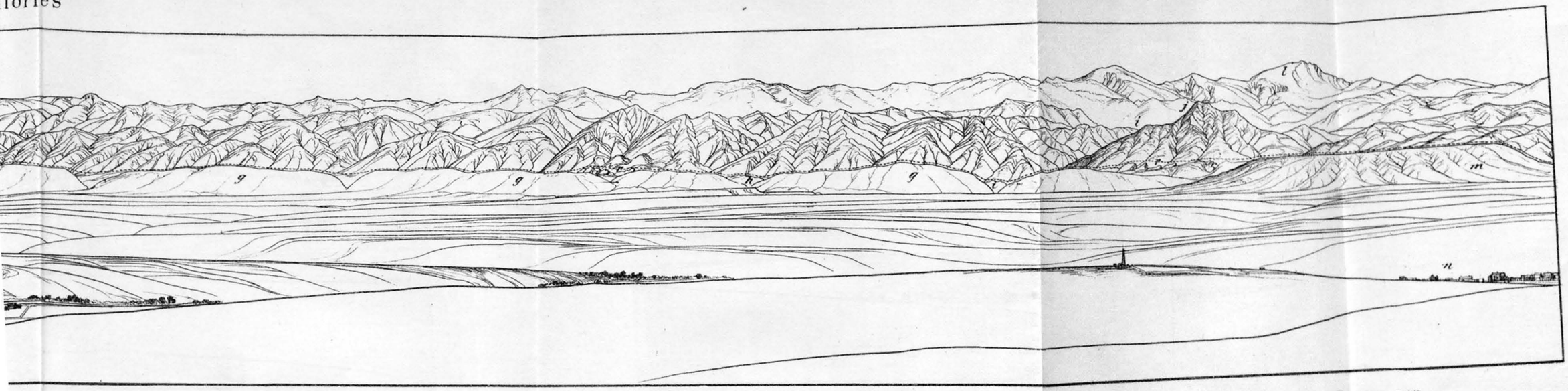


a, Old Squaw-11733. c c, Table Mts. b b, Clear Cr. d, Golden Pk. 9771. e e, Ralston Cr. f, Coal Cr. g, Arapaho Pk. 12520 ft. h h, S. Boulder i Boulder Pk. 8533 ft. U, N. Boulder. m, Long's Pk. 14271. n, Estes' Park. o o, St. Vrain's Cr.

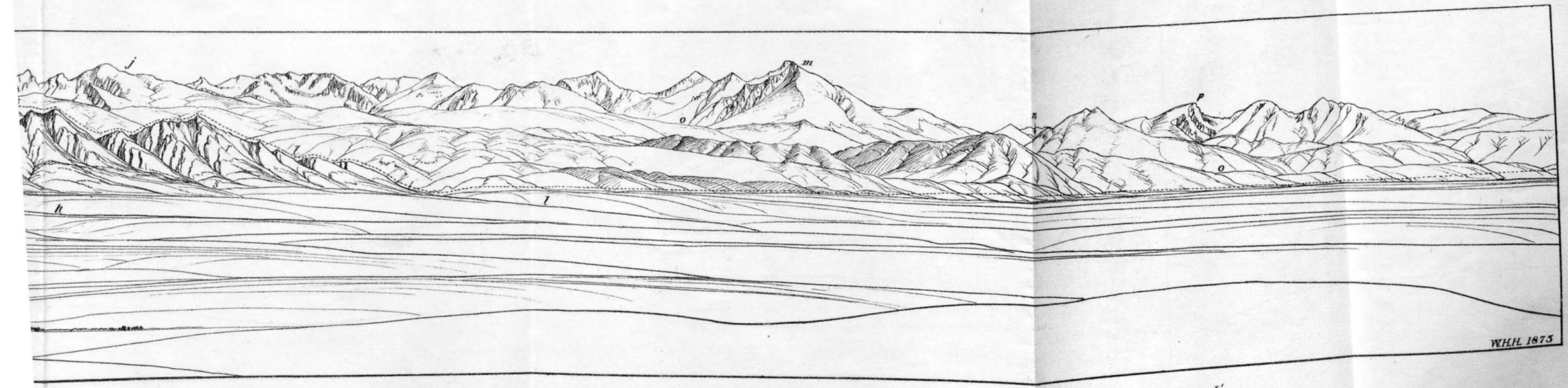
The GRANITES occupy all the elevated areas beyond the dotted line This line follows the upturned edges of the sedimentary strata. CRETACEOUS rocks are exposed in the hogbacks g.g.g.g. above, and s.s.s. below - behind these are the RED BEDS r r. LIGNITIC Strata and DRIFT cover nearly all the plain. VOLCANIC Rock caps the Table Mts. & occurs

THE FRONT OR COLORADO RANGE

From near Denver



Backs Cret. No 1. r, Red Beds h, Turkey Cr. ii, Bear Cr-7909. j, Bear Sta. l, Mt Evans-14330. m, Green Mt. n, Denver-5197.



V. Boulder. m, Long's Pk. 14271. n, Estes' Park. oo, St. Vrain's Cr. p, J.

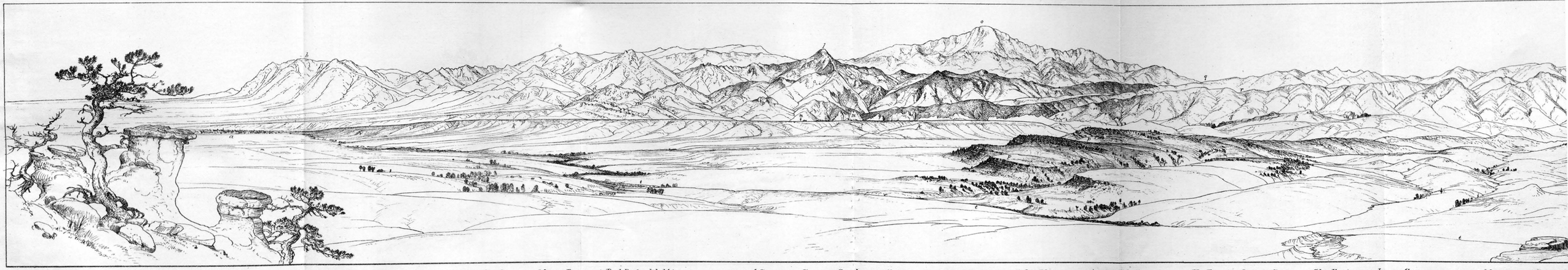
r.r. LIGNITIC Strata and DRIFT cover nearly all the plain. VOLCANIC Rock caps the Table Mts. & occurs at m on Green Mt. at v. near Ralston's Creek and on the Arkansas Divide t.t.

RANGE

PLATE X.

View of the Pike's Peak Group, taken from bluff east of Monument Creek.

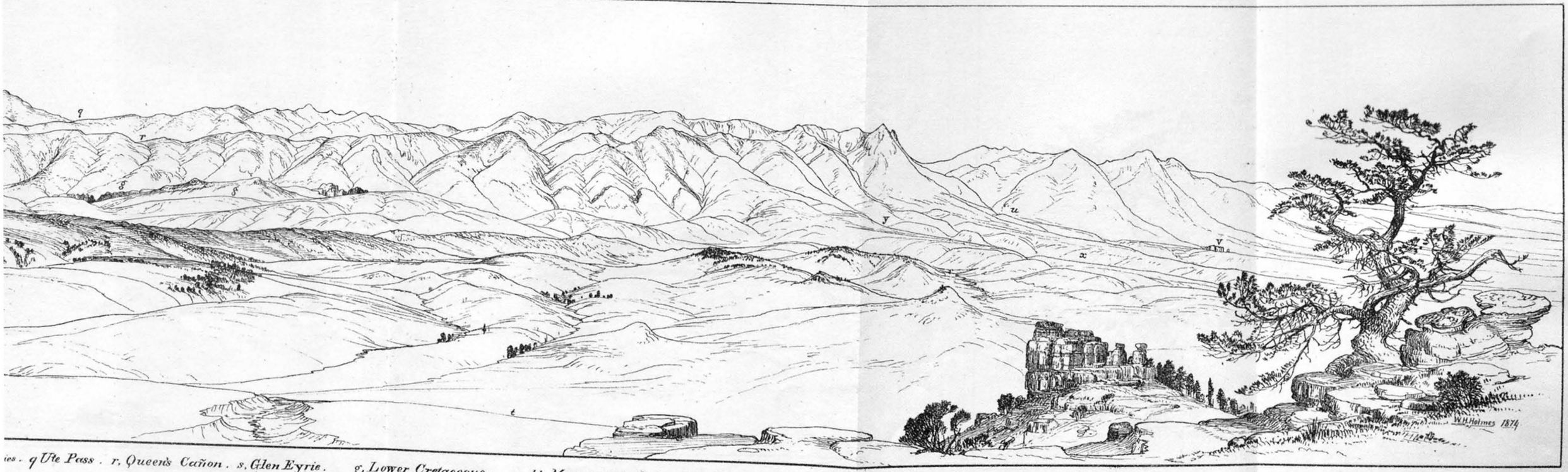
U.S. Geological and Geographical Survey of the Territories



a, Colorado Springs. b, Cheyenne Mt. c, Cheyenne Cañon. d, Bear Creek. e, Monte Rosa. j, Red Beds. k,k, Mesa.– Cretaceous No. 4 and 5. l, Camerons Cone. m, Garden of the Gods. n, Location of Manitou. o, Pike's Pk 14647 – pp, Austin's Bluffs, cond series. q Ute Pass. r, Queen's Cañon. s, Glen Eyrie. g, Lower Cretaceous. tt, Monument Cr.

THE PIKE'S PEAK GROUP

From Bluff East of Monument Creek



ies. q Ute Pass. r, Queen's Cañon. s, Glen Eyrie. g, Lower Cretaceous. tt, Monument Cr. u, West Monument Cr. v, Castle Rocks. x, Monument Park. y, Coal Series, near the Granite.

THE TERTIARY PHYSOPODA OF COLORADO.

By Samuel H. Scudder.

Some years ago* I described a genus of fossil *Physopoda* from the North American Tertiaries. Since then I have found other species among the specimens collected by Prof. William Denton, and bring together in this place a connected account of all of them. They all belong to the *Terebrantia*. Species of *Physopoda* have been found in a fossil state in other places. Thus, Menge has described three species from the Prussian amber, and Oustalet, in a communication before the Société Philomathique of Paris (still I believe unpublished), gave the characters of several species from Aix, in Provence, in addition to the one long since described by Heer, from the same beds.

Melanothrips extincta, *nov. sp.*

Head small, tapering; the only appendages visible are the antennæ; these are only sufficiently preserved to recognize that they are very long and slender, longer than the thorax. The thorax is rather small, quadrate; wings nearly as long as the body, fringed on the costal border as in *Palæothrips fossilis*. The abdomen is composed of only eight joints, but is very long and very tapering, fusiform, the last joint produced, as usual in the physopods; the third joint is the broadest; of the wings only the costal border and a part of one of the longitudinal veins can be seen; there are no remains of legs. Length of body, 2^{mm}.2; of antennæ, 0^{mm}.8.; of head, 0^{mm}.14.; of thorax, 0^{mm}.5.; of abdomen, 1^{mm}.56; greatest breadth of abdomen, 0^{mm}.5. Chagrin Valley, Professor Denton.

Lithadothrips, *nov. gen.* (λιθάς, θρίψ).

Allied to *Melanothrips* Haliday. The head is large, broad, globose; the eyes exceedingly large, globose, each occupying, on a superior view, fully one-third of the head; the antennæ very slender, equal, as long as the thorax, the joints eight or nine in number, cylindrical, equal, scarcely enlarging toward their tips. The prothorax is no larger than the head, of equal breadth with it, the whole thorax shaped as in *Palæothrips*. Only fragments of the wings remain, sufficient to render it probable that they agree well with the character of the group to which *Melanothrips* and *Æolothrips* belong. The legs resemble those of *Palæothrips*, but are slender and appear to be rather profusely supplied with hairs. The abdomen differs considerably in the two specimens referred to this genus. In one it is very broadly fusiform, the tip a little produced, nine joints visible, the apical furnished with a few hairs, and bluntly rounded at the tip; the other has the sides equal, the apex not at all produced, but very broadly rounded, only seven or eight joints vaguely definable.

* Proc. Bost. Soc. Nat. Hist., xi, p. 117; Geol. Mag., v, p. 221.

LITHADOTHRIPS VETUSTA, *nov. sp.*

The specimens, both of which represent the upper surface of the body with fragments and vague impressions of the members, are too poorly preserved to add anything to the above description of their generic features excepting the following measurements: *First specimen:* length of body, 1^{mm}.76; of antennæ, 0^{mm}.6; of thorax, 0^{mm}.64; of abdomen, 0^{mm}.87; breadth of head, 0^{mm}.28; of thorax, 0^{mm}.52; of abdomen, 0^{mm}.56; length of fore femora, 0^{mm}.37 ?; breadth of same, 0^{mm}.14; length of hind femora, 0^{mm}.42; breadth of same, 0^{mm}.13. *Second specimen:* length of body, 1^{mm}.96; of antennæ, 0^{mm}.76; of thorax, 0^{mm}.56; of abdomen, 1^{mm}.10; breadth of head, 0^{mm}.38; of thorax, 0^{mm}.59; of abdomen, 0^{mm}.59. Fossil Cañon, Professor Denton.

PALÆOTHRIPS Scudder.

This genus, hitherto but briefly described, is allied to *Æolothrips* Haliday. The head is small, globose; eyes rounded, much smaller than in *Lithadothrips;* antennæ slender, fully as long as the thorax, not more than seven-jointed, the joints cylindrical, subequal. Prothorax considerably larger than the head, the thorax, as a whole, very large, stout, and tumid; fore femora very stout, scarcely more than twice as long as broad; fore tibiæ also stout, a little longer than the femora; the other legs are moderately stout, long, reaching beyond the tip of the abdomen, with a few scattered rather short spinous hairs; the hind tarsi three-jointed, the last joint smaller than the others and all together two-sevenths the length of the tibiæ. Fore wings unusually broad, broadest apically, where their breadth more than equals one-fourth of their entire length, provided with two longitudinal veins, dividing the disk into three nearly equal portions, connected in the middle by a cross-vein, and with either border by other cross-veins at about one-third and two-thirds the distance from the base to the tip of the wing; the wing is heavily fringed, especially along the hind border. Hind wings veinless, nearly as long, and, at the tip, nearly as broad as the fore wings. Abdomen nine-jointed, half as long again as the thorax, rather tumid, scarcely or not at all produced apically.

PALÆOTHRIPS FOSSILIS Scudd. (*loc. cit.*)

Head small, tapering a little in front, where, however, it is broadly rounded. The antennæ are certainly seven-jointed, and none of the apical joints show any indication of being connate, the last joint being of the same length as the two preceding it, tapering and bluntly pointed; none of the joints show any enlargement in the middle, but the middle joints are slightly larger at the distal extremity than at the base; they appear to be destitute of hairs. The prothorax is subquadrate, a little broader than long, with rounded sides; the fore femora are unusually stout, as long as the width of the prothorax. The longitudinal veins of the fore wings approach each other somewhat abruptly in the middle, where they are united by a cross-vein; and, at the tip of the wing, they curve away from each other; the two cross-veins on the lower third of the wing are, respectively, slightly further from the base of the wing than the corresponding veins of the upper third; the fringe on the posterior border is largest near the tip of the wing, where the hairs are about three times as long as those on the costal border. The first hind tarsal-joint is scarcely longer than broad, cylindrical; the second

of about the same length, but decidedly broader at apex than at base; the apical joint is nearly globular, smallest at base, as large in the middle as the base of the other joints. There are a few hairs at the tip of the abdomen, and a few short ones on the hind tibiæ; the apical ones stouter than the others, resembling spines; but the insect appears to have been unusually destitute of hairs, excepting on the wings, where not only the edges but also all the veins are fringed. Length of body, 1^{mm}.6–1^{mm}.8; of antennæ, 0^{mm}.58; of fore femora, 0^{mm}.32; breadth of same, 0^{mm}.14; length of fore tibiæ, 0^{mm}.32; of hind femora, 0^{mm}.38; breadth of same, 0^{mm}.11; length of hind tibiæ, 0^{mm}.42; of hind tarsi, 0^{mm}.12; of fore wings, 1^{mm}.4; of hind wings, 1^{mm}.27; greatest breadth of fore wings, 0^{mm}.37; length of prothorax, 0^{mm}.16; breadth of same, 0^{mm}.32; length of whole thorax, 0^{mm}.64; of abdomen, 0^{mm}.92; greatest breadth of the same, 0^{mm}.37. Fossil Cañon, Professor Denton.

OUTLINES OF A NATURAL ARRANGEMENT OF THE FALCONIDÆ.

By Robert Ridgway.

[Read before the Philosophical Society of Washington, April, 1875.]

Until very recently, the Birds of Prey have been classified entirely according to their external characters, the primary division being into three so-called families, as follows: (1) *Vulturidæ*, or vultures, characterized by their naked heads, sluggish habits, and filthy food; (2) *Falconidæ*, or falcons, hawks, eagles, and other diurnal birds of prey, distinguished by their feathered head and predatory nature; and (3) *Strigidæ*, or owls, known from both the preceding by having the eyes directed forward, instead of laterally, and by being nocturnal.

Notwithstanding the fact that occasional genera constituted transitional forms intermediate between two "families",* the above classification was adopted almost universally until the year 1867, when Professor Huxley clearly demonstrated† that the so-called family *Vulturidæ* had no existence in fact, it being an unnatural association of members of two very distinct families, viz, the *Cathartidæ*, or American vultures, on the one hand, and a group of the *Falconidæ* (the Old-World vultures) on the other. Besides the announcement of the above important discovery, Professor Huxley also proved that the secretary bird (*Serpentarius reptilivorus*), previously included among the *Falconidæ*, was in reality the sole representative of a very distinct family, which he named "*Gypogeranidæ*."

To sum up the important results of Professor Huxley's studies of the osteology of the raptorial birds, they are briefly as follows: (1) The demolition of the old so-called family *Vulturidæ*, the typical members of which were referred to the *Falconidæ;* (2) the recognition of a separate family, *Cathartidæ*, to accommodate the aberrant ones; and (3) the removal of *Serpentarius* from the *Falconidæ* and its establishment as a distinct family, "*Gypogeranidæ*." The families of diurnal Raptores, according to Huxley's views, then were as follows: (1) *Cathartidæ* (American vultures); (2) *Gypaëtidæ* (=*Falconidæ*, hawks, &c., including the Old-World vultures); and (3) *Gypogeranidæ* (=*Serpentariidæ*, the secretary bird).

After a very careful consideration of all that relates to the principles of a natural classification, I find every reason for adopting, without hesitation, Mr. Huxley's conclusions. ‡

* Examples of these perplexing "intermediate" forms are the genera *Gypaëtus* and *Polyborus*, among the *Falconidæ*, which combine "vulturine" and "falconine" characteristics of habits and external appearance; while among the *Strigidæ* the genus *Surnia* is strictly diurnal, and its appearance decidedly hawk-like. The falconine genus *Circus*, on the other hand, has a distinct facial ruff and other characteristics belonging chiefly to the owls. These cases were very embarrassing to the followers of the old classification, and by different authors were shifted from one family to the other.

† Proceedings of the Zoölogical Society of London, 1867, pp. 440, 443, 462, 465.

‡ I cannot follow, however, in substituting the name *Gypaëtidæ* for the old term *Falconidæ*, which in its former signification is sufficiently comprehensive to justify its continued use as the proper name for this family; the term *Gypogeranidæ* is equally objectionable, since *Gypogeranus* (Illiger, 1811) is antedated by *Serpentarius* (Cuvier, 1798), in consequence of which *Serpentariidæ* (Selys, 1842), as adopted by Gray (Hand List, 1869, p. 38), is preferable.

A fifth family, the *Cariamidæ*, or Cariamas, is quite nearly related to those mentioned, and has by some authors been even included among the *Falconidæ;* but the degree of its relationship by no means justifies that view of its affinity. The families *Strigidæ*, *Falconidæ*, *Cathartidæ*, *Serpentariidæ*, and *Cariamidæ* may possibly be eventually combined to form an order; but whether this association would be a natural one is an undecided question, beyond the province of this paper.

Having defined the limits of the family *Falconidæ*, it now remains to treat of this alone; the subdivisions of the family being the subject of discussion.

To the present time, the *Falconidæ* have been divided into a greater or less number of so-called "subfamilies", the number varying according to the author; those founding their classification on purely external characters finding it necessary to adopt a great many, and those relying upon the anatomical characters carefully avoiding any subdivision at all.*

To review in this connection all the classifications of the family which have been proposed up to the present time would require far more space than the limits of this memoir will allow; each author, while following a generally-recognized plan, having his own peculiar views regarding certain details of arrangement. It will, therefore, suffice for the present to give a mere outline of this generally-adopted plan, and supplement it by the modified systems of our latest and best authorities.

The "subfamilies" usually recognized are the following: (1) "*Falconinæ*", (2) "*Milvinæ*", (3) "*Accipitrinæ*", (4) "*Circinæ*", (5) "*Buteoninæ*", (6) "*Aquilinæ*", and (7) "*Polyborinæ*." Some authors add "*Circætinæ*" and "*Pandioninæ*"; while previous to the important discovery, made by Professor Huxley, regarding the vultures before alluded to, this supposed family was divided into the so-called subfamilies, (1) "*Vulturinæ*", (2) "*Gypinæ*", (3) "*Neophroninæ*", (4) "*Gypaëtinæ*", and (5) "*Gypohieracinæ*",—some authors grouping two or more of these in one, others recognizing all. They are all, of course, typical *Falconidæ*, thus making a total of fourteen subfamilies into which this family has been divided, when there are in reality but two.

Mr. George Robert Gray, in his "Hand List of Birds in the British Museum",† divides the *Falconidæ* into seven so-called subfamilies, as follows: (1) *Polyborinæ*, LAFR., 1839 (=*Polybori* of the subfamily *Falconinæ*); (2) "*Buteoninæ*, SWAINS., 1837"; (3) "*Aquilinæ*, SWAINS., 1837"; (including *Pandion*!); (4) "*Falconinæ*, SWAINS., 1837" (including *Harpagus*!); (5) "*Milvinæ*, BONAP., 1838"; (6) "*Accipitrinæ*, SWAINS., 1837" (including *Herpetotheres* and *Micrastur*, both groups of the subfamily *Falconidæ*) and (7) "*Circinæ*, BP."

Messrs. Philip Lutley Sclater and Osbert Salvin, in their "*Nomenclator Avium Neotropicalium*",‡ divide the American members of the family into the following "subfamilies": (1) "*Pandioninæ*", (2) "*Circinæ*", (3) "*Buteoninæ*", (4) "*Accipitrinæ*", (5) "*Falconinæ*," (6) "*Milvinæ*", (7) "*Herpetotherinæ*", and (8) "*Polyborinæ*."

Mr. R. Bowdler Sharpe, in his recently-published great-work upon the diurnal "*Accipitres*",§ employs a singularly inconsistent classification,

*This has, perhaps, been mainly due, not to the difficulty of finding sufficiently good characters, but to the fact that the conclusions arrived at were so opposed to views long established by usage.

†London, 1869, (vol. I).

‡London, 1873, pp. 118–123.

§Catalogue of the *Accipitres*, or diurnal birds of prey, in the collection of the British Museum. London, July, 1874.

which can only be considered a decided retrograde from, instead of an improvement upon, the better classifications which preceded it. In the first place, the genus *Pandion* is made to form a "suborder"—*Pandiones!* This would not be so bad, all things considered, were it not that the genus *Polioaëtus* is included in this so-called "suborder", the latter being a very near relative, probably a subgenus, of *Haliaëtus*, one of the group *Buteones* of the subfamily *Buteoninæ*, and not at all allied to *Pandion* (group *Pandiones* of *Buteoninæ*), though it represents that genus in its group; that is, is analogous, but not affined to it. In the next place, *Serpentarius* (= family *Serpentariidæ*) and *Cariama* (= family *Cariamidæ*) are placed in the "subfamily" *Polyborinæ!* The subfamilies which Mr. Sharpe recognizes are the following: (1) *Polyborinæ*, (2) *Accipitrinæ*, (3) *Buteoninæ*, (4) *Aquilinæ*, and (5) *Falconinæ*.

In this connection, it may be well to call attention to the importance of distinguishing between evidences of affinity and those of mere analogy in the birds of this family. Certain types of teleological modifications are repeated in members of different subfamilies, and in different groups of one subfamily, to such a degree of perfection, that, if we were to follow external appearance only, we would not hesitate to place them near together in a systematic arrangement. This is what has led to such confusion and such utterly unsatisfactory results as have characterized most attempts at a natural classification. Among the more prominent instances of analogy between members of different groups or subfamilies, or even different families, the following may be mentioned: The family *Cathartidæ* is reproduced in the vultures of the Old World (vulturine series, group *Buteones*, subfamily *Buteoninæ*, family *Falconidæ*); the *Gypogeranidæ* and *Cariamidæ*, in a less degree, by *Polyboroides* and *Geranospizias* (*Buteones*); the *Strigidæ*, in a very slight degree, by *Circus* (*Buteones*, *Buteoninæ*), *Micrastur* (*Micrastures*, *Falconinæ*), and *Pandion* (*Pandiones*, *Buteoninæ*).* The *Falcones* are represented in the *Buteoninæ* by *Ictinia* and *Harpagus* (*Buteones*); also by *Baza* (*Pernes*); one of the *Polybori* (*Ibycter*) by *Rostrhamus* (*Buteones*); the *Micrastures* are repeated in the genera *Circus* and *Nisus*† (*Buteones*), and *Herpetotheres* very nearly imitated by *Circaëtus* (*Buteones*). Taking the *Buteoninæ* alone, the *Pandiones* are mimicked by certain *Haliaëti* (*Buteones*); Certain *Pernes* (*Elanoides*) by *Milvus* and *Nauclerus* (*Buteones*); and others of the same group (*Baza* and *Aviceda*) by *Harpagus* and *Ictinia*.

In three widely-distinct "series" of genera in the group *Buteones*, we find a very peculiar type of modification, viz, the excessive abbreviation of the outer toe. This occurs only in *Heteropus* (an "aquiline" form, with densely-feathered tarsus), *Polyboroides* (a long-legged terrestrial form, with reticulated tarsus), and *Geranorpozias* (similar to the last, but with scutelate tarsus); these latter two differ from the first in being of terrestrial habits, and in a very remarkable teleological modification of the tibio-tarsal joint, whereby it can be bent with ease *in both directions*.

The following tabular arrangement expresses the equivalents of the two subfamilies and several groups, adopted in this memoir in the numerous "subfamilies," or "families" of leading authorities, and suc-

* *Circus* resembles the owls merely in the possession of a distinct facial ruff and large ear-aperture; *Micrastur*, in the same respects, and also in decomposed downy edges to the inner webs of the primaries, the rounded, concave wing, as well as in the dimorphic plumage of some of the species ("rufescent" and "gray" "phases"); *Pandion*, in having the outer toe reversible and in lacking after-shafts to the feathers.

† In general form, *Micrastur* exactly repeats the genus *Nisus*, and has, besides, the facial ruff of the genus *Circus*.

ceeding it a series of diagnoses explaining the reasons which justify such a classification :*

Subfamilies—present arrangement.	Ridgway. ("*Groups.*")	Sharpe. ("*Subfamilies.*")	Scl. & Salv. ("*Subfamilies.*")	Sundevall [1] ("*Families.*")
Falconinæ.	Falcones.	Falconinæ.	Falconinæ.	Falconinæ.
	Polybori.	Polyborinæ.	Polyborinæ.	Polyborinæ.
	Micrastures.	Accipitrinæ (pt.).	Accipitrinæ (pt.).	Circaëtinæ (pt.).
	Herpetotheres.	Aquilinæ (pt.).	Herpetotherinæ.	Circaëtinæ (pt.).
	Pandiones.	Pandiones.[2]	Pandioninæ.	Circaëtinæ (pt.).
Buteoninæ.	Pernes.	Aquilinæ (pt.), Falconinæ (pt.), Milvinæ (pt.).	Milvinæ (pt.).	Circaëtinæ (pt.).
	Buteones.	Accipitrinæ (pt.), Buteoninæ (pt.), Aquilinæ (pt.), Falconinæ (pt.), Vulturidæ (pt.).	Falconinæ (pt.), Milvinæ (pt.), Circinæ, Accipitrinæ (pt.).	Falconinæ (pt.), Circaëtinæ (pt.), Aquilinæ (pt.), Gypaëtinæ, Vulturinæ, Haliaëtinæ (pt.).

[1] Förnyad anordning av Dagrovfoglarna (Dispositio nova Accipitrum Hemeroharpagorum). Öfversigt af Kongl. Vetenskaps Akademiens Fordhandlingar 1874. No. 2. Stockholm.
[2] "Suborder."

A.—Scapular process of the coracoid produced forward so as to meet the clavicle.† Nasal bones almost completely ossified, the nostril being a small, usually circular, opening, with a conspicuous, usually central, bony tubercle.‡ Inferior surface of the supramaxillary with a prominent median angular ridge. Superciliary process of the lachrymal consisting of a single piece.§ . . . . Subfamily *Falconinæ*.

B.—Scapular process of the coracoid *not* produced forward, but separated from the clavicle by a wide interval.‖ Nasal bones very incompletely ossified, the nostrils large, without bony tubercle, and frequently with an incomplete septum. Inferior surface of the supramaxillary without median ridge.¶ Superciliary process of the lachrymal usually consisting of two pieces, joined by a cartilaginous hinge.** . . . . . Subfamily *Buteoninæ*.

* It is proper to explain here that the key to the leading character was furnished by Professor Huxley in the paper before referred to (p. 464), in the following words : "The scapular process of the coracoid sometimes is * [* *e. g.*, in the Falcons proper, and in *Polyborus*] and sometimes is not produced to the clavicle"—having reference to the family *Falconidæ*. Following up this clew by examining the coracoid apparatus of every genus available, I was surprised to find it to be a character which separated trenchantly not only the "Falcons proper" (=*Falcones*) and *Polyborus*, but also all the genera related to the latter, besides *Micrastur* and *Herpetotheres*, from all other *Falconidæ*.

† See Plate XI, Figs. 1–4.

‡ Except in *Micrastur*. (See Plate XII, Fig. 4.)

§ See Plate XIII, Figs. 1–4.

‖ See Plate XI, Figs. 5–11.

¶ In Fig. 6, Plate XII, the tomium of the supramaxillary is so deeply sinuated as to allow the middle portion of the under surface to be seen from the side ; but this has no analogy to the *raised* median ridge of the falconine forms.

** The exceptions are the *Pandiones* (*Pandion*) and *Pernes* (*Elanoides*, *Cymindis*, *Regerhinus*, *Aviceda*, *Baza*, &c.), in which this bone much resembles that of the *Polybori*, as shown in Figs. 6 and 7, Plate XIII.

Subfamily FALCONINÆ.

The term *Falconinæ* has been restricted in most previous arrangements to the true falcons (=*Falcones* of the present system), but in view of its being a subfamily-name it becomes necessary to make it cover all the forms allied to these by subfamily-characters; hence the wider signification given it here.

The subfamily *Falconinæ* is composed of four well-defined groups, the *Falcones*, *Polybori*, *Micrastures*, and *Herpetotheres*, which are distinguished as follows:

A.—Posterior toe abbreviated, very much shorter than the lateral pair; tarsi and toes covered with small hexagonal scales, larger in front.

a. Nostril a small, round, or oblique opening, with a bony rimmed margin and central tubercle. (Plate XII, Figs. 1–3.)

1. Superior tomium with a conspicuous tooth, and inferior tomium with a corresponding notch. (Plate XII, Fig. 2, and Plate XV, Fig. 1.) Superciliary process of the lachrymal elongated, narrow, reaching nearly across the orbit. (Pl. XIII, Fig. 2.) Posterior margin of the sternum nearly even, with a pair of large oval foramina. One or two outer primaries with their inner webs emarginated near their tips. (Plate XVII, Figs. 1 and 2.)..Group 1, *Falcones*.

2. Tomia without tooth or notch.*
Superciliary process of the lachrymal abbreviated, reaching only half-way across the orbit. (Plate XIII, Fig. 1.) Posterior margin of the sternum with a pair of deep indentations. Three or more outer primaries with their inner webs sinuated near the middle portion. (Plate XVII, Figs. 3 and 4.)..... Group 2, *Polybori*.

b. Nostril a large opening without bony-rimmed margin or central tubercle. (Plate XII, Fig. 4.)

3. Superciliary process of the lachrymal elongated, broad, extending nearly across the orbit. (Plate XIII, Fig. 4.) Tomia without tooth or notch. (Plate XII, Fig. 4, and Plate XIV, Fig. 2.) Posterior margin of the sternum as in *Falcones*. Four or more outer primaries with inner webs sinuated near the middle portion...Group 3, *Micrastures*.

B.—Posterior toe elongated, almost equal to the lateral pair. Tarsi and toes covered uniformly with thin, rough, imbricated scales.

4. Tomia without tooth or notch. (Plate XII, Fig. 3, and Plate XIV, Fig. 1.) Nostril as in *Falcones* and *Polybori*. Superciliary process of the lachrymal elongated, very broad, reaching nearly across the orbit. (Plate XIII, Fig. 3.) Posterior margin of the sternum nearly even, entire, and without foramina. Primaries as in *Polybori* and *Micrastures*.....Group 4, *Herpetotheres*.

The pterylography of the members of this subfamily affords some very important diagnostic characters. From the descriptions given by Nitzsch† (pp. 55–57), the following arrangement may be tabulated,

* Though faint indications of these are observable in some genera (*Milvago* and *Phalcobænas* (see Plate XV, Fig. 2) in the horny sheath, they cannot be detected in the bone of the bill. (See Plate XII, Fig. 1.)

† Nitzsch's Pterylography, translated from the German, edited by Philip Lutley Sclater, M. A., Ph. D., F. R. S., secretary to the Zoölogical Society of London. London: Published for the Ray Society, by Robert Hardwicke, 192 Piccadilly. 1867. pp. 118, ppl. 10.

which, in the main, supports the one founded on the osteological structure.

A.—Dorsal portion of the spinal tract deeply divided, and each branch dilated exteriorly ..... *Falcones*

B.—Dorsal portion of the spinal tract enlarged on all sides, undivided, and sparsely feathered.

a.—Eyelids with distinct lashes; lumbar tract present; dorsal portion of the spinal tract sparsely feathered to the caudal pit, thence diminished and continued as a narrow band along the caudal vertebræ to the oil-gland ..... *Herpetotheres.*

b.—Eyelids without distinct lashes; lumbar tract absent; dorsal portion of the spinal tract in the form of an elongated ellipse, only contracted into a band immediately in front of the oil-gland (but even there still broad), consisting exclusively of scattered feathers, which become stronger posteriorly. *Micrastures.*

The only close relationship between any two groups of this subfamily is seen in the generalized forms of the *Falcones* and *Polybori* (*Hieracidea* and *Milvago*), whose specialized forms (*Falco* and *Polyborus*) are so extremely dissimilar in appearance. In the two genera mentioned, the approach is so very close as to almost form a transition between the two groups.* There is a wonderful similarity in the general form and relative proportions of all the parts, the arrangement of the scutellæ of the tarsi and toes, the character of the plumage, and the size of the species. But notwithstanding this apparent correspondence of external characters, they are found to differ in all those osteological characters diagnostic of their respective groups, and, when their external structure is examined closely, agree severally with the other members of the groups to which they belong in an apparently trivial yet really pertinent character, viz, *the cutting of the inner webs of the outer primaries*, which is always essentially different in the two groups. The external diagnostic characters (associated with osteological, indicated on p. 229) are thus reduced to the structure of the primaries, as follows:

FALCONES.—Two, or less, outer primaries with their inner webs cut; this always an abrupt emargination on the first, and situated near its end. Second or third quill longest; first longer than the fifth.

POLYBORI.—Three, or more, outer primaries with their inner webs cut; this an oblique sinuation on the first, and near its middle. Third or fourth quill longest; first shorter than the fifth.

The *Falcones* comprise very few genera in proportion to the number of species, which is very considerable; but it is outside the purpose of this paper to discuss the subject of what the genera of the group are. Suffice it to say that neither *Baza* nor *Harpagus* belong here, as many have supposed, being members of different groups (*Pernes* and *Ictiniæ*) of the subfamily *Buteoninæ*. The genus *Spiziapteryx*, however, which many consider a synonym of *Harpagus*, is a true Falcon.

The groups *Micrastures* and *Herpetotheres* have but one genus each, so these are passed by without further notice; but the Polyborine genera are numerous, and, as they have never been satisfactorily defined, the following diagnoses are presented:

* The typical *Hieracideæ* will, upon examination, probably be found to have the superciliary process of the lachrymal much shorter than that of the typical *Falcones*, if it does not approach the extreme brevity of this bone which characterizes the Polyborine group.

Genera and subgenera of POLYBORI.

A.—Tarsus ½–⅔ its length longer than the middle toe; outer toe but little longer than the inner; posterior toe very decidedly shorter than the inner; claws slightly curved, blunt. Inner webs of primaries deeply sinuated. Habits chiefly terrestrial.

a. Nostril linear, obliquely vertical, its tubercle concealed.

1. POLYBORUS. Nostril linear, obliquely vertical, its posterior end the upper one;* situated in the upper anterior corner of the cere. Anterior outline of the cere nearly straight and vertical. Occipital feathers elongated into a depressed crest.

b. Nostril circular, in the middle of the cere, its tubercle exposed;† anterior outline of the cere doubly curved.

2. PHALCOBÆNUS. Tooth and notch of the tomia of the bill nearly obsolete; lower jaw nearly naked; outer toe not appreciably longer than the inner; posterior toe reaching much beyond the first joint of the middle toe; claws remarkably blunt, slightly curved; posterior face of the tarsus without distinct rows of quadrate scales; upper tail-coverts remarkably developed, covering nearly two-thirds the tail; size large.

a. Frontal feathers (of adult) recurved, very soft, lanceolate; loral and maxillary regions naked; fore-neck feathered. In the adult, the abdomen, anal region, crissum, upper tail-coverts, and lining of the wing white; secondaries and tail tipped with white; other parts deep black . . *Phalcobænus.*

β. Frontal feathers pointed backward (normally), stiff and lanceolate; lower jaw and lores densely covered with strong bristles; fore-neck naked. In the adult, abdomen and anal-region ochraceous; crissum and upper tail-coverts black; lining of the wing and tibiæ black mixed with ochraceous; breast and nape longitudinally streaked with dingy whitish; secondaries not tipped with white . . . . . *Senex.*

3. MILVAGO. Tooth and notch of the tomia of the bill distinctly indicated; lower jaw normally feathered; outer toe decidedly longer than the inner; posterior toe not reaching the first joint of the middle toe; claws sharp, strongly curved (as in the *Falcones*); posterior face of the tarsus with two distinct rows of quadrate scales. Upper tail-coverts normal, covering about one-third the tail; size small.

B.—Tarsus scarcely longer than the middle toe; outer toe very much longer than the inner, which is but little longer than the posterior one. Inner webs of primaries shallowly sinuated. Habits strictly arboreal.

4. IBYCTER. Nostril circular, near the middle of the cere, its tubercle either concealed or exposed; anterior outline of the cere doubly curved. Tarsus without transverse scutellæ either in front or behind.

a. Size large. Bill slender, the tip much produced; gonys barely convex, nearly horizontal. Bare superciliary region very narrow. (See Plate XVIII, Fig. 1.) . . *Ibycter.*

β. Size small. Bill thick, the tip only slightly produced; gonys strongly convex, decidedly ascending terminally. Bare superciliary region very wide. (See Plate XVIII, Fig. 2.) . . . . . *Daptrius.*

* This is exactly the reverse of the position of the nostril in all other *Falconidæ*, in which its direction is oblique! †As in the Falcones!

PLATE XI.

CORACOID APPARATUS.

(*All natural size.*)

FIG. 1. Falco anatum.
2. Ibycter americanus.
3. Micrastur semitorquatus.
4. Herpetotheres cachinnans.
5. Pandion carolinensis.
6. Elanoides forficatus.
7. Elanus leucurus.
8. Ictinia mississippiensis.
9. Rostrhamus sociabilis.
10. Buteo borealis.
11. Aquila canadensis.

[*a*. Anterior process of the coracoid.
b. Basal process of the scapula.
c. Scapular process of the coracoid.]

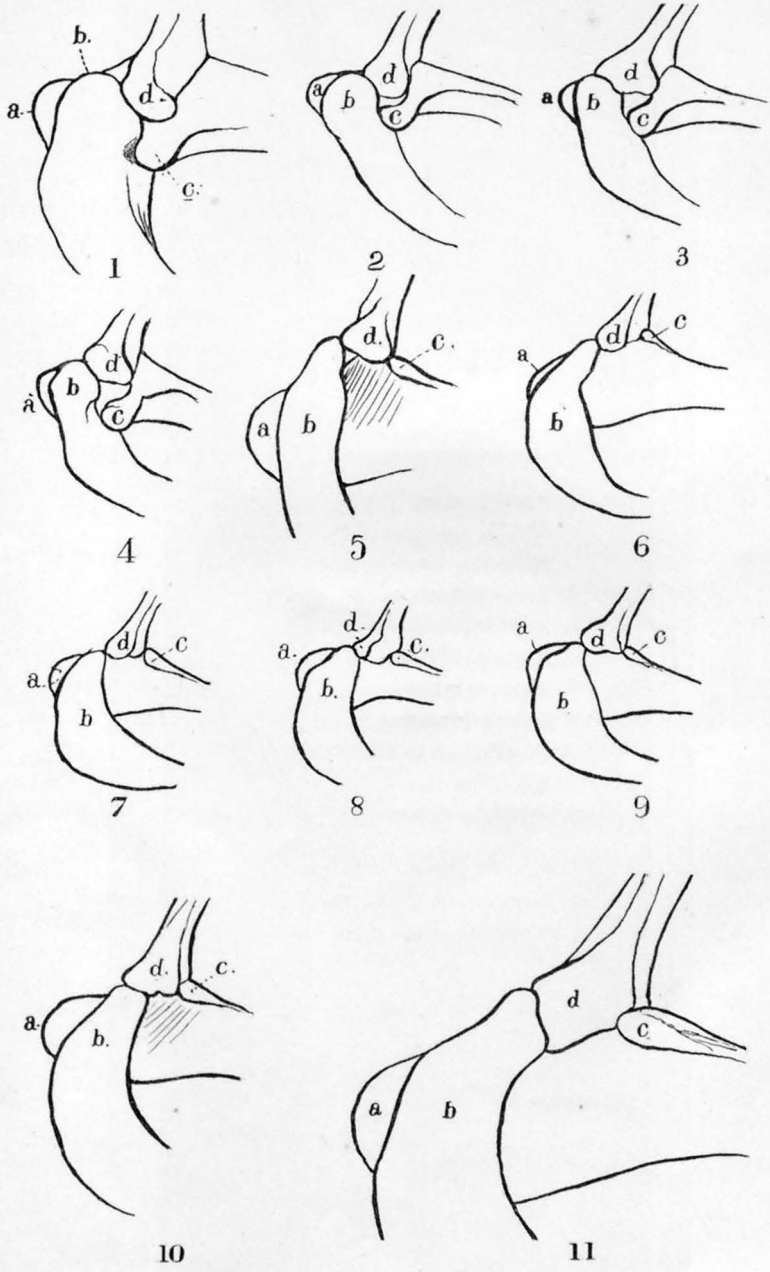

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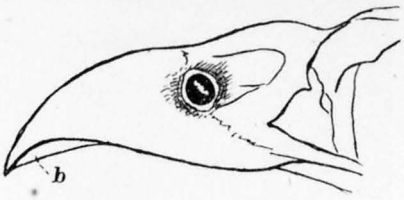
PLATE XII.

SUPRAMAXILLARY AND NASAL BONES.

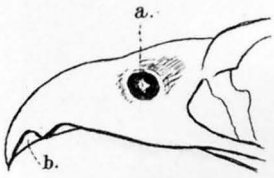
(*Natural size.*)

FIG. 1. Phalcobænus australis.
2. Falco anatum.
3. Herpetotheres cachinnans.
4. Micrastur semitorquatus.
5. Pandion carolinensis.
6. Ictinia mississippiensis.
7. Antenor harrisi.
8. Harpagus bidentatus.

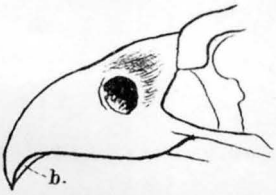
[*a*. Bony tubercle of the nostril.
b. Median ridge of the supramaxillary.]



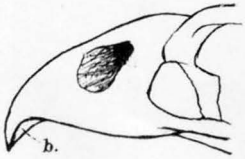
1



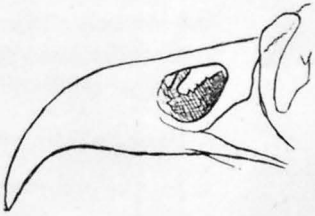
2



3

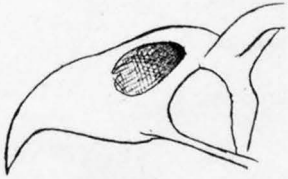


4



5

6



7

8

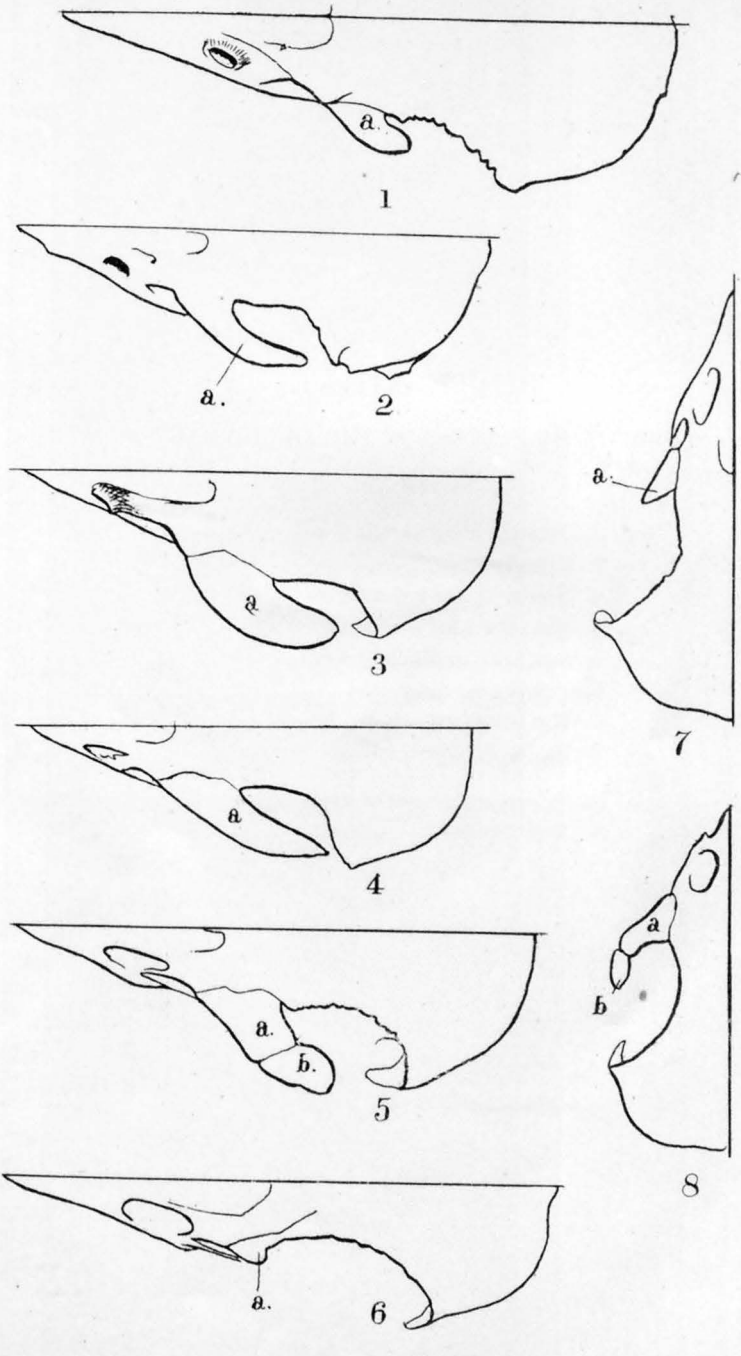
PLATE XIII.

SUPERCILIARY PROCESS OF THE LACHRYMAL.

(*Natural size.*)

FIG. 1. Phalcobænus australis.
2. Falco anatum.
3. Herpetotheres cachinnans.
4. Micrastur semitorquatus.
5. Antenor harrisi.
6. Pandion carolinensis.
7. Elanoides forficatus.
8. Harpagus bidentatus.

[*a*. Superciliary process of the lachrymal.
b. Accessory piece.]


a.
1
a.
2
a
3
a
4
a.
b.
5
a.
6
a.
7
a
b
8

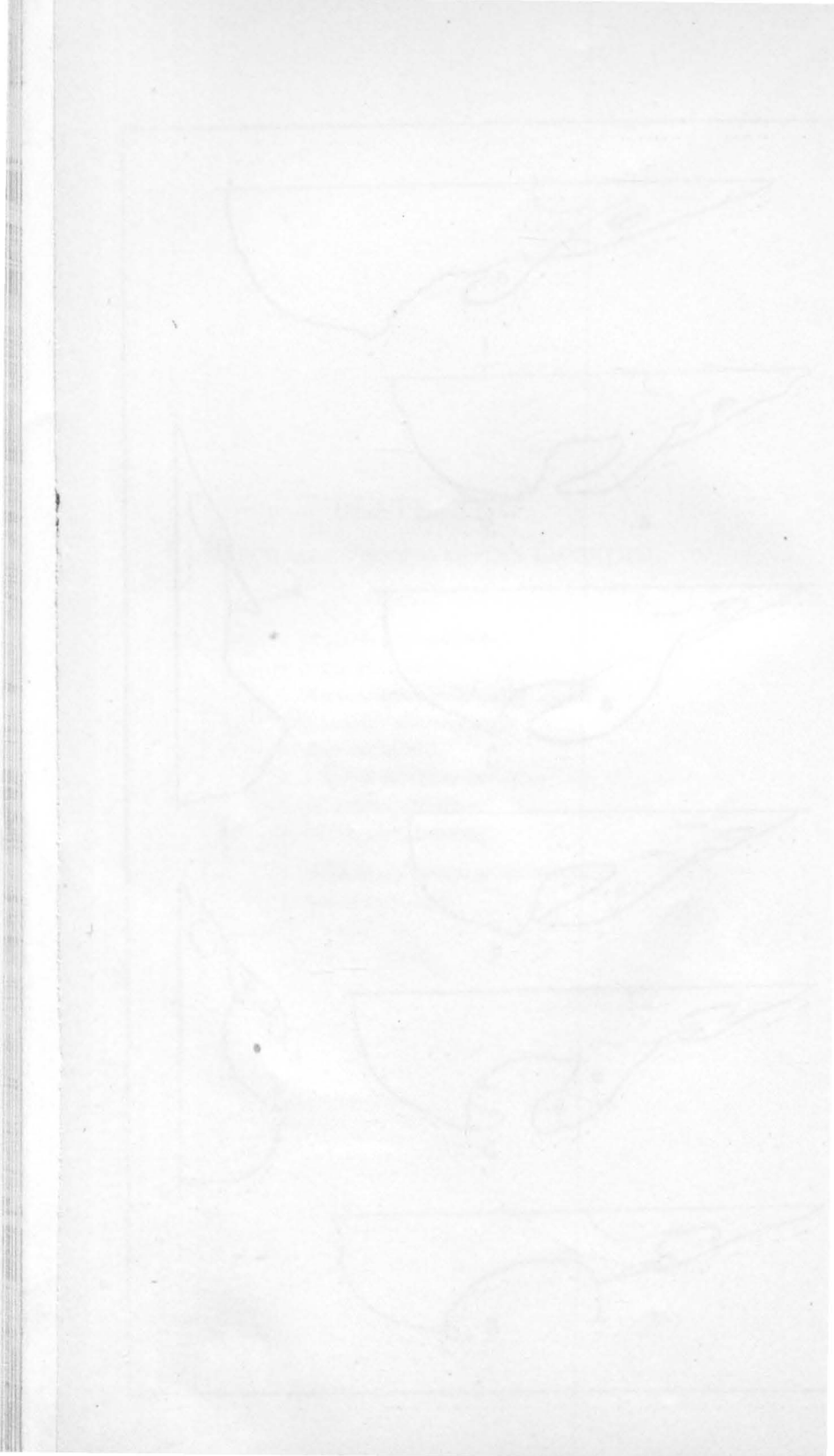


PLATE XIV.

(*Natural size.*)

FIG. 1. Herpetotheres cachinnans.
2. Micrastur semitorquatus.

1

2

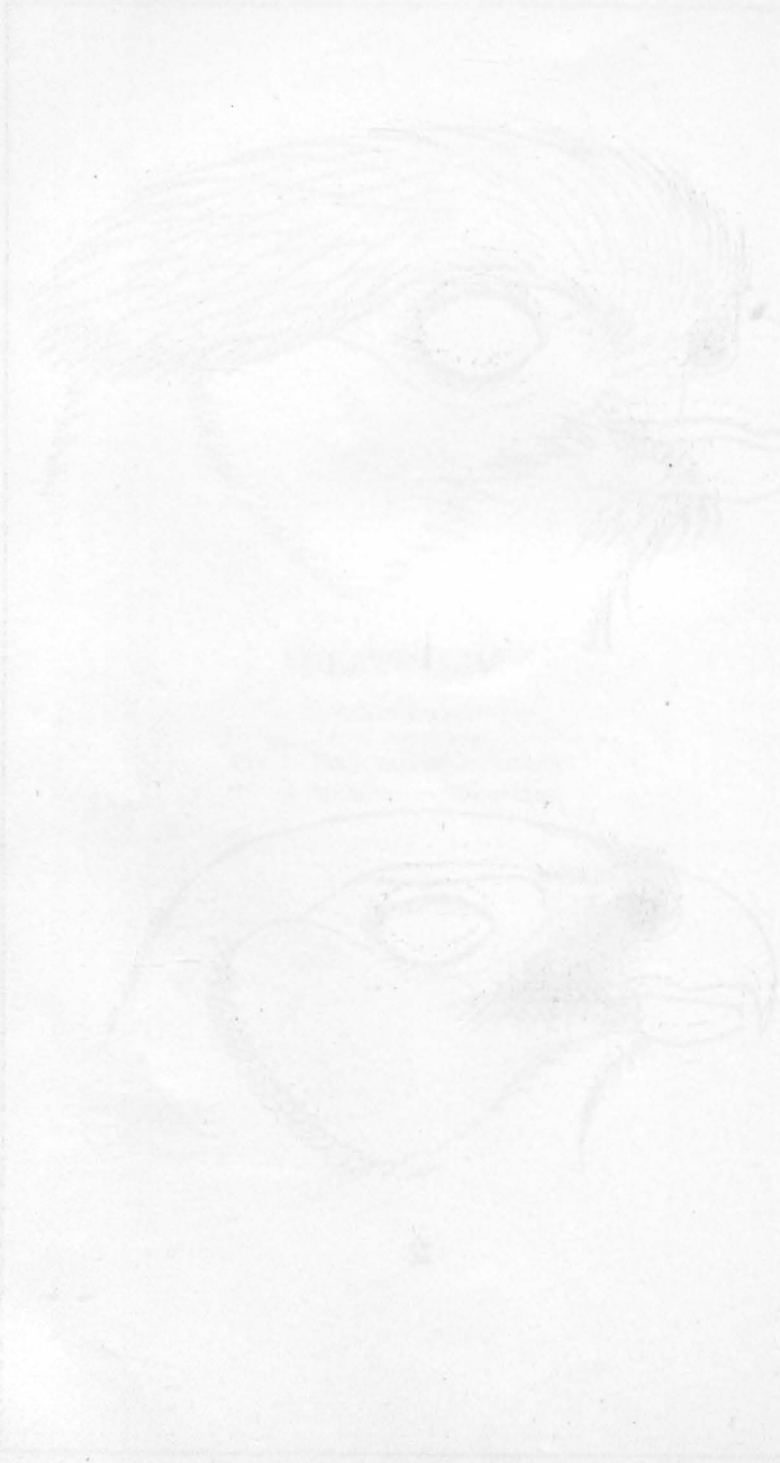


PLATE XV.

(*Natural size.*)

FIG. 1. Hieracidea berigora.
2. Milvago chimango.

1

2

PLATE XVI.

(*Natural size.*)

FIG. 1. Hieracidea berigora.
2. Milvago chimango.

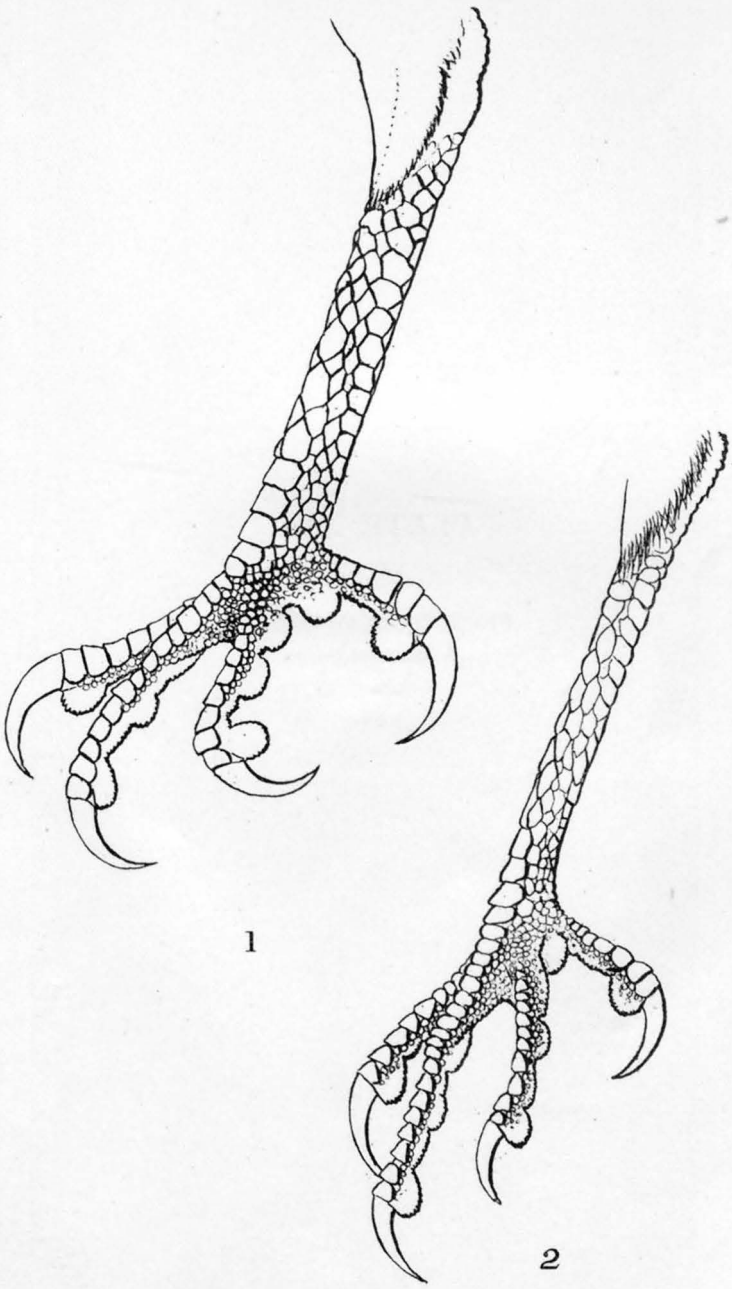
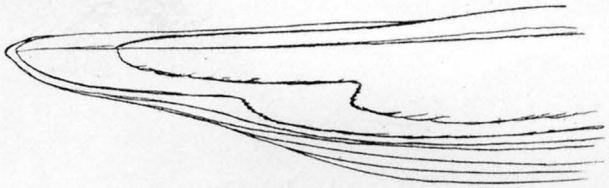

1
2

PLATE XVII.

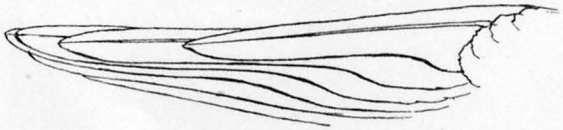
(*One-half natural size.*)

FIG. 1. Falco aurantius.
2. Hieracidea berigora.
3. Milvago chimango.
4. Phalcobænus megalopterus.

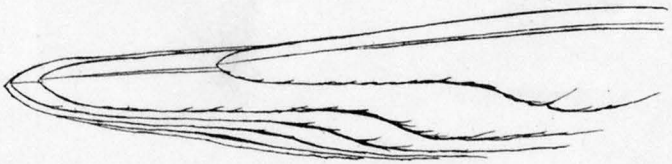
1



2



3



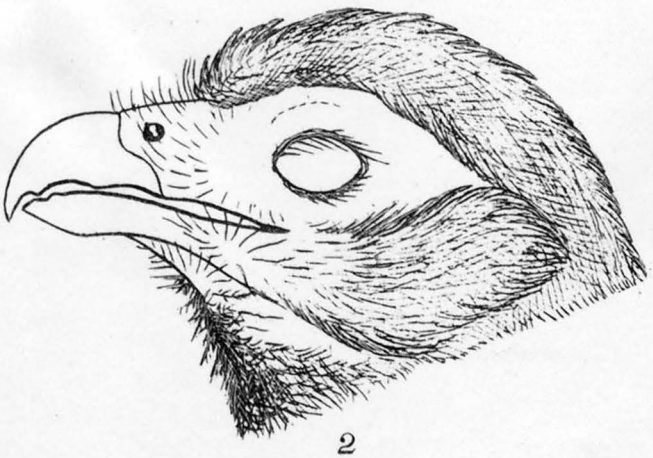
4

PLATE XVIII.

(*Natural size.*)

FIG. 1. Ibycter americanus.
2. Ibycter (Daptrius) ater.

1



2