quently met with at a distance from the coast. The very large size of some of the specimens would perhaps indicate some different use from any proposed by Mr. Henderson, and in fact some of them run so decidedly into the group of implements classed as "pestles" that it is almost impossible to draw the line between the two groups, which are well marked by their extremes. The peculiar shape of these instruments has also caused them to be regarded as weights, used to stretch the thread in spinning. This supposition is rendered very probable by the fact that stone weights have been used in spinning, and from the statement (made to me in conversation by Dr. Palmer of Washington, I think) that similar stones are still in use among the Indians of the Northwest. As it is generally accepted that the Mound Builders were informed in regard to the spinning of fibre of some kind, and certainly of the *twisting* of materials which they could manufacture by some process akin to weaving, the use of these implements as weights seems very probable, and as household implements they would often be more or less elaborately finished or carved. For my own part I have for some time considered them as representing, to a greater or less extent, according to size, material, shape and finish, 1st, Pestles, 2d, Sinkers, 3d, Spinning weights, 4th, Ornaments. That their principal use was as "plummets" may be perhaps questioned, as there are far too many of them found, and of too great a variation in size, to lead us to infer that they were used mainly for that purpose. Though if it was necessary, in ancient architecture, to establish a perpendicular line, the implements were at hand as "weights" with lines attached. — F. W. PUTNAM.]

CONTRIBUTIONS TO THE NATURAL HISTORY OF THE VALLEY OF QUITO.—No. III.

BY PROF. JAMES ORTON.

ARTICULATES.

Of crustaceans, the only representative, we believe, is a small cray-fish abounding in the filthy, stagnant waters about Quito: its name is undetermined.

In regard to the character of the insect fauna of the Valley, we quote from a letter addressed by Andrew Murray, Esq., to Dr. Packard. "It is thoroughly Columbian. It would be natural to expect that northern types should run down the Andean chains, at high elevations like Quito; but I have not found the effect to be so much the presence of such types more there than in the rest of the Columbian district (in which they are very largely introduced as I think), as the absence of tropical looking species, which occur lower down in Venezuela, Cayenne, etc. Not that there are not large and gorgeous species, but that the mass seems minute in size and of little brilliancy, but still such genera and forms as are also met with in Columbia itself."

The Valley is not rich in insects, and in this respect is in strong contrast with the Pacific and Napo slopes, where there is no lack of vegetation, heat and moisture. Collectors have generally confined themselves to these prolific regions, so that the Valley has not received the attention it deserves. Still more, they have generally failed to note the vertical and horizontal ranges of the species — important data in illustrating distribution and affinities. A systematic exploration of the equatorial Andes, such as has been given to Amazonia and Central America by Bates, Salvin and Godman, will throw much light on the migration and relation of species and the effect of physical barriers. Messrs. Hewitson, Walker, Butler and Murray have done most towards developing the entomology of the Quitonian highlands. The researches of Bates show that the north-western part of South America constitutes quite a distinct province, having a considerable proportion of species peculiar to itself and a general specific dissimilarity from the adjoining region of Guiano-Amazonia.

The insects of the Valley are not only few in number, but are dull; there is nothing, *e. g.*, to compare with the magnificent beetle *Chrysophora chrysochlora* of Napo, which is on the same line of latitude, but eight thousand feet lower. It would be interesting to know whether the generalization of Bates and Wallace, that coleoptera are brighter near the tropics than at the equator, is truer of the high altitudes than of the lowlands.

It would be premature to draw any geological inferences from our present data, but the change of species seems to show, as Bates observes, that the Columbian highlands (including the Andes of New Granada and Ecuador) were formerly separated from those of Guiana and Mexico.

The following list must be very incomplete.

Hymenoptera.

Bombus funebris Smith.
" robustus Smith.
Apis (sp.?)
Euglossa bombiformis Pack.
Anthophora pilifrons Pack.
Halictus rimosiceps Pack.
Scolia bisignata Pack.
Pompilus vinicolor Pack.
Montezumia Andeus Pack.
Ponera carbonaria Smith.
Augochlora fuscipes Pack.
Xylocopa (sp.?)
Vespa Peruana Sauss.
Hypoclinea ursus Mayr.

Lepidoptera.

Pyrameis carya Hübn.
Anartia amalthea Linn.
Thecla atymna Hew.
Dædalma inconspicua Butler.
Colias Semperi Reak.
Callicore eluina Hew.
Amphirene Epaphus Latr.
Euptychia nossis Hew.
" harmonia Butler.
" tiessa Butler.
" Enyo Butler.
" jesia Butler.
" libya Linn.
Catagramma ceryx Hew.

Eueides eurysacus Hew.
Heterochroa collina Hew.
" ethelda Hew.
Satyrus Orchus Latr.
Hesperia carmenta Hew.
Heliconia hygiana Hew.
Leptalis avonia Hew.
Steroma Andensis Feld.?
" pronophila Feld.?
Devara (?) frigida Walk.
Epilais melda Boisd.
Bombyx mori Linn. (var.?)
Hyperchiria nyctimina Walk.
Eupyra regalis Boisd.
Tephrosia litharia Guen.
Urapteryx politia Cram.
Chœrodes tetragonata Guen.
Clysia succedens Walk.
Heterolocha ruminaria Guen.
Gypsara exularia Walk.
Scordylia unanimaria Walk.
Sybarites leptaliaria Guen.
Mocis notescens Walk.
Amphigonia insana Guen.

Diptera.

Pangonia ocellus Walk.
" testaceiventris Macq.
Tachina transiens Walk.
Tabanus auribarbis Macq.
" Peruvianus Macq.
Pulex irritans Linn.
" penetrans Linn.

Coleoptera.

Oxygonia Vuillefroyi Chaud.
Deltochilum Burmeisteri Har.
Uroxys elongatus Har.
Anomala marginicollis Deyr.
Phanacus (velutinus Murr. ?)
Chalepus Zoilus Burm.
Golofa (sp.?)
Colinus subviolacra G. and P.
Chalcolepidius limbatus Esch.
Lampyris (sp.?)
Astylus lateralis Buq.
Callichroma velutina Fabr.
Steirastoma brevis Linn.
Elytrosphæra fulminigera Deyr.
Hippodamia (sp.?)
Podischnus Agenor Burm.?
Diabrotica Saundersi Baly.
Tæniotes marmoratus Thom.

Hemiptera.

Pediculus capitis De G.
Coccus cacti Linn.
Rhiginia immarginata Stal.
Tettigonia immaculata Walk.
" longipes Walk.
" stipata Walk.
" plumbea Walk.
" decorata Walk.
Triquetra sobria Walk.
Hoplophora proxima Walk.
Zammara (sp.?)

Orthoptera.

Disceratus nubiger Scudd.
Panacanthus varius Walk.
Phasma (sp.?)

Doubtless many species credited to "Columbia," "New Granada," "Ecuador" and the "Andes of Quito" occur in the Valley; but I have rigidly excluded all such in default of precise localities.* Want of certainty in a given case is indicated by an interrogation point. I have not attempted to eliminate introduced species. The jigger is confined to the lower, sandy localities, as at Ambato. In my ascent of Pichincha, I observed large flies near the summit (fifteen thousand five hundred feet) but am unable to give the name. The spiders, of which a hairy species (*Mygale*) occurs at Quito, are also undetermined.

PLANTS.

While the east and west slopes of the Ecuadorian Andes are covered with a rich, subtropical vegetation, the Valley between the

*Kirby gives a list of 227 Diurnal Lepidoptera from "Ecuador."

Cordilleras, including their synclinal sides, is singularly barren. The birch-grove of Baños and the cinchona wood of Loja furnish the nearest approach to a forest. Herbaceous vegetation predominates over the arboreal. The "plain," or bottom of the Valley, is generally covered with vast quantities of volcanic ashes, mud and trachyte, with little to relieve the dreary landscape but hedges of agave, cactus and heliotrope. The neighborhood of Quito is the most verdant part of the whole basin. The paramos are treeless, rolling steppes on the shoulders of the mountains, having an average elevation of twelve thousand feet, and overgrown with *paja*, a species of Stipa. High up, reaching even to the snow-limit, is the peculiar shrub *chuquiragua*, while the gulleys are sprinkled with rigid tufts of Valeriana, Viola and Geranium. The last zone of vegetation consists chiefly of yellow-flowering *Compositæ*, the ruling order throughout the Valley. Last of all the trees is the Polylepis, reaching the altitude of nearly fourteen thousand feet. The most common tree in the Valley is the "Aliso" (*Betula acuminata*); and the most abundant moss is the *Tayloria erythrodonta*. Flowers are found in Quito all the year round, but the most favorable months are December and May. Yellow and blue are the predominating colors. The higher the altitude the brighter the hues of any given species. Thus, the *Gentiana sedifolia* is a small, light blue flower in the lowlands, but on the Assuay it has bright blue petals three times as large and sensitive.

The following facts noticed by Kerner in a special study of the Tyrolese Alps are observable on the Quitonian Andes: (1) The very small number of annual plants, bearing to perennials the proportion of four to ninety-six, while in the Mediterranean district it is forty-two to fifty-eight. (2) The large proportion of Alpine plants with rosettes of fleshy or succulent leaves, as Gentians, Saxifrages,* etc. (3) The poverty of the Alpine flora in plants having stores of underground nourishment in the form of bulbs. (4) The almost entire absence of climbing and creeping plants. (5)The large proportion of flowers of intense hues. (6) The deficiency of spiny and stinging species.

To this I may add what is characteristic of insulated tablelands as well as oceanic islands, the remarkable absence of large groups of plants; in other words, the great ordinal and generic diversity in proportion to the total number of species. As Hum-

*The *S. Boussingaultii* occurs on Chimborazo at the height of sixteen thousand feet.

boldt says: "The character of the flora of the elevated plateaux of Mexico, New Granada and Quito, of European Russia and of Northern Asia, consists, in my opinion, not so much in the relatively larger number of species presented by one or two natural families, as in the more complicated relations of the coexistence of many families and in the relative numerical value of their species."

The flora of islands and highlands are strikingly akin in their present features and also in their origin. Both resulted from migration, for since the great mountain chains are recent upheavals, evidently our Alpine plants must be only altered forms of lowland species.

The flora of Quito has some bearing on the question of a glacial winter within the tropics. The identity of many plants on mountain summits, separated from each other by hundreds of miles of lowlands where the Alpine species could not possibly exist, is well known. The peaks of the Alps and Pyrenees show a number of plants like those in Lapland, but nowhere found in the intervening plains. The flora of the top of Mount Washington is identical with that of Labrador. Mr. Wallace tells us that the isolated volcano of Pangerango, in Java (which has the same latitude and altitude as Quito), presents a vegetation closely allied to that of Europe, and Forbes has shown that the mollusca of Britain migrated during the ice period into the Mediterranean.

Mr. Darwin has explained these remarkable facts on the theory that as the cold of the glacial epoch came slowly on, and each more southern zone became fitted for arctic beings, and ill fitted for their former more temperate inhabitants, the latter would be supplanted by arctic productions and migrate into the tropics. In the New World it would follow that by the time the cold had reached its maximum, the now temperate regions of the United States would be covered by an arctic flora, while the plants indigenous to the latitude of New York would be driven into Mexico and the Isthmus;—as when our winter creeps down from the north, our summer birds travel southward. As the warmth returned, the arctic forms would retreat northward, while the temperate plants, unable to bear the returning heat of the tropical lowlands, would scatter,—many species returning to their old northern quarters, some of which could not survive the journey, perishing utterly, and others, naturally seizing upon the tropical

mountains, ascending higher and higher as the cold receded, till they found an asylum at the altitude where the climate corresponded with that of the latitude of their native home. As the tide leaves its drift in horizontal lines, so would the living waters leave their living drift in isothermal lines on the mountains of the equator.

If, then, a vast glacier covered North America from the Pacific to the Atlantic, and from the Pole to the Ohio River, or still more southerly, the depression of temperature would be sufficient to allow some temperate plants to sojourn in the Isthmus, and even to reach the equator. We should, therefore, look with some confidence for some remnants of our flora on the highlands of New Granada and Ecuador, or at least for some allied and representative forms. There would, of course, be some stragglers from the south: but, as Hooker has remarked, many more plants have migrated from the north to the south, than in a reversed direction. We have excellent evidence, says Darwin, that the glacial epoch was an enormous age, so that there was time enough for such a migration. Doubtless, there was time also for modification, and some of these wanderers might exist in their new habitat, as new varieties, or even distinct species. Still they would be plainly related to their brethren of the Temperate Zone.

The climate of North America 36° 30′ and northward corresponds to the climate of the equatorial Andes at the altitude of eight thousand feet and upwards. The intervening land of Central America is too low and tropical to allow the passage of temperate plants by ordinary migration. But if this region was turned into a temperate zone in the glacial epoch, the chasm is bridged. Comparing the exogenous flora of the Valley of Quito with that of our Northern States east of the Rocky Mountains and eliminating those species which occur in both localities, but are indigenous to neither, such as chickweed (*Stellaria media*), strawberry (*Fragaria vesca*), goose grass (*Galium aparine*), mudwort (*Limosella tenuifolia*), black night-shade (*Solanum nigrum*), pansy (*Viola tricolor*), and peppermint (*Mentha piperita*), we find the following which are native to the United States, and also occur at Quito:— (1) The bellwort (*Specularia perfoliata*). This is a temperate plant, and would not be likely to endure the transit of the tropics as they now are. We may suppose it was intentionally introduced by the Quitonians, but this is not probable, as it is not

a showy or useful flower; or that it was accidentally conveyed to the valley, which is possible. He who doubts it must believe in a special creation or the glacial theory. (2) The evening primrose (*Œnothera biennis*); but as this is found only in the cultivated parts of the valley, it was doubtless introduced through Europe or down the western coast, as it occurs also in California. (3) The gymnosperm (*Ephedra Americana*) is found by the shores of Great Salt Lake, yet appears to be a native of Quito, though Dr. Torrey doubts their identity. (4) The *Erigeron gnaphalioides* of Gray grows in Texas and about Quito. I know no other species apparently indigenous to Quito and the United States.*

If we take a more general survey, we shall find that the largest order in Quito, as in the United States, is the Compositæ. But here the correspondence ends.

The following list of orders shows their relative importance in the two countries:—

United States.	*Quito Valley.*
1. Compositæ.	1. Compositæ.
2. Leguminosæ.	2. Scrophulariaceæ.
3. Rosaceæ.	3. Labiatæ.
4. Scrophulariaceæ.	4. Leguminosæ.
5. Ranunculaceæ.	5. Cruciferæ.
6. Labiatæ.	6. Rosaceæ.
7. Cruciferæ.	7. Ranunculaceæ.

The Compositæ have one hundred and fifteen genera in the United States, and fifty-six at Quito, nineteen of which are common to both, but no species alike. The Leguminosæ have fifty-four genera in the United States and just half that number in Quito, sixteen being common. The Scrophulariaceæ have thirty-five genera in the United States and fourteen in Quito, half of which are common; Cruciferæ, thirty genera in the United States and eight in Quito, six being common. Solanaceæ, thirteen genera both in the United States and in Quito, four of which are common. There are twenty-three species of Eupatorium in the United States and twenty-four at Quito—all different. Our country is remarkable for its Solidagoes, outnumbering those of any other region; in the whole valley of Quito there is not one.

* It is fair to state that according to Hooker, sixty Arctic American species of phænogamic plants are found on the tropical mountains (probably of Mexico); but it is fair to ask why none of our hardy, diffusible plants—our daisies, thistles and golden rod were pushed across the Isthmus and left on the mountains of the equator. *Trisetum subspicatum* is common to both regions, but occurs also in Tasmania.

The botany of our Pacific states (California and Oregon), so far as it is known, reveals no nearer affinity to that of Quito — although the near relatives of Californian plants, when they have any in other lands, are in the Mexican plateau. Quito has plenty of Bignoniads, Acanthads and Lobelias; on our Pacific slope there are none. In Quito the Compositæ are mainly Heleniæ; on our Pacific coast there are few, if any, Heleniæ, but the order tends chiefly to Senecionidæ.

The recent researches of Griesbach prove the absence of temperate American species or types of plants on the loftier mountains of the West Indian Islands. These rise in Jamaica to eight thousand feet, and yet with the exception of a few naturalized plants, as *Fragaria vesca*, *Ranunculus repens*, etc., we find scarcely any North American temperate genera or species. Of nearly eleven hundred West Indian genera, only thirty are decidedly northern. This almost total absence of typical North American plants in the highlands of the West Indies, is a feature incompatible with their having shared in the effects of a glacial migration.*

[Parts I and II of these "Contributions" are given in Volume V of the NATURALIST, commencing on pages 619 and 693. — EDS.

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* *Appendix.* The Weasel, *M. aureoventris* Gray, mentioned on p. 622. Vol. v. is probably from the Valley. The following *Birds* should be added to the list given in the NATURALIST, Oct. 1871, Vol. v, p. 623; —

Pheuticus aureoventer Scl.
Tyranniscus nigricapillus Lafr.
Orthoëca citrinifrons Scl.?
Micocerculus gratiosus Scl.?
Leptasthenura andicola Scl.
Stenopsis ruficervix Scl.
Nyctibius Jamaicensis Gm.?
Entoxeres heterura Gould.
Chlorostilbon melanorhynchus G.
Panoplites Mathewsi Lodd.
Heliangelus micraster Gould.
Cynanthus cyanurus Steph.
" mocoa D. et B.
Phaëthornis yaruqui Bourc.
Heliotrypha Parzudakii L. et P.
Petasophora iolata G. et M.
" cyanotis Bourc.
Bourcieria torquata Boiss.
Urochroa Bougieri Bourc.
Sycalis arvensis *should read* Sycalis luteiventris Mey.