

specimen, when fresh, agreed very well with the description given by Mr. Shull, but it has a third row of brown speckles on the tegmina between the radial and cubital veins. Mr. Scudder's figure in the *Entomological News* is undoubtedly overcolored, being more reddish than pink and the speckles are also probably more prominently shown than really exists in the living insects.

Dr. Wm. M. Wheeler in a recent number of the *Journal of the New York Entomological Society* says, that of the twenty records of these insects the only male known is that taken by Mr. Scudder. Mr. Shull's specimen and the one under present consideration, both being males, are therefore of unusual interest.

The theory that the pink coloring is due to the influence of cold on the developing nymph seems to be completely upset when we consider that August 1 is an early date for a full-grown specimen and that the species is found until frost.

These pink "sports" are not confined to the Orthoptera but occur in the Hemiptera also. I took a pink specimen of *Amphiscepa bivittata* Say, a normally green insect, at Lakehurst, August 23, a rarity with this species; but the tettigoniid, *Gypona octolineata* Say is almost as often pink as green in my experience.

JOHN A. GROSSBECK

#### SPECIAL ARTICLES

##### PLEISTOCENE TERRACING IN THE NORTH CAROLINA COASTAL PLAIN<sup>1</sup>

TERRACES of Pleistocene age occurring in the coastal plain of Maryland have been described by Professor G. B. Shattuck in several papers, including the recent report on the "Pliocene and Pleistocene Deposits of Maryland." In the fall of 1906 the writer, while engaged in the study of the underground waters of the coastal plain of North Carolina for the United States Geological Survey, noticed similar terracing in that area, and a series of terraces extending across the state from north to south, separated from each other by well-defined seaward facing scarps

<sup>1</sup> Published by permission of the director of the U. S. Geological Survey.

which extend approximately in a north-south line, rising one above the other from sea level to elevations of over 400 feet along the eastern edge of the Piedmont Plateau, were traced out.

Reentrants, sometimes of great breadth, extend from the lower up into the higher and older terraces. In North Carolina the conditions existing during Pleistocene time were such that the terraces were formed over broad areas and each succeeding terrace was well developed and still preserves much of the level character which it had when first uplifted. The lowest lying and most recent terrace retains almost perfectly its original level surface, being but little dissected by stream erosion. Each succeeding higher and older terrace is more and more dissected until in the oldest and highest mere remnants of the former level surface remain and the separating scarps can only be traced with difficulty.

In general, the materials composing the terraces are thicker, more highly colored, more heterogeneous in composition, more highly cross-bedded, and contain a large per cent. of pebbles and boulders of the crystalline rocks near the Piedmont border than farther eastward. Seaward the material becomes finer, the deposits thinner and the coloring less brilliant, until in the lowest terrace the sandy loams are gray or mottled with a small amount of yellow, and grade down into interstratified bluish quartz sands and bluish to drab clays.

A noticeable feature in nearly all sections of the terrace materials is the gradation from a mottled sandy loam at the surface (the mottling at places showing evidences of being due to the disturbance of stratified material of slightly different colors) to stratified sands and clays or sands and gravels of different colors at the base.

The lowest lying and youngest of the terraces in the North Carolina coastal plain attains at its maximum development a width of over 60 miles in the northeastern part of the state. It includes the area enclosed by the present "banks" from Beaufort to the Virginia line and east of the meridian 76° 35'. In the southeastern part of the coastal plain this terrace is present only as a narrow strip

fringing the shore and the larger rivers. Re-entrants of this terrace penetrate the next higher terrace along the Chowan, Roanoke, Pamlico and Neuse rivers. The elevation of the surface of the terrace varies from sea level to from 20 to 25 feet at the foot of the scarp separating it from the next higher terrace. The uplift which formed this lowest terrace was so recent that the terrace is but poorly drained. Its surface is very level, and much of it is swampy. Within the area where this terrace attains its maximum development are the Hyde County and Great Dismal Swamps and Albemarle and Pamlico sounds. Both of the swamps include large lakes, resting in slight depressions in the terrace surface. Fossils have been found in the materials composing this terrace at several places.

Beginning at the Virginia line in Gates County, and extending southward to the coast in western Carteret County, then swerving southwest along the coast to the South Carolina line is a sandy ridge separating the two lower terraces. This ridge is well shown on the topographic maps of the Beckford and Edenton quadrangles of the United States Geological Survey. It is also well developed in western Pamlico and eastern Pender counties. The eastern side of this ridge is a well-defined scarp. The summit is sandy, with long, low, rolling sand hills extending north and south, their major axis parallel to the edge of the scarp. The elevations along this ridge vary from 40 to 60 feet. The land slopes off gradually on the western side of the ridge to a broad level plain, at an elevation of from 30 to 50 feet above sea level, the second terrace. This terrace extends as a narrow band across the coastal plain. About 10 miles in width near the Virginia line it gradually widens to the southward and in Pender County has a width of from 25 to 30 miles. The surface of this terrace while better drained than the lowest lying terrace still contains many large swamps, such as Angola Bay. Fossiliferous beds occur within the materials composing this terrace.

The next higher terrace lies at an elevation

of 60 to 80 feet, with a width of from 20 to 25 miles. It is well developed in the vicinity of Williamston and Greenville and covers most of the Parmele and Falkland quadrangles. The scarp separating it from the 30- to 50-foot terrace is low and at many places the two terraces grade into each other in a manner similar to that in which the lowest lying terrace in some places passes gradually into the terrace at present being formed beneath the sounds. The eastern edge of this terrace is very irregular, although having an approximately north-south trend. Broad re-entrants of the next lower-lying terrace extend far within its borders along the large rivers.

The fourth terrace has an elevation of 110 to 140 feet and is best developed in the Wilson, Tarboro and Rocky Mount quadrangles. It has a width of approximately 25 miles. The scarp separating this terrace from the 60- to 80-foot terrace extends approximately north and south and is steep and well defined. In the central and northern parts of the coastal plain the materials forming this terrace rest in many places directly upon the uneven surface of the rocks of the Piedmont Plateau. In this region, therefore, the higher terraces are but poorly preserved. The westward extension of the 110- to 140-foot terrace is limited by a long narrow ridge extending in a north-south direction through Nash, Wilson and Johnston counties. The elevation of the surface of this ridge varies from 220 to 260 feet. In appearance the ridge resembles that described as separating the two lower terraces.

On the western side of this ridge the land slopes gradually to the next higher terrace at an elevation of 180 to 200 feet. Because of the uneven surface of the Piedmont rocks this terrace is but poorly preserved north of Johnston County. Broad level stretches occur, however, in northern Sampson and eastern Cumberland counties.

Remnants of terraces at 220 to 260 feet and at 280 to 320 feet can be seen on the topographic maps of the Springhope and Kenly quadrangles. It seems probable, however, that accurate topographic mapping of the south-

western corner of the Coastal Plain in western Cumberland, Moore, Richmond and Scotland counties, where the coastal plain materials lie at greater elevations, would disclose well-developed terraces at these and greater elevations.

*Conclusions.*—In a short paper like the present it is impossible to go into details regarding the origin of these terraces. The present topography of the North Carolina coastal plain appears to be due to the successive formation, with the uplift of the coast, of the three sandy ridges described above, the latest of which is represented by the present banks or bars enclosing Pamlico, Albemarle and Currituck sounds, and the formation of the several terraces within the areas thus enclosed.

The marked difference in elevation of the coast in the northern and southern parts of the coastal plain of this state is due to the fact that the lowest lying terrace borders the coast from Bogue Inlet north while to the south the next higher terrace fronts on the shore.

Terraces at these same elevations appear on topographic maps in Virginia and Maryland.

B. L. JOHNSON

U. S. GEOLOGICAL SURVEY

PLANT ZONES IN THE ROCKY MOUNTAINS OF  
COLORADO

IN order to see the true relations of the flora of a mountain region some sort of classification into zones is necessary. Humboldt and later other students have pointed out the zonation on mountain sides and the zones have been delimited with greater or less accuracy. In order to call attention of my students to the zonation in our own Rocky Mountains I have prepared a classification which is proving useful for teaching purposes. It emphasizes to the student the various climatic and edaphic influences which accompany changes in altitude.

Schimper's three regions of mountains,<sup>1</sup> the *basal*, the *montane* and the *alpine*, are not

<sup>1</sup> Schimper, "Plant Geography" (English translation), p. 702, 1903.

exactly represented in the Rocky Mountains. Thus the *basal* region of Schimper is "like that of moist stations in the lowlands." In the Rocky Mountains there is no such basal region. In fact there are no true lowlands near the mountains to be used for comparison and the foothill plants are not like those of gulch and stream-side in the plains region. Schimper's *montane* region has a flora "resembling that of the lowlands in higher latitudes." In northern Colorado this zone would extend from about 8,000 to 10,000 feet in altitude. Here the general character of the vegetation reminds one of the northern parts of New England, Michigan, Wisconsin and Minnesota. Above 10,000 feet I believe it more conducive to clearness to make two zones—an alpine and a sub-alpine—the former including everything above "timber line."

The following classification of the zones of plant life is suggested as pointing out what the limits of the zones seem to be. I am by no means sure that the names used are the best which might be selected. The zones here indicated are those recognized along the eastern slope of the Rocky Mountains, especially in northern Colorado. The names and characterizations are offered in the hope that they may call forth criticism from other students of Rocky Mountain vegetation.

1. *Plains Zone.*—Altitude up to about 5,800 feet. This is a grassland formation, the grasses interspersed with and sometimes displaced by coarse composites. Trees and shrubs occur only along water courses or on rock ridges and buttes.

2. *Foothill Zone.*—Altitude 5,800 to 8,000 feet. This is generally a rather open forest of rock pine (*Pinus scopulorum*) on hillsides with a few scattered cedars (*Sabina scopulorum*), while there is a mixture of Douglas spruce (*Pseudotsuga mucronata*) on north slopes with some deciduous trees in the canyons and draws.

3. *Montane Zone.*—Altitude 8,000 to 10,000 feet. This is a closer forest than that of the preceding zone. Lodgepole pine (*Pinus mur-rayana*) is the dominant forest tree, frequently forming dense, pure forests. Rock pine