made up of a stream of particles 1/2000 the size of those of the α-rays and carrying a charge of negative electricity; (3) the γ-rays analogous to X-rays, but much more penetrating; (4) the emanation, which in a process of 'decay,' gives off α-rays as described, and eventually the β- and γ-rays mentioned above. The emanation behaves as a very heavy gas and may be condensed on a solid surface at a temperature of —150° C. The influence of radium upon plants, therefore, is of the nature of radiant energy.

The radium was employed in the form of the salt, radium bromide, of three strengths of activity, 1,500,000, 10,000 and 7,000 enclosed in sealed glass tubes, and also in the form of celluloid rods and cylinders covered with Lieber's radium coating of 10,000 and 25,000 activity. The glass shuts off practically all the α-rays, the β-rays penetrate through the glass more easily, while the γ-rays pass through glass very readily. By the use of the coated rods and tubes all three kinds of rays are available as well as the emanation.

The experiments indicate that the rays act as a stimulus, which varies in intensity with the strength and amount of radium used, the thickness of the seed-coats, distance of exposure and the intervention of moist soil between the radium and the plant. If the stimulus ranges between a minimum and an optimum germination and subsequent growth are accelerated. Within these limits the rate of alcoholic fermentation is at first increased, but continued exposure may result in over-stimulation and consequent decrease in rate.

By over-stimulation germination and growth of seeds, gemmæ of Hepaticæ, and pollen grains are retarded and may be completely inhibited. Under the influence of the rays chloroplasts change their position in the cell, as under too intense illumination, and they are eventually destroyed, as is embryonic tissue in stems and roots.

Results similar in kind to the above are obtained by the use of radio-tellurium in a sealed glass tube. The influence here is confined chiefly to the α-rays. Experiments with a rod coated with pollonium, which gives off α-rays exclusively, have thus far given negative results.

Growth is retarded and may be inhibited by growing plants in an atmosphere containing the radium emanation, such as may be drawn from a cylinder lined with Lieber's coating.

Photographs of the experiments and specimens of the various radio-active preparations were exhibited.

The second paper, entitled 'Some Interesting Plants from Colombia,' was by Dr. H. H. Rusby.

In view of the lateness of the hour Dr. Rusby stated that he desired to reserve his paper as planned for some future meeting, when he could take the time to treat it more adequately, and for the present he would show some of the more interesting specimens and briefly comment on the same.

The collections were made by Herbert H. Smith, who spent four years collecting in the United States of Colombia near the town of Santa Marta, which is about fifty miles from the coast in the Sierra Nevada Mountains. Although this territory was collected over quite extensively by Karsten, whose collections are at St. Petersburg and consequently not readily accessible, and by Wm. Purdy, and various orchid collectors, Mr. Smith's efforts disclosed many novelties.

The total collection studied contained about 3,000 numbers, embracing between 2,300 and 2,400 species, of which number about fifteen per cent. are likely to prove new to science.

The specimens exhibited were most interesting, embracing arborescent Violaceæ, handsome twining Senecios, showy Vacciniaceæ, numerous anomalous Compositæ, and many other things undreamt of by collectors in temperate climes.

EDWARD W. BERRY,
Secretary.

DISCUSSION AND CORRESPONDENCE.

EXOGLOSSUM EAST OF THE DELAWARE BASIN.

TO THE EDITOR OF SCIENCE: In the issue of June 30, last, Mr. H. W. Fowler, of Philadelphia, writes on the occurrence of *Exoglos-*

sum maxillingua (Le Sueur), in the Delaware basin. It may be of interest to know that *Exoglossum* also occurs east of the Delaware basin. I caught one in 1899, in Peckman's Brook where the Morris Canal crosses the brook near Little Falls, Passaic Co., N. J. If *Exoglossum* is not indigenous to the Passaic basin it may have reached there from the Delaware River *viâ* Musconetcong River and Lake Hopatcong. This lake is the summit feeder of the Morris Canal. The fish lived for many months in an aquarium. It has the feeding habits of the suckers and remains mostly near the bottom.

EUGENE SMITH.

HOBOKEN, N. J.

SPECIAL ARTICLES.

DISCOVERY OF THE COMANCHE FORMATION IN SOUTHEASTERN COLORADO.[1]

DURING a visit to the Two Butte in Prowers County, Colo., some time ago, I found that a small local uplift east of the butte reveals the Comanche formation filled with characteristic *Gryphœa corrugata*. The locality is on the main, or South Butte Creek, four miles west-northwest of the old town of Albany, or five miles east-northeast of the Two Butte. To the east and west the low bluffs in the valley consist of Dakota sandstone rising gently towards the Two Butte laccolith and the general anticline extending north and south in the southeastern portion of Prowers County. The Comanche beds are exposed just southwest of Mechling's Ranch in a small local anticline and they extend for some distance along the south side of the creek, in low bluffs capped by Tertiary deposits. The lowermost member appearing is a dark shale, more or less sandy, grading upward into a friable, brown sandstone, in part calcareous. The fossils occur in great abundance in the sandstone and sparingly in the dark shale. Owing to overlap of Tertiary sands and gravels, the precise relation to the Dakota sandstone is not clearly revealed, but it is apparent that the Comanche beds lie a very short distance below the main Dakota ledges appearing to the eastward, although probably separated by some dark, non-fossiliferous, sandy shales which lie at the base of the Dakota cliffs in a gorge extending eastward. Probably the Red beds lie at no great distance below, but they do not appear in the immediate vicinity. A few miles west, about Two Butte, the Red beds, with their capping of Exeter sandstone, and included limestone, are extensively exposed. Down stream a short distance, east of Two Butte, the Exeter sandstone is seen to be overlain by shales and limestone of typical Morrison formation, in turn capped by Dakota sandstone. No traces of Comanche beds were found in this vicinity. It was hoped that the relations of the Morrison and the Comanche formations could be ascertained in this general region, but, owing to the apparent failure of the former to reappear in the uplift near Mechling's Ranch, no evidence was obtained on this point.

In December, 1902, Mr. Willis T. Lee gave the Geological Society of America an account of the extension of the Morrison formation down the Cimarron Valley to Exeter, Oklahoma, and the discovery of a low anticline ten miles farther east, in which the Dakota sandstone is underlain by fossiliferous Comanche beds.

Another item of interest which I observed in the vicinity of Two Butte uplift was the occurrence of oyster shells in considerable numbers in the Dakota sandstone on Butte Creek just below the Downing Ranch, three and a half miles due east of Two Butte and constituting a ten-foot bed a half mile southeast of Pilleau's Ranch on the headwaters of the North Fork of North Butte Creek, five miles north by east of Two Butte.

N. H. DARTON.

U. S. GEOLOGICAL SURVEY.

[1] Published by permission of the director of the U. S. Geological Survey.

SOME OF THE RESULTS OF THREE YEARS' EXPERIMENTS WITH CROWN GALL.[1]

THE diseases ordinarily classed as crown gall are found on the following plants: almond, apple, apricot, ash, blackberry, chestnut, cherry, grape, hop, oak, peach, pear, plum,

[1] Summary of a lecture given at the annual meeting of the American Association of Nurserymen at West Baden Springs, Ind., June 15, 1905.