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.

prune, poplar, quince, raspberry, rose, walnut and willow. Of a number of these, little is known of their nature. Those of the apple, pear and quince are similar in nature, and are not yet proven to be contagious. Those of the almond, apricot, blackberry, cherry, peach, plum, prune and possibly chestnut and walnut, are similar in nature and origin, and are often very contagious. Those of the grape and rose appear to be slightly contagious, but can not be classed with either of the preceding groups with our present knowledge. The crown gall or root galls of the hop contain a slime mold, a *Plasmodiophora* resembling *Plasmodiophora brassicæ*. No study has been made at the laboratory of the disease on the other plants mentioned in the list, but these will be taken up at once in connection with the others.

Careful experiments with apple, quince and pear seedlings raised from sterilized seed in sterilized soil, watered with sterilized water, indicate strongly that both the apple and pear crown gall of the ordinary hard type, the one devoid of numerous side roots or 'hairy roots,' is not contagious. These seedlings of apple, pear and quince inoculated with insertions of live apple and pear galls beneath the bark and wood of the roots, and also with minced galls in the soil, remained free from disease in both the control and inoculated portions of two years' experiments. Carefully selected apple seedlings grown in the nursery were inoculated both in the greenhouse and in field plots. In the experiments for two years the average result from such inoculations was ten per cent. of diseased plants in the inoculated portion and fifteen per cent. in the control portions of the plot. All galls were counted, whether located on the plant at the place of inoculation or not. Extensive inoculation of apple root grafts in the field for two years gives an average of 27 per cent. of plants with galls both in inoculated and control portions of the plots. About 10,000 apple trees were used in the above sets of experiments.

embodying a portion of the results of an investigation at the Mississippi Valley Laboratory of the U. S. Department of Agriculture (Dr. Hermann von Schrenk in charge).

The ordinary apple crown gall is of two types, the one a more or less woody gall with no roots growing from it, the other with few to numerous roots present. The former type has been used in the experiments just described. There is in addition a diseased form called 'hairy root' in which numerous side roots branch from a stunted root. Galls may or may not occur in connection with this form, which is now considered a distinct disease, and which is at present under investigation.

The crown galls of the peach, plum, cherry, raspberry, almond and apricot have been proved by careful inoculation experiments with seedlings of each grown from sterilized seed in sterilized soil, watered with sterilized water, to be one and the same disease on each of these plants. Peach and raspberry are most susceptible to wound inoculation, but also become diseased in infected soil without artificial wounds being made. This disease has not been contagious on the apple, pear and quince.

The results from an experiment with 300 two-year-old apple trees, 175 of which were diseased and 125 healthy, all trees being selected with care to have a uniformity of size and root system, indicate that the disease has no immediate effect on the duration of the life of the tree where other diseases do not enter. At the end of one year, five of the healthy trees and seven of the diseased had died, and no difference in the growth and appearance of the two classes of trees could be noted. This experiment will be continued for a number of years. Field observations bear out the conclusion that the disease does not often kill young trees, as has been asserted.

There is present on the roots of some apple seedlings, and more rarely on grafted apple trees a gall growth of a softer nature, more like that on the stone fruits, and which may prove to be of a slightly contagious nature. A study is being made of this type and the 'hairy root' disease, which also occurs on the cherry and peach. Grafted apple trees often have as high as 50 per cent. of diseased trees, budded trees, on the other hand, usually have

only a small per cent. affected. Most of the galls on grafted trees occur at the lower end of the scion at the point of union of the root and scion. Much of the work of the previous two years is being repeated this year, field plots in eight different localities having been planted with 120,000 apple seedlings and root-grafts.

George Grant Hedgcock.

MT. TSUKUBA METEOROLOGICAL OBSERVATORY, FOUNDED BY H. I. H. PRINCE YAMASHINA.

Since the time of Pascal it appears to have been recognized that the exploration of the upper atmosphere is one of the most important for the advancement of cosmical physics. So long as this ocean remains unexplored, modern meteorology will remain at a standstill, since the thermal, electrical, and dynamic conditions of this ocean are in great measure responsible for the meteorological conditions at the earth's surface. Many balloon ascents and kite experiments have, therefore, been undertaken from time to time, and many mountain observatories have been established in Europe and elsewhere by men who determined to capture the secrets of the upper air.

In Japan, too, the importance of the exploration of the upper atmosphere has been recognized ever since the organization of the meteorological service in 1875. Many meteorological expeditions to high mountains have been undertaken by the officials of the Central Meteorological Observatory at Tokio, and by those of the provincial stations, to investigate the phenomena and processes in the high strata of the atmospheric ocean. For instance, to Mt. Fuji (3,720 meters above sea level) during every summer since 1889; to Mt. Gosaishodaké (1,200 meters) in 1888; to Mt. Ontaké (3,060 meters) in 1891; to Mt. Ishizuchi (1,980 meters) in 1894; and to several other mountains whose heights range from 3,000 meters to 740 meters. But all these expeditions have been undertaken only in the warmest season of the year, on account of the impracticability of long residence on the summits in winter time. For the establishment of a first permanent mountain observatory, we owe thanks to the illustrious Prince Yamashina. His Imperial Highness has selected for his observatory Mt. Tsukuba, a remarkable mountain, which stands lonely on a most extensive plain, isolated from all mountain ranges, and which is, moreover, on that part of the Island Empire where cyclones of a very intense character frequently pass by.

Mt. Tsukuba is situated on the eastern coast of Japan, forty miles north-northeast of Tokio. The shape of the mountain is quite conical and its summit splits into two peaks, the western and the eastern. These peaks are one half mile distant from each other, the west peak being the higher of the two. Though only 2,925 feet, or 870 meters, in height, Mount Tsukuba has a commanding view over Musashino, the most extensive plain in Japan. Still grander is the view southwestward from the top of the mountain. The city of Tokio and innumerable towns are dimly visible on the plain. Many miles beyond, the snow-capped summit of Mt. Fuji, the volcanic peak of the Asama, and the holy mountains of Nikko form a magnificent panorama. Toward the south there is nothing visible but the vast Pacific Ocean fading away into infinite space. The whole mountain is covered with pines and cryptomerias, and its summits are dotted with legendary curiosities and shrines, the largest of which latter are sacred to Izanagi and Izanami, the first god and goddess of the mythological Japan. The legend is that Izanagi and Izanami constructed this mountain as a bulwark against the waves of the Pacific, which they had forced to retire to the other side of Kashima, formerly an island in the sea. This tradition is in accordance with the fact, recently verified by Japanese geologists, that the east coast of Japan has been gradually rising during many centuries past. In the midst of this region of poetry and legend our prince-scientist has established his meteorological observatory on the top of the west peak, which, with its two base stations, has been in active operation since the first of January, 1902. The geographical coordinates of the observatory are: