the Crops Section; Professor J. D. Luckett, New York Agricultural Experiment Station, *editor;* and Dr. G. G. Pohlman, University of West Virginia, *secretary-treasurer.* Dr. R. J. Garber, Bureau of Plant Industry, and Dr. F. B. Smith, University of Florida, were elected to represent the society on the council of the American Association for the Advancement of Science in 1939. Officers of the Soil Science Society of America elected for next year are: Dr. W. A. Albrecht, University of Missouri, *president;* Dr. W. H. Pierre, Iowa State College, *secretary,* and Dr. G. G. Pohlman, University of West Virginia, *treasurer.*

THE third annual meeting of the Carolina Geological Society was held on November 12 and 13 with thirty-five members and twenty-six visitors in attendance. The meeting was held at the University of South Carolina. On November 12, there was a field trip of some 117 miles with twelve stops to examine the local geology about Columbia, S. C., both in the coastal plain and the Piedmont. The University of South Carolina gave the members a complimentary dinner. On November 13, there was an additional field trip of some 78 miles with five stops including the Haile Gold Mine near Kershaw, where refreshments were served. The field trips were arranged and directed by Professors Taber, Smith and Petty, of the University of South Carolina. The following officers were elected for the coming year: *President,* Professor L. L. Smith, University of South Carolina; *Vice-president,* Professor J. H. Watkins, The Citadel, Charleston, S. C.; *Secretary and Treasurer,* Professor Edward Willard Berry, Duke University; *Chairman of Membership Committee,* Professor Raymond Binford, Guilford College, N. C.

THE U. S. Civil Service Commission announces that the Department of Agriculture is in need of a number of principal chemists and principal chemical engineers at salaries of $5,600 a year. It is expected that the number will exceed twenty-five. Dr. Henry G. Knight, chief of the Bureau of Chemistry and Soils, suggests that all persons interested in these examinations communicate at once with the Civil Service Commission, Washington, D. C., in regard to the announcement containing the detailed information concerning the technical qualifications required. He urges all chemists having the technical qualifications to apply for this examination. Applicants will not be required to report for examination but will be rated on education, training and experience as shown on their applications. There is no obligation involved in taking the examination, although in view of the need for qualified persons it is hoped that it will be possible for an applicant to accept a position should one be tendered him. The list of eligibles from these examinations will be used for the appointment of project leaders in the four regional research laboratories being set up by the Department of Agriculture in accordance with an act of the last Congress. Work in the laboratories, each of which has an appropriation of a million dollars a year, will be based on the major farm commodities in the neighborhood of the laboratory.

THE St. Anthony Falls Hydraulic Laboratory of the University of Minnesota was dedicated on November 17. Dr. Guy Stanton Ford, the newly elected president of the university, presided. Among the speakers were Dr. S. C. Lind, dean of the Institute of Technology, and Corrington Gill, assistant administrator of the Works Progress Administration, Washington, D. C.

ADDITIONS to the present facilities of the Engineering Building at Rutgers University will increase the laboratory space available for engineering students by 6,242 square feet or about 57 per cent. The work will be started shortly and will be financed jointly by the university and the Works Progress Administration, which recently approved a grant of $34,576 for the project. The additions and alterations consist of two parts, one of which will provide for the construction of a new wing in the rear of the present building, and the other for reenforcing the floor over the swimming pool in the present Ballantine Building. This pool is the only unit remaining from the old Ballantine Gymnasium, which was destroyed by fire in 1930. The pool has been used by the department of engineering as a hydraulics laboratory since the present Ballantine Building was completed in 1932.

DISCUSSION

BEAVER-DAMS AS GEOLOGIC AGENTS

IN the mapping of the Schuylerville, Cohoes and Troy quadrangles of the Capital District and more recently of the Catskill quadrangle, the senior author had occasion to observe various broad and flat alluvial plains, affording rich farm-land, that in size are completely out of proportion to the small brooks that drain them at present. A typical case is the long, perfectly leveled valley east of Troy at the foot of the Rensselaer plateau, extending nine miles north and south and one-fourth to one-half mile wide. The origin of this partly "dead valley" is undoubtedly from glacial meltwater, as indicated by traces of terraces on the banks; but now it is drained by four different creeks, the Tomhannock, flowing north, the Quackenkill, flowing south, the Poestenkill, crossing it obliquely in the middle, and

the Newfoundland creek, coming into it from the south. Another characteristic case is the Stony Creek alluvial plain, east of Madelin, near the southern margin of the Catskill quadrangle. This broad plain is 4 miles long and one-half to two miles wide and drained by creeks much too small to produce such a broad plain.

These alluvial plains are currently considered as post-glacial lake bottoms, but Mr. J. H. Cook, who has written the glacial chapters of the State Museum bulletins published by the senior author, has insisted that they were formed by brooks merely meandering over the plains and has given as proof that these plains are distinctly graded and descend with the brooks, a condition that seems irreconcilable with the lake origin. This is quite notable in the Stony Creek alluvial plain, where, according to the new topographic map now being published, the upper end is at 216 feet A. T. and the outlet at 164 feet. This would seem to exclude a former lake bottom, except when a slowly subsiding lake is assumed, which again fails to be supported by the presence of low terraces, and in the Troy valley the drainage running in opposite directions is distinctly hostile to such a view. Neither could have merely meandering brooks been able to produce the continuous Troy valley, independent from the direction of the brooks.

For these reasons the senior author came to the conviction that a third agent had to be found and this is seen in the beavers who, by building dams successively upward from the lower reaches to the very sources of the creeks and repeating this process as often as the ponds are filled by sediment and carrying on the cycles of wandering up the creeks with dam-building for untold thousands of years (25,000 years are available in post-glacial time!), must have accomplished an enormous amount of aggrading work in the course of time in the northern half of North America. And if the giant beaver *Castoroides ohioensis,* of the size of a black bear, was also given to dam-building, which is not proven, even smaller river valleys could have been graded by its influence.

It is significant that the older settlers in parts of New York, as around the Tug Hill plateau (*fide* Dr. D. H. Newland) still know these alluvial valleys as "beaver-meadows."

Geologists apparently have overlooked this important geologic agent, a fact which is illustrated by the omission of the beavers as physiographic factors in Nevin M. Fenneman's authoritative "Physiography of Eastern United States," just published (McGraw-Hill Book Company, 1938).

The ceaseless activity of the beavers became very impressive to the senior author when he saw this summer how they, when driven by a flood from their dam below Cranberry Lake in Rensselaer County, repaired that dam and at once built a second above and started still a third dam a little farther up for the protection of the second. This wonderful industry is fully appreciated by the United States Government, as recently reported by the press; for it has set between 500 and 600 beavers to work in the northwest, notably Idaho, but also in Oregon, Washington, Utah and Wyoming, to stop erosion in brooks and creeks by importing beavers from regions where they are not needed, to the fast eroding waters and building there small provisory dams by CCC workers. The beavers as loyal government officials promptly complete work valued at $300 for each at a cost of $5.00 per head, according to a report by Mr. Ickes.

The junior author, who as assistant state zoologist has for many years studied the fascinating habits of the beavers in Rensselaer County, has undertaken to gather the following data on the present aggrading activities of the beavers in eastern New York. These data not only seem to illustrate the rapid work of the beavers, but above all the great width and height of the dams beavers can build on occasion and the size of the ponds they can form.

It seems reasonable to first consider the possible number of beavers that have inhabited the country and judging from such remains as beaver meadows and evidences of dams, it seems that every lake, pond, river and brook in New York State was occupied by this industrious rodent. Radford estimates that in the days of Champlain, the beavers in what is now New York State numbered probably several million and states that according to an old Dutch writer the Province of New Netherlands furnished eighty thousand beaver skins in the year 1671.

The next consideration might be the size of the dams and the area of the ponds. Mills records a Montana beaver dam that was 2,140 feet long. This, however, is extreme, and the junior author has found dams of fifty to two hundred feet to be more common and a six hundred-foot dam to be exceptional. Shiras writes that the left bank of what is now Echo Lake on Grand Island in Lake Superior is an ancient beaver dam 1,500 feet long and probably 400 years old. The dam which makes Beaver Lake in Yellowstone Park is about 700 feet long, and two dams described by Morgan are 488 and 551 feet in length.

The height of the dam is usually five or six feet, although the long Montana dam recorded by Mills was in two short sections, fourteen feet high, and Morgan described a dam 35 feet long and 12 feet in vertical height.

The bodies of water impounded by these dams vary in size. Warren reports that a 103-foot dam formed a pond 225 by 350 feet and a 165-foot dam flooded an

area 340 by 800 feet. Three dams, 35, 50 and 60 feet long, respectively, formed ponds 350, 375 and 475 feet in length.

A dam 75 feet long is reported by Johnson to have backed up a mile of water, and Houk records 1,241 acre-feet of water impounded by beaver dams in the San Luis Valley, Colorado.

The number of dams on a stream is also an important factor in determining the size and shape of the beaver meadow and to locate six dams on a mile of stream is not uncommon. In fact, according to Houk, in Silver Creek Valley in Colorado there were 46 dams located on 5¾ miles of stream, and these averaged about 660 feet apart. In some cases the water was backed up to a depth of five and one-half feet.

So long as the beavers occupy the ponds no beaver meadows are formed, but as soon as the ponds are made the silt begins to settle in and fills them, and this forces the animals to continue to raise the dam. When the rodents abandon the pond, however, a meadow may be formed in a very short time.

In 1897 Seton mapped and described some ponds on Lost Creek in Yellowstone Park which were inhabited by a colony of beavers. These animals began to desert the area in 1903 or 1904, and in 1912 when Seton revisited the site the colony was abandoned and the meadows were pretty well formed. In 1921 the ground was solid and the dams practically obliterated. It is evident then that a meadow can be formed in about 15 years.

CONCLUSIONS

The authors, from the data presented here, conclude that beavers are able to aggrade all smaller valleys below the size of navigable rivers and having been active for many thousands of years have accomplished an enormous amount of aggrading work and are important physiographic agents. Their work is characterized by complete aggrading of valley floors, originally in small descending steps, which disappear in time and leave a gently graded, even valley plain horizontal from bank to bank. The fine silt gathered in the beaver pools has produced the rich farm land in the valleys of the wooded areas of the northern half of North America.

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THE MOVEMENT OF WATER FROM CONCENTRATED TO DILUTE SOLUTIONS THROUGH LIQUID MEMBRANES

AN experiment by W. J. V. Osterhout and J. W. Murray was described under the above title in the issue of May 13 of SCIENCE, page 430. To quote, "In certain models set up to imitate living cells the behavior of water is the opposite of what is expected, for it moves from a concentrated to a dilute solution or from a region of low to one of high activity. This apparent violation of the laws of thermodynamics may continue for months before equilibrium is attained." Briefly, this experiment consisted in using guaiacol (o-methoxy-phenol) as a membrane in the bottom of a U tube and placing water on one side and a solution of acetic acid in water on the other side. The water moves from the acetic acid to the pure water side.

In attempting to discover a possible thermodynamic explanation for the above experiment or to show that a thermodynamic explanation does not apply we have performed the following experiments. The freezing point of guaiacol was determined and the lowering in the freezing point was determined when water or acetic acid was added and finally when both were added simultaneously. It is found that water and acetic acid produce the same lowering of the freezing point when equal numbers of moles are added. This first experiment was not too conclusive, since the solubility of water is small in guaiacol. Three hundredths of a cubic centimeter of water was added to 50 cc of guaiacol. In the next experiment a large amount of acetic acid, 1 cc, was added to 50 cc of guaiacol, producing a lowering of 2.49 degrees. Addition of water to this solution in 0.1 cc quantities gave only one fourth the lowering which one would have predicted from the number of moles added. In this experiment there is no difficulty from small solubility, as water is quite soluble in this solution.

One may draw the conclusion from these experiments that the water and acetic acid are associated in the guaiacol solution. The fact that the water produces some lowering in the freezing point may indicate that the association is not complete or that acetic acid is associated by itself in guaiacol, and the addition of water increases the dissociation of double acetic acid molecules.

An explanation for at least part of the anomalous diffusion of water in the experiment of Osterhout and Murray may be as follows. Water and acetic acid are associated in water solution. This attracts no attention ordinarily, since the water is the solvent, but may be inferred from the fact that acetic acid, which exists associated as double molecules in the gas phase, exists as single molecules in water solution. The solute which is diffusing through the guaiacol is, therefore, this rather stable pair, which has been shown from the above freezing points to exist in the guaiacol solution. The diffusion of this pair is then a typical case of osmosis, except for the fact that the solvent is very