station at Fort Washington, and some of the Potomac fishing-shores. Col. McDonald, in charge of the fish-hatching station, displayed the apparatus for, and explained the process of, hatching shad and herring eggs at all the various stages. After the roe is taken from the fish and cleaned, it is put into glass tanks, through which the water is allowed to flow constantly. About forty-eight hours are required to hatch out the eggs. A shad a day old looks like a hair with two black spots attached to the end. When two days old, they measure about one-fourth of an inch in length. In twelve days the whole body is distinguishable. The spawn are not, as a rule, kept at this hatching-station more than thirty-six hours; at the end of which time, just previous to hatching, the eggs are placed in crates, and brought to the principal station at the armory building, near the national museum, where the final stages of incubation occur. The commission has this year hatched five million shad-eggs. The herring yield has been much larger, as the catch of this fish in the Potomac has been unusually abundant; nor are so many eggs of the herring destroyed during the process of hatching as of shad. The commission employs eighteen men at Fort Washington, who are constantly kept busy preparing the spawn and eggs for transportation. The day before the party visited this station, sixty thousand shad-eggs were taken. After the hatching process had been explained to the visitors, they were summoned to refreshments, which had been provided in one of the frame buildings belonging to the commission. The principal dish was 'planked' shad. By this process four fish are fastened to a board, and held towards a hot fire. Whilst cooking, the fish are constantly basted with a preparation made of butter, salt, and other ingredients. At a meeting on board the vessel, the commissioner of agriculture made some remarks on fish-culture in the west, and Col. Marshall McDonald offered an address on our fishing interests in general, and the work of the society in particular.

The following officers were elected for the present year. President, Col. Marshall McDonald, Washington. Vice-president, Dr. William M. Hudson, Hartford, Conn. Treasurer, Eugene G. Blackford, New York. Corresponding secretary, W. V. Cox, Ohio. Recording secretary, Fred. Mather, New York. Executive committee, G. Brown Goode, Washington; F. L. May, Fremont, Neb.; Roland Redmond, New York; J. A. Henshall, Cynthiana, Ky.; Frank N. Clark, Northville, Mich.; S. G. Worth, Raleigh, N.C.; George Shepard Page, Stanley, N.J.

INLAND NAVIGATION OF EUROPE.[1]

THE lower parts of the chief rivers of the United Kingdom are mostly arms of the sea, navigable at high water by ships of the largest burden. The principal waterway, the Thames, is navigable for about 194 miles, and is united by means of a grand network of canals with the Solent, the Severn, the Mersey, the Humber, and the Trent, being thus in direct communication not only with the English and Irish channels, but also with every inland town of importance south of the Tees. The estimated length of inland waterways in the United Kingdom is 5,442 miles, which has been constructed at a cost of £19,145,866.

Russia's principal highway is the Volga, the largest river in Europe, which affords, with its tributaries, 7,200 miles of navigation. Hitherto no permanent works have been undertaken to improve the navigation of the Volga, but dredging has been resorted to in the lower part of the stream; and recently a system of scraping by iron harrows has been employed, which has doubled the depth of water over certain shoals in a few days. Other important water communications in Russia are the Caspian; the River Don, 980 miles in length; and the Dnieper, with a course of 1,060 miles. Of secondary rivers, the Bug, the Dniester, the Duna, and the Neva are all navigable. In the case of the latter short but most important means of communication, a maritime canal 18 miles in length has recently been completed to unite Cronstadt with St. Petersburg. About 900 miles of canal have been constructed in European Russia. In most instances they have been built to connect the head waters of rivers which had their outlets at opposite extremities of the continent.

Sweden abounds with lakes; but none of the rivers are navigable except those which have been made so artificially, nearly all of them being obstructed by cataracts and rapids. Nevertheless, Sweden possesses remarkable facilities for internal navigation during the seven months that the country is free from ice, intercourse being carried on by means of a series of lakes, rivers, and bays connected by more than 300 miles of canals.

Germany owns parts of seven river-valleys, and three large coast-streams. Of these, the Weser is the only one which belongs wholly to Germany, while of the Danube but one-fifth part runs through her territory. The inland navigation of Germany is of the most advanced character, an immense trade being carried on by means of barges and rafts. In the case of the Elbe, the system of towing by submerged cable has taken a large development. As early as 1866 chain-tugs were running on 200 miles of its course; and in 1874 this mode of traction had been so increased that there were then twenty-eight tugs running regularly between Hamburg and Aussig. These tugs are 138 to 150 feet long, 24 feet wide, with 18 inches draught. On the upper Elbe the average tow is from four to eight large barges, and, taking the ice into consideration, there are about three hundred towing-days in the year. Although Germany possesses a length of nearly 17,000 miles of navigable rivers, or more than double the combined length of the navigable streams of the United Kingdom and France, it cannot be said to be rich in canals. In South Germany the Regnitz and Ludwig canals, from the Main at Bamberg to the Danube, were the only ones of importance until the annexation of Alsace-Lorraine.

[1] From a lecture by Sir C. A. HARTLEY before the Institution of civil engineers.

Holland possesses the great advantage of holding the mouths of the Rhine, the Maas, and the Scheldt. Her means of river communication with Germany, France, and Belgium, are unbounded; and the possession of a length of 930 miles of canals and 340 miles of rivers enables her, apart from her railways, to carry on her large trade with greater facility of transport than, perhaps, any other European country.

Belgium shares with her northern neighbor the advantages of an elaborate system of waterways. By far the most important river is the Scheldt. Thanks to its unique position at the head of a tidal estuary, to the abolition of the Scheldt dues, and to the foresight and liberality of the Belgian government, which has spent $20,000,000 on dock and river works since 1877, Antwerp has now become in many respects the foremost port of the continent. Besides her 700 miles of navigable rivers, Belgium possesses about 540 miles of canals, by means of which communication exists between all the large towns and chief seaports of the kingdom.

France has built up, and is constantly extending, an elaborate system of canals and canalized rivers. Of the latter, the Seine is the most important in regard to the artificial works undertaken for its improvement, and for the tonnage of the traffic, which was in 1872 more than one-eighth of the whole waterborne traffic of France. The Loire, the Garonne, and the Rhone have all been largely benefited by the art of the engineer. The canal system of France is historic; one of the earliest of these artificial cuts being the celebrated canal of Languedoc, 171 miles long, built in 1667–81, and now forming part of the Canal du Midi. From its summit-level 600 feet above the sea, it communicates with the Garonne, and therefore with the Atlantic, by twenty-six locks, while its southern slope descends by seventy-three locks to the Mediterranean. Up to 1878, on 7,069 miles of waterways, France had spent upwards of $215,000,000. Nevertheless, it is intended still further to extend this means of communication at an estimated further cost of $200,000,000.

Spain and Portugal possess, partly in common, eight principal rivers, of which five — the Minho, Douro, Tagus, Guadiana, and Guadalquivir — drain the western valleys, and flow into the Atlantic; while the other three — the Ebro, Incar, and Segura — discharge into the Mediterranean. As a rule, these rivers are only navigable for a limited portion of their course, and are chiefly remarkable for extremes of flood-discharge; a velocity of sixteen knots an hour having been noted in the Douro under certain conditions of tide. The canals of the Iberian peninsula are unimportant. Spain possessed a length of 130 miles in 1875.

Italy is not rich in waterways except in the valley of the Po, the navigable portion of her rivers only attaining an aggregate length of 1,100 miles. Although the total length of navigable canals in Italy is only 435 miles, the Italians were the first people of modern Europe that attempted to plan and execute such artificial waterways. As a rule, however, they have been principally undertaken for the purposes of irrigation.

Austria-Hungary possesses in the Danube the largest river in Europe as regards the volume of discharge, although it is inferior to the Volga in the length of its course and the area of its basin. This great stream first becomes navigable for flat-bottomed boats at Ulm, 130 miles from its source. In its total length of 1,750 miles, it is fed by at least 300 tributaries, many of them large rivers. Although the Danube between Vienna and Old Moldova had been regulated in numerous places and at great cost, there had been but little appreciable improvement effected in its general navigable depth. On this account, projects having in view the permanent acquisition of a sufficiently wide channel, of from six to eight feet deep at every point between Passau and Basias, have lately been prepared, which involve an outlay of $10,000,000 to effect the desired improvements. Traffic on the upper and lower Danube is mostly carried in barges, of which the greater number gauge 250 tons. The effect of the improvements at the Sulina mouth has been to increase the trade from 680,000 tons gross in 1859, to 1,530,000 gross tons in 1883, and to lower the charges on shipping from an average of five dollars per ton for lighterage, to half a dollar per register ton at the present time for commission dues. As a commentary on the hostile criticism evoked when the scheme was initiated, the lecturer drew attention to two facts; namely, that the works so unsparingly criticised in 1857 had already effected a saving of $100,000,000, and that experience had abundantly proved that the predictions of a rapid silting-up to seaward of the Sulina piers had been completely erroneous.

THE GEOLOGY OF WISCONSIN.

THE nearly simultaneous appearance of the two final volumes of the 'Geology of Wisconsin' some months since, marked the close of one of the most rapid of the state geological surveys, and, for the time and money expended, one of the most thorough and complete. The work has been done in less detail than in some other states, whose surveys have run through much longer periods of time, and have consequently necessitated much greater financial outlays. The results are embodied in four large octavo volumes, containing something more than three thousand pages. The text is well illustrated; and the judicious use of cuts, which express much more than the best verbal descriptions occupying the same space, has contributed to the embodiment of a large amount of material in relatively small compass. In the same line may be noted the predominance of observational results over theoretical deductions, and the absence of irrelevant discussions which have sometimes served to swell

Geology of Wisconsin. Professor T. C. CHAMBERLIN, chief geologist. 4 vols. Madison, Wis., 1877–83. 3,147 p., 140 pl. 8°