COMMERCE OF THE GREAT LAKES.

The story of the development of trade on the Great American lakes is one of the most remarkable in the wide domain of industrial and commercial activity. In the fourscore years which have elapsed since the inauguration of steam navigation on this great chain of inland seas, the growth of the shipping interests has at all times been constant, and in recent years the increase in the volume of traffic has been truly marvelous. When the settlement of the great Northwest had opened up its vast storehouses of agricultural and mineral wealth, the farmer and the miner found ready to hand in this noble waterway a cheap and easy route for the transportation of their products to Eastern markets.

The growth of the fleet of vessels on the lakes has kept pace with, if it has not anticipated, the growth of the flourishing cities which line their shores, until to-day we are confronted with the curious spectacle of a maritime nation with a seaboard that confronts two oceans for thousands of miles possessing a larger tonnage upon its rivers and lakes than it does upon the high seas.

While it is true that the volume of trade on the lakes is largely due to the advantageous location of this waterway in regard to the natural flow of traffic, much credit is due to the energy with which the facilities of travel have been enhanced by the efforts of the engineer and the capitalist, and by the fostering care of the governments of the United States and Canada. The efforts of the capitalist are manifest in the construction of special types of vessels suited to the requirements of traffic on those inland seas and in the vast and excellently equipped docks and loading facilities which abound at all principal points. The hand of the government is seen in the deepening of channels, the improvement of harbors and the construction of canals where natural obstacles limit or absolutely prevent the passage of vessels.

The most noted work of improvement by the government is that which has been carried out at Sault Sainte Marie, or the Rapids of St. Mary's River. St. Mary's River is the natural outlet by which Lake Superior discharges into Lake Huron, and near its head are situated the famous Sault or falls from which the thriving American city takes its name. The total fall of the river is some 18 or 19 feet in a distance of half a mile, and while the obstruction furnishes a valuable source of water power, it absolutely prevents navigation.

The first ship canal around the rapids was built by the State of Michigan, in 1853 to 1855. It served at once to stimulate trade upon the upper lakes, and in view of its great economic results, especially in the Lake Superior regions, and the enormous traffic which it has handled in its time, it will always rank as having been one of the most important canals in the world. It was 350 feet in length and contained two locks, the total cost of the undertaking being in the neighborhood of $100,000.

The rapid development of the Lake Superior country and the consequent increase in the shipping interests soon exceeded the capacity of the canal and enlargement became necessary. The Federal government accordingly took the canal under its control, and superseded it in 1881 by a larger structure. The new canal was given liberal dimensions, the single lock being 515 feet in length, with a width of 60 feet at the gates and 80 feet in the chamber, the depth over the sills being 14 feet. The total cost of the canal was $2,150,000.

Although the opening of the second canal relieved the congestion, the relief was only temporary; for, great as the increase in tonnage passing through had been during the period from 1855 to 1881, the growth of traffic was even more rapid during the next decade. In 1870, when the old canal had been opened 15 years, the total tonnage was some 691,000 tons, among which was about 50,000 bushels of wheat; but, in 1894, when a third canal was built, parallel to the first government structure, the total tonnage had risen to 13,110,366 tons, in which was included 34,896,483 bushels of wheat. This was a greater tonnage than that passing through the Suez Canal, although the latter is open the whole year and the Sault Sainte Marie locks were open for only eight months. The new lock on the American side is a very imposing structure. The chamber is 800 feet long, with a width of 100 feet. The walls measure 44 feet in height from the floor, and the total length of the masonry over all is 10,010 feet. The depth over the sills is 20 feet 3 inches, sufficient to accommodate lake vessels with a tonnage rivaling that of the large ocean freighters.

In 1888 the Canadian government passed a bill authorizing the construction of a canal on the Canadian side of the river. A contract was let for a canal which was to be 600 feet long between gates, 60 feet wide at the gates, with a depth of 16 feet; but before much work had been done, and in view of the fact that the draught and length of lake vessels was increasing so rapidly, it was decided to increase the dimensions to those upon which the canal was finally built. The present structure is 900 feet long between gates, 60 feet wide at the gates and the depth over the sills is 20 feet 3 inches. The width of the chamber is 60 feet. Compared with the American lock, it will be seen that it has the same depth, but is 40 feet narrower. The capacity of the lock was shown when three steamers of the Minnesota Steamship Line, with a combined length of 936 feet and registered tonnage of nearly 5,000 tons, were put through at one locking.

The tonnage passing through the American canals, during the eight months of the year 1896, was 17,249,418 tons, whereas the total amount passing through the Suez Canal in the whole twelve months of the same year was but 8,594,307 tons, or less than one half as much. The mean tonnage of the lake vessels was 927, as against a mean tonnage of 2,788 for those passing through the Suez Canal. Of course it will be understood that the Suez Canal ships are on long voyages, and many of them pass the canal only once in a year, whereas the lake ships will some of them pass the canals from forty to fifty times in a year. The figures for the two canals show the actual tonnage passing through, and are not an indication of the total number of ships employed. Thus the "Soo" traffic was represented by 18,618 lockings, and the Suez traffic by 3,047 passages of the canal. Of the total registration through the American canals, 4,391 were sailing vessels and 13,404 were steamers.

An analysis of the traffic shows that 37,066 passengers passed through, and the figures for the leading items of freight were: Iron ore, 7,909,250 tons; coal, 3,023,340 tons; wheat, 63,256,463 bushels; other cereals, 27,448,071 bushels; flour, 8,882,858 barrels; lumber, 684,986,000 B. M.; pig iron, 121,872 tons; copper, 116,873 tons; salt, 237,515 tons. The total value of the freight was $195,146,842 and the value of the fleet that carried it is estimated at $43,000,200.

Duluth is, by virtue of its geographical position and its vast and evergrowing trade, the Chicago of the Northwest, and the vast amount of trade that seeks this city as being the most westerly shipping point on the lakes has caused it to grow in a few years to a leading position among the great ports of the world. On the front page of this issue will be found illustrations of the grain elevators, the ore docks and the city itself. The ore docks, of which there are two, were constructed at a cost of $860,021, and have a capacity of 92,160 tons. They are typical of the great system of ore docks that is to be found on the shores of Lakes Superior and Michigan. It is estimated that the combined capacity of these docks on the two lakes is 633,804 tons, and their special loading facilities are such that a 5,000 ton vessel can be loaded in the space of a few hours. The total capital invested in mines, railways, docks, etc., concerned in the mineral traffic of this region is approximately $240,000,000. The entire commerce of the Great Lakes is estimated to amount to between 32,000,000 and 34,000,000 tons, and in the successful endeavor to encourage this traffic by deepening harbors and channels and improving and protecting waterways, the government has expended some $281,000,000.

The necessities of the lake traffic have produced a special type of cargo steamer which is a compromise between the barge and the ocean freight steamer. Of recent years a remarkable fleet of these large ships has been launched and it is growing rapidly both in numbers and the size of its individual boats. Among these are such vessels as the "Bessemer," 432 feet long by 48 feet beam and 28 feet draught; the "A. Carnegie," about the same dimensions, which has carried as much as 5,586 tons of grain on a single trip. The later ships show a continued tendency to increased size and tonnage.

These boats have the engine room and boilers located at the stern, and devote the unbroken length of the body of the ship to cargo. The whaleback is another distinctive type which has been evolved by the lake ship builders, and a large fleet of them has already been turned out of the Duluth yards. In our illustrations the whaleback type is shown in the engraving of Duluth ore docks, where three of these vessels are to be seen alongside the ore pockets, and in the engraving of the "Christopher Columbus," a passenger whaleback which was familiar to visitors to the World's Fair. The latter ship is a beautifully modeled vessel, 362 feet in length, with a beam of 42 feet and of high speed.

Two other famous passenger vessels are the "North Land" and the "North West," of 4,244 gross tonnage, 7,000 horse power, and a speed of 21 miles an hour. They ply between Buffalo and Duluth, and carry their passengers at a speed and amid luxurious accommodations that rival those of the great Atlantic liners.

In conclusion it should be mentioned that this truly wonderful traffic is carried on at a surprisingly low rate per ton. For the ten years 1886 to 1896, the average cost was 1·35 cents per ton per mile. For the three years 1893 to 1896 the rate has been 0·99 cent, or say one cent per ton.

The significance of the figures which have been given is only realized when it is borne in mind that the first ore was shipped but forty-two years ago, and that the bulk of the lake trade is the growth of less than half a century.

The Perfected Joly Color Process.

This process invented some time ago by Prof. J. Joly, of Dublin, Ireland, has been improved upon and perfected in this country so that it is now commercially practical, and is being introduced by a company styled "The Joly-Sambra Company," of Montclair, N. J. At the Camera Club, of this city, on the 7th instant, Prof. J. S. Gibson showed through the lantern several interesting natural color photographs, made by this process, and remarked that film plates and other things needful for the practical utilization of the process were now to be obtained.

The essential feature of the process, as is well known, is founded upon the combination of the three primary colors, red, blue and green; but, instead of having three red, blue and green separate pictures merged into one, as has been customary, Joly prepares a single glass plate, with a series of triple parallel colored lines on the surface, separated only the $\frac{1}{225}$ of an inch apart; that is, a red line, a blue line, a green line, then a red, blue and green, one after the other, respectively, until the whole plate is covered. This is the key of the process. A special plate of this kind is called the taking screen, and is used by placing it in a plateholder having a hinged back, with the ruled or film side upward and in close contact with the film of a panchromatic sensitive dry plate, that is, a plate universally sensitive to colors.

This company recommends the Cadett panchromatic plate. The holder, with the two plates, is next inserted in the camera, and what is called an orthochromatic light filter, or intercepter, consisting of a sheet of glass, coated with a delicate yellow film for the purpose of checking the too rapid action of the violet rays, is placed in the camera just back of the lens. The diaphragm aperture is varied according to the subject and intensity of light, but the most effective is f/6 down to f/16, and the exposure may be varied from three seconds to $\frac{1}{17}$ of a second.

The exposed plate is next developed in the usual way, but, on account of the character of the plate, development must be begun in almost total darkness and carried on in very deep, feeble ruby light. After fixing, the plate is washed for one or two hours and is a perfect monochrome negative, in which the reduced silver deposit is proportional to the color value of the objects photographed, and contains numerous minute lines $\frac{1}{225}$ of an inch apart, as were in the original taking screen.

From this monochromatic negative a positive is made by contact on an ordinary slow emulsion lantern slide plate developed not quite as far as the negative. After fixing and washing, this monochrome transparency is very slowly dried in a damp closet; twenty-four hours for drying being recommended, in order that the shrinkage of the gelatine film may be uniformly even and the lines of the transparency coincide precisely with the lines of the taking screen.

It is evident any number of these transparencies may be made from one negative, so that the number of natural color duplicates is not limited.

Having secured the transparency, the final step is to cover it with the ruled red, green and blue cover glass, film side in contact with the film of the transparency, and adjust it so that the lines of the cover glass correspond or overlap exactly the lines in the transparency. When that is done the two glasses are bound together with gummed paper, and the result is a beautiful photograph viewed by transmitted light in all the natural tints, colors and gradations of nature. The various false and curious colors obtainable by slightly moving to the right or the left the ruled cover glass over the picture are very interesting and remarkable. Some may object to the obtrusiveness of the lines, but if a lantern slide of this character is held distant from the eye two feet away, the lines merge with the rest of the picture and are not observed.

At the lecture colored slides of different subjects were thrown on the screen in size about six feet square, which naturally magnified the lines proportionately. In some classes of pictures they were too prominent, in others they produced no unpleasant effect. Among them was a picture of a United States flag showing the red and blue very effectively. In a portrait of large size, taken in about two seconds, the natural color of the skin, hair necktie and the rose in the buttonhole of the lapel, were very effective. A portrait of a blanketed horse drinking from a water trough, taken in $\frac{1}{17}$ of a second, was especially good, the different colors of the stripes of the blanket being perfectly reproduced. A bouquet of pink roses in a blue vase was quite interesting.

We have no doubt but what the process will prove of great interest and value to amateur photographers, as only a few simple precautions are needed to secure beautiful effects, and it is a satisfaction to note that the practical perfection of the process is due to the ingenuity and perseverance of Americans.

FOR half an hour 31·9 knots was the rate of speed of the "Star," a new 30-knot torpedo boat destroyer built by the Palmers. The average for the three hour trial was 30·68 knots.