rapids, frazil will be formed quicker and in greater quantity than in quiet water. To prove this he performed several interesting experiments. He had previously made arrangements with the management of the Chauteau Laurier to put various sized bottles of water in the hotel's ice-making plant.

The water in these bottles was chilled to 32°F., and the bottles were then carried from the basement of the hotel to the palm room on the ground floor, where the discussion was taking place. With one exception, all of the bottles were perfectly clear when they were brought into the palm room, no ice crystals being visible. "Certainly the bottles are no cooler than they were when they left the refrigerating room at 32°F.," said Mr. Murphy. "They have gained a little heat in being carried upstairs. No ice has formed in these bottles, but if we agitate them, ice will form." Mr. Murphy then shook various bottles and it was seen clearly that quantities of frazil had formed immediately upon agitation.

Experiments by Mr. Murphy

To prove his point further, Mr. Murphy poured the apparently clear water rapidly from one of the bottles into a bucket that had been covered with light netting. The agitation resulting from the water being poured out of the bottle was sufficient to cause the formation of a quantity of frazil, which was caught by the netting and showed clearly the needle-like formation of this ice.

To show the attraction that sheet or surface ice has for frazil and the way the latter clings to it, Mr. Murphy dropped a lump of ice as big as a walnut into a 5-gallon bottle of clear, chilled water. Immediately frazil formed throughout the upper half of the bottle and rose rapidly toward the chunk of ice, massing around same.

Another experiment tried by Mr. Murphy was not quite so successful. He introduced an iron rod which was supposed to have been chilled to 32° F., into one of the clear bottles to show how frazil would form and stick to the metal, but the rod had been allowed to remain too long in the room before the experiment was performed, and while frazil could be formed by agitating the water with the rod, it did not stick to the metal.

Mr. Murphy said that when liquids reach the freezing point, they have the tendency to form ice crystals and to freeze solid, but that there is a certain inertia which is not overcome until still lower temperatures are reached unless the water is agitated, but if the water be agitated and the freezing started, then, said Mr. Murphy, it continues and spreads.

He attributed the thickness of bordage ice to constant agitation along the shore.

The fact that the turbines at Cedars are of the single runner type has nothing to do with the lack of ice trouble, thought Mr. Murphy. There would have been no difference, he said, whether there was a single runner or a hundred runners, provided that they were all kept warm, like the single runner is, from the heated air of the generator room. On the other hand, if the single runner were not in the plant, it would freeze up just as tight as any multiple runner had done.

Small Boiler Keeps Plant Running

The fact that the metal parts were kept a little warmer than the ice was the reason that the ice did not stick and was the only reason, said Mr. Murphy. This had been proven in a plant that had frozen up every year for years. A very small boiler had been put in to heat it, and as a result, it had not frozen up all winter.

Mr. Murphy referred to the experiments which had been carried on in 1904 by Col. Leonard at St. Catharines to show the loss of heat in iron pipes. Col. Leonard had discovered in his experiments that if pipes are kept warm, ice would not stick to them and they will not freeze up. In 1906, Mr. Murphy had kept a plant running "with just a breath of hot air," when it had been frozen up tight right along previously. On November 26th, 1905, there were no electric light, street cars or power in Ottawa excepting from one little plant which he had thawed out at 2.30 a.m. with a small outfit generating 30 pounds of steam. This plant he had started running in thirty minutes. The plant of the Ottawa & Hull Electric Co., said Mr. Murphy, depends on a very small steam boiler.

Col. Leonard said that he had conducted experiments in 1914 at St. Catharines for the Dominion Power & Transmission Co. and found that a very small amount of heat applied to the rack bars kept them from being blocked. They made the racks of hollow bars, practically of pipe, and passed a small amount of hot water through them. They found that these bars were unnecessarily bulky, however, and that a small amount of heat applied in other ways was equally satisfactory.

A great many people, said Col. Leonard, believe that if one builds a dam and dams the rapids, that the ice is destroyed. This is not true, he said, and was a bad message to get abroad. He cited the instance of the Dominion Power & Transmission Co.'s plant, which takes water from the Welland canal. Despite the fact that the system is apparently fully canalized, there are ice troubles, and would one say that dams could be built all the way up the lakes for hundreds of miles to prevent the ice from forming?

Mr. Thornton replied that while in a case of this sort the ice could not be entirely prevented from forming, that the canal undoubtedly greatly reduces ice troubles and also is of use in connection with the formation of surface ice.

As it was 6 p.m. before the discussion was finished, Dr. Dawson's paper on "Standard Datum Planes" and Mr. Busfield's paper on "The Montreal Tunnel" were postponed to the next day.

In the evening a formal reception was tendered by the newly elected president, Col. Leonard, in the ball-room of the Chateau Laurier. Dancing continued until nearly 2 a.m., a buffet supper being served at midnight.

Railway Electrification Discussed by John Murphy, W. G. Gordon, F. H. Shepard and H. H. Vaughan

THURSDAY morning was devoted to a topical discussion on railway electrification by John Murphy, electrical engineer of the Department of Railways and Canals, Ottawa; W. G. Gordon, transportation engineer, Canadian General Electric Co., Toronto; and F. H. Shepard, director of heavy traction, Westinghouse Electric and Manufacturing Co., Pittsburgh.

Mr. Murphy stated that 106 cars are operated by the Ottawa Electric Railway, the average horse-power of each motor being 106, or a total motor installation of 11,236 h.p., but the maximum power demand is less than 7,000 h.p., or in round numbers only about 7/12 of what might be called the installed power capacity. The economy of generating the power in a central station instead of having steam engines on the cars themselves is therefore evident. At least 5/12 of the coal that would otherwise be required is saved, and, assuming that the plant is operated by water, all the coal is saved.

Mr. Murphy stated that 18% of the energy in the coal is obtainable at the switch-board in a modern pumping plant, but 97% of the energy of the coal hauled by locomotives is wasted either by loss of efficiency in the locomotive or by the power required to haul coal and water for its own purposes, and by the radiation and standing losses, etc. The locomotive cannot have the benefit of modern condensing apparatus and other fuel-saving apparatus that is available to modern