side closed, the other being open and exposed to the wind. The lifting pressure on the roof was found equal to that on an equal normal plane. Model plate-girder bridges were next tested, with the result that when the two girders were separated by distances equal to their height, the leeward one was fully sheltered, but when the distance was doubled the pressure on the leeward one experienced a pressure of one-fifth that on the windward one. The pressure on latticework was tested by means of two cards, each 6 in. by 8 in. One of these cards had 16 rectangular openings cut in it, removing 43 per cent. of its area. The pressure on it was found to be 83 per cent. of that on the solid card. Placing the grating in front of the solid card, the pressure on the latter was reduced, as shown by the following figures :—

		Pressure.
Card......................	6 in. by 8 in.	.37 lb.
" grating	1½ in. in front	.23 "
" "	3 "	.17 "
" "	4½ "	.12 "
" "	6 "	.11 "
" "	7½ "	.16 "
" "	9 "	.20 "

One curious point was noted, viz., that when a card 3 in. square was placed in front of a card 9 in. in diameter, the pressure on the former was reduced. The large card apparently caused a deflection of the stream lines which were banked up in front of it, diverting the current round the small card, the pressure on which was therefore reduced. When tested alone, the small card showed a pressure on it of .15 lb. With the disc 12 in. behind it, this was reduced to .14 lb., at 9 in. to .11 lb., at 6 in. to .09 lb., at 3 in. to .7 lb., and at 1 in. to .03 lb., or only one-fifth of what it endured if the disc were removed. The well-known phenomena of attraction between a large disc and a small one placed behind it was also observed. Another important point noted was that if the wind was prevented from escaping on one side of a cylinder or cone, the pressure was increased about 20 per cent. The effect was not noted with rectangular blocks.

ROAD TESTS OF A MODERN LOCOMOTIVE.

W. G. Kranz, Berlin, Ont., and J. B. Turner, of Cornell University, last year made some road tests of a ten-wheel freight and passenger locomotive, No. 593, built in the C. P. R. Co.'s shops at Montreal in 1892. The dimensions of this locomotive were as follows: Diameter of cylinders, 18 in.; stroke, 24 in.; diameter of driving wheels, 62 in.; number of tubes in boiler, 192; length of tubes, 12 ft.; outside diameter of tubes, 2 in.; heating surface of same, 1,008 sq. ft.; heating surface of firebox, 123 sq. ft.; total heating surface, 1,131 sq. ft.; diameter of pop-valves, 2¼ in.; weight of engine on drivers, 102,000 lbs.; weight of tender, full of water, no coal, 65,600 lbs. The tests were planned to show the economy of the engine under the wide variation of conditions found in every-day working, the intention being not to interfere with the time schedule in ordinary use. The amount of coal used was accurately arrived at by first weighing the tender empty of coal and filled with water, and then weighing it with coal and water, the difference giving the required result. Four or five gunny bags filled with about 200 lbs. of coal each were placed on the tender and were used in firing up the engine in the round house, and in bringing the weight of fuel in the firebox up to a predetermined standard, at the time when the run began; at the end of the run the firebox was left in the same condition with the weighed coal. At the end of the run again the coal remaining in tender was weighed in buckets on a platform scale. Feed water was determined by a 2 in. Hersey meter placed in the suction pipe of one of the injectors. A check valve was inserted between the meter and injector to prevent hot water from flowing back and injuring the meter. The cubic feet of water used was read on the dials of the meter, which was new and accurately calibrated. Meter readings were taken just before starting the run and immediately after ending it, the water level in the boiler being brought in both cases to a certain height on the gauge glass. Measurement of steam pressure was read from the gauge in the cab. Measurement of speed was noted in the cab by means of mile posts and a stop watch. Speed was at no time so great that the revolutions could not be accurately observed. For measurement of the dryness of steam, a throttling calorimeter was used, the pipe extending into the dome just below the mouth of the throttle valve. The thermometer was bared to steam, no cap being used, and was held securely by means of a stuffing box. For measurement of injector overflow, the injector was put on a number of times and the overflow caught and the waste per time averaged. Deductions for this last were made from records of meter. The time of popping was noted and approximate calculations made for this waste by comparison with previous tests on an engine carrying the same steam pressure. This loss was found to be 100 pounds per minute at full lift of valve, and for average lift, about 50 pounds. The measurement of vacuum in smoke-box was found by means of a glass U tube connected by rubber tubing to a ¼ inch plug placed on centre line of boiler and opposite the nozzle. Temperature of smoke-box was found by Schaeffer and Budenberg pyrometer registering up to 912° F. This pyrometer was screwed into the smoke-box at the centre line, extending to just below the exhaust nozzle. Cut-off was noted by the notches on the quadrant. Indicator diagrams were taken every other mile with the engine working in all positions of reverse lever, throttle and speed; also at all prominent changes in physical condition of the road. The authors, in their thesis of the tests, prepared for Cornell University, give very full and detailed descriptions of the runs made, but we give the conditions and chief results of each trip in condensed form. Part dimensions of locomotive tested have already been given. First run: Distance, 91.1 miles; distance of actual steaming, 68 miles; time on road, including stops, 5 hours 35 min.; time of actual running, 271 min.; number of cars plus van, 22; weight of train back of engine and tender, 618.65 tons; weight of train, engine and tender included, 704.65 tons; ton-miles of train, 56,359; ton-miles of train, engine and tender included, 64,194; coal used, 6,045 lbs.; coal used in handling train, 5,925 lbs.; coal used per ton-mile of train, .0923 lbs.; coal used per sq. ft. of grate per hour, 45.6 lbs. (a), 69.25 lbs. (b); coal used per mile travelled, 66.3; water used, 49,036 lbs.; water evaporated on trip, 48,997 lbs.; water used in hauling train, 47,997 lbs.; water used per ton-mile, from and at 212°, 879 lbs.; evaporation per lb. of coal at boiler pressure, 8.1 lbs.; evaporation per lb. of coal from and at 212°, 9.4 lbs.; evaporation per lb. of combustible from and at B.P., 9.4; evaporation per lb. of combustible from and at 212° F., 10.9; average speed, including stops, 16.6 miles per hour; average