means of a long wire rope running over large sheaves at each end of the line. One of these is connected with the driving power, where necessary. (Under suitable conditions of incline the line works automatically without any external assistance.) The other sheave is in connection with the tension gear.

Our diagram indicates the conditions of service from the mines to the shore. There are in all four lines, as follows:

1. From the charging station Silvarosa to the depot on the shore: lines I. and II.

2. From the charging station Lavandeira to the station Silvarosa, and from there without reloading to the depot of the main line on the shore: line III.

3. From the depot on the shore to the pier head: line IV. The service on this line is independent of the other three lines.

Only the lines I., II., and IV. were at first erected, the line III. being built later. It is this third line that we will describe first.

This line starts from the Lavandeira gorge. Here the rock had to be blasted to provide accommodation for the charging station. A wall 10 meters (33 feet) high was built diagonally across the cutting. The ore is carried in dumping trucks to the top of this wall and thence dumped into a depot below. Here the ore is shipped from four stock-bins into the ropeway cars. A workman pushes each car as it is loaded to a point where the grip is applied automatically, and the car travels to Silvarosa station. In our third illustration the ropeway of this line is shown. In the left-hand bottom corner a portion of the station appears; and 56 meters (185 feet) from it the first iron pillar, 34 meters (112 feet) high. From this pillar to the next is a span of 72 meters (236 feet) across the Lavandeira gorge. On the right of this ropeway rises the Monte Silvarosa, the line running along its flank. The depot at the Silvarosa station is arranged like that at the Lavandeira gorge and has accommodations for 10,000 tons of ore.

The central station (Silvarosa) belongs partly to the newer Lavandeira line and partly to the old main line running to the sea. These lines are so connected as to allow the main line to be worked with or without the branch line. If both lines are worked, the cars of the branch line proceed to the main line without causing any inconvenience in the loading of the cars at the Silvarosa station. The arrangement is shown in part in our second figure, where the portion on the left, carrying the suspension rails, is the more recent connection with the older part on the right, of which the suspension and traction ropes and a car are visible.

The main line consists of two branches joined at the Garganta Curve station. The steepest incline occurs on the main line between the Silvarosa station and the Garganta curve, the gradient being about one in four. There are also on this part of the line spans ranging up to 324 meters and crossing deep valleys. One of these is shown in Fig. 5. It is 324 meters (1,064 feet) wide and passes at a height of 70 meters (230 feet) above the level of the valley. Half way between the Silvarosa and the curve station is an intermediate tension gear, which equalizes the strain of the rope along its 2,900 meters (9,600 feet) length.

The erection of the Garganta Curve station was rendered necessary by peculiarities in the nature of the locality. The two lines here meet at an angle of 170 deg. Each has a separate traction rope. The supporting ropes are firmly anchored in the ground, and in the station the cars run upon suspension rails (not ropes). The cars must be unclamped and again clamped to the traction rope by hand, but the operation is so simple that two men are sufficient for the work, although the traffic is very considerable. The traction rope of the upper line is provided at the curve station with an automatic tension gear, which is connected with the lower line in such a way as to equalize the speed on the two lines and transfer the surplus of power from the one to the other. The second part of the main line, extending from the curve station to the shore, offered no particular difficulties beyond the crossing of an arm of the sea some 280 meters (924 feet) wide. This part of the line, with its terminus on the shore, is shown in Fig. 6, while Fig. 4 is a view of the dumping ground on which the ore is stored at that terminus. The cars arrive on a bridge supported on masonry pillars, and from here their contents are dropped out upon the inclined embankment on which the pillars of the bridge stand. The bridge is about 52 feet high and 180 feet long; the quantity of ore which can be stored here is about 30,000 tons. From this ground the ore is transferred to the ship by a special lading line. It was found best to have a break in the line here, as the main line works continuously, bringing a regular supply of ore, its working capacity being about 67 tons per hour, while the lading line works only when required. This arrangement makes it possible to effect the lading of a ship very rapidly, so that every favorable opportunity of sailing and weather can be used to the best advantage. It is possible to put no less than 3,000 tons of ore on board in one day, the working capacity of the lading line being 250 tons per hour, about four times that of the main line. The cars are filled by means of chutes passing from the dumping ground into a tunnel beneath, into which the cars are run. At the other end these travel out upon a pier, and discharge the cargo from above into the steamer, as shown in our illustration (Fig. 6). This pier is built upon a rock which projects some 400 feet into the bay. The illustration also shows the whole of the lading line. Near the left hand margin, about halfway up, is the exit of the charging station. In order to neutralize to some extent the sudden descent of the cliffs, four iron pillars are erected at a distance of about 20 meters (66 feet) apart, bearing three parabolic girders, which are continued toward the bay by a series of parallel girders supported on pillars spaced 10 meters (33 feet) apart. The last 20 meters (66 feet) of the line form part of the discharging station. When a car arrives here, its grip upon the traction rope is automatically released, and the contents of the car are shot directly into the hold of the steamer below, which is anchored to buoys. The ore chute can rotate about a horizontal axis and telescope to allow for the rise and fall of the steamer under the tide. This arrangement is of peculiar advantage as the Bay of Vivero is ill protected from the sea.

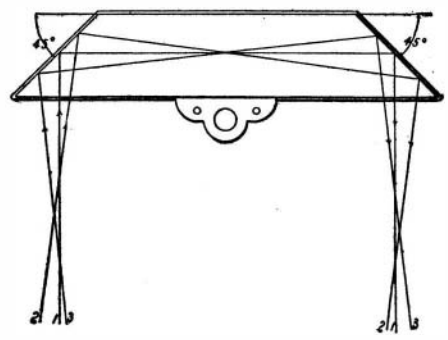

DIAGRAM OF THE PRISM.

MEASURING THE ACTUAL DIP OF THE HORIZON.

The following are some numerical data respecting the different lines:

The main line has a total length of 15,000 feet and a drop of 1,000 feet. Of this 5,400 feet length and 260 feet drop go to the upper line, and 9,600 feet length and 740 feet drop to the lower line. Line III. has a length of 2,828 feet with a rise of 340 feet, line IV. a length of 590 feet with a drop of 50 feet. The capacities of the lines are as follows:

Main Line from Monte Silvarosa to Dumping Ground on the Coast.—This carries 90 cars per hour, with a load of 67.5 tons, in 10 hours, therefore 675 tons. This figures out to 200,000 tons per annum. The velocity of the traction rope is 2½ meters (8 1-5 feet) per second, and the distance between two consecutive cars 40 seconds or 100 meters (330 feet).

Branch Line Lavandeira to Monte Silvarosa.—This has a capacity of 45 tons per hour, carrying 60 cars per hour with a load of 1,650 pounds each. The velocity of the traction rope is 2 meters (6 2-3 feet) per second, and the cars are one minute or 120 meters (396 feet) apart.

Loading Line.—The capacity of this is 250 cars per hour of one ton each. The cars are spaced 14 seconds or 21.6 meters (72 feet) apart and the velocity of the traction line is 1.5 meters (5 feet) per second. It is therefore possible to load 3,000 tons in 12 hours.

In consequence of the drop, no driving power is required, on the contrary a powerful brake mechanism is inserted in the line.

A PRISM FOR MEASURING THE ACTUAL DIP OF THE HORIZON.

A serious deficiency in the ordinary sextant lies in the fact that it measures the altitude of the sun above the apparent, rather than the actual, horizon. The usual "dip table," as it is called, corrects errors due to the altitude of the observer above sea level, but of course takes no account of variations in the apparent height of the horizon due to atmospheric conditions. The attention of Lieutenant-Commander John B. Blish, U. S. N., was particularly directed to this deficiency while on board a cable-laying steamer a few years ago. In order to accurately plot the location of the cable, most careful observations were made from early dawn until dark, sights being taken by nine experienced navigators. But on one bright day, when the horizon was seemingly perfect, all observations seemed to be wrong, and at noon the vessel was reckoned according to the sextants to be three miles north of the line on which it was supposed to be sailing. This was due to the fact that a change in the atmosphere had raised the apparent horizon above normal. As there was no means of ascertaining the amount of this change, the location of the cable was plotted on the chart by "dead reckoning" until the next day, when normal conditions of the atmosphere were restored. This incident suggested to Commander Blish the invention of a prism by which the actual dip of the horizon could be easily and accurately measured. This prism, as shown in the accompanying illustrations, has a rectangular cross section and the ends are beveled off to an angle of 45 degrees. The prism is entirely incased in aluminium with the exception of an opening located at each end of the longest face. It will be evident that a ray of light entering one of these openings or windows will be turned through an angle of 180 degrees, being reflected from one beveled face to the other, and thence out through the window at the opposite end. An observer holding the prism vertically before him, with the lower window on a level with his eye, will see the back horizon in the prism and the front horizon on either side of the prism, the two horizons being separated by the angle of twice the dip. With the prism attached to the sextant in the position illustrated, this angle can be measured by moving the index bar until the two horizons coincide. On taking a sight the prism is swung up out of the way, and the observed angle is first corrected for any error in the construction of the prism, after which the measured dip is subtracted, the remainder being the altitude above the true horizon. Experiments with the prism have shown the dip to vary as much as ten minutes of arc in five days, and that, too, with only slight changes in the temperature and barometric pressure.

The prism will also be found useful in pilot waters, enabling the navigator to exactly determine his line of position; for the observer will, obviously, be located on the straight line joining an object in the front landscape with one in the rear landscape appearing directly above in the prism. Such observations, though important, have not heretofore been much used, owing to the difficulty of making them. This simple prism should, therefore, prove of great assistance to navigation, offering, as it does accurate observations both for the harbor and the open sea.

J. E. Mills makes several interesting applications of the kinetic theory of gases. By considering the transition from the liquid to the gaseous state in a particular way, an equation is obtained in which all the quantities are measurable, and it affords an experimental test of the assumption that the molecular attraction varies inversely as the square of the distance from the molecule, and does not vary with the temperature. This assumption is found to be in agreement with the experimental data as tested by the equation. It is further shown in the paper that the molecular attraction differs from the attraction of gravity in being determined primarily by the chemical constitution of the molecule, and not by its mass.