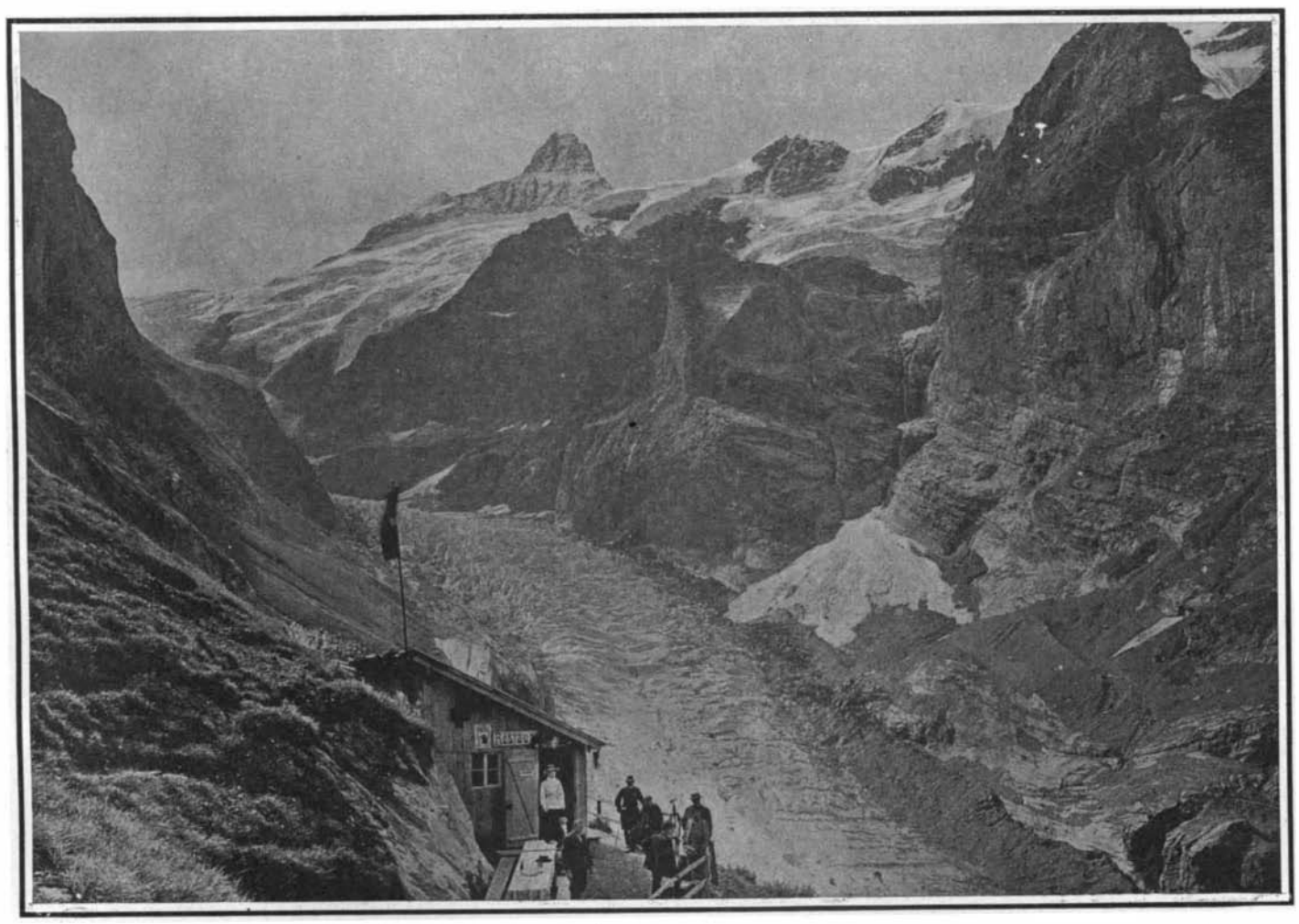
THE ELECTRIC AERIAL MONO-RAIL UP THE WETTERHORN.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

An entirely new departure in railroad engineering, in its relation to the ascent of mountains, has recently been inaugurated by the opening of the new line for ascending the steep precipices of the Wetterhorn in Switzerland. The topographical features were such that the construction of a surface railroad was out of the question except at enormous expense, while the route would have been tortuous and lengthy, winding up the mountain face and entailing the heavy cutting of galleries and tunnels for the laying of the track.

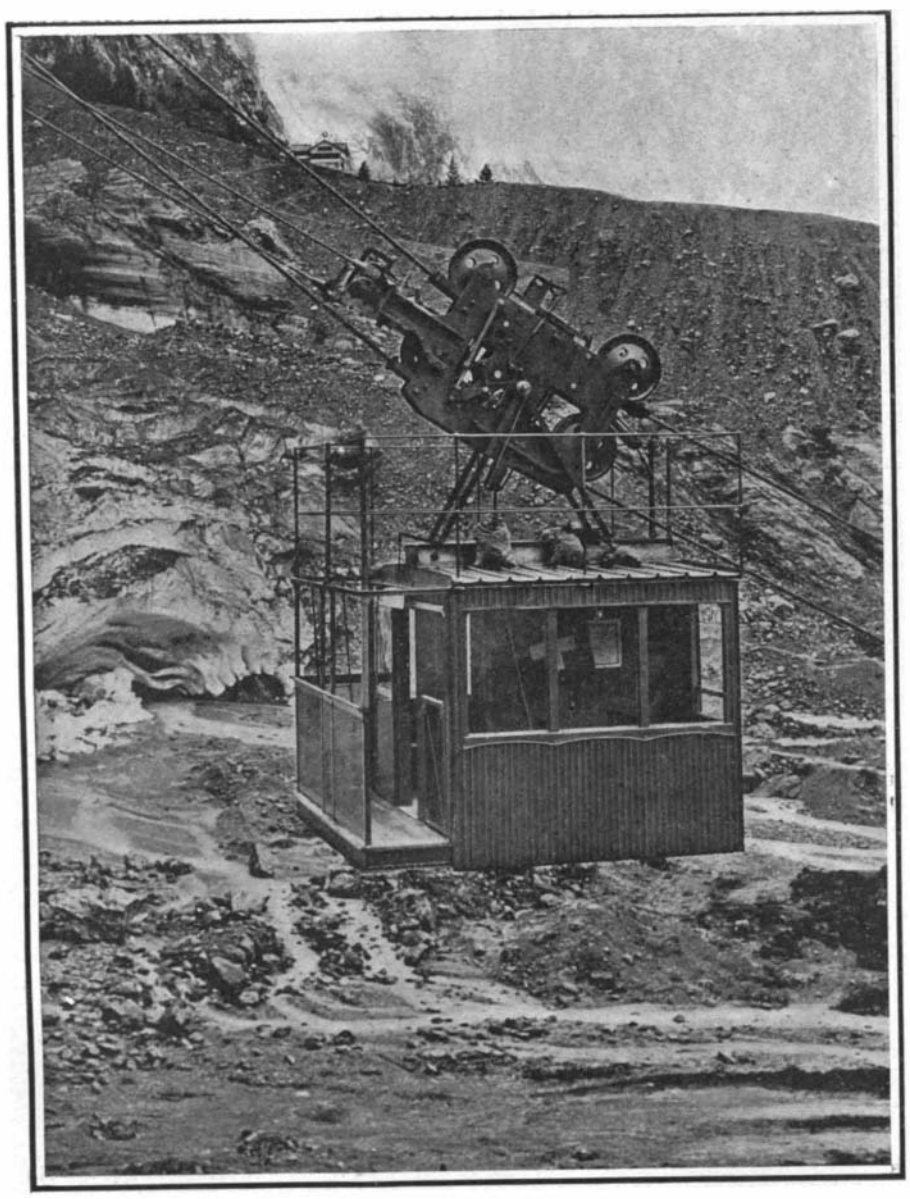


The restaurant near the upper station. View from the Grindelwald glacier.

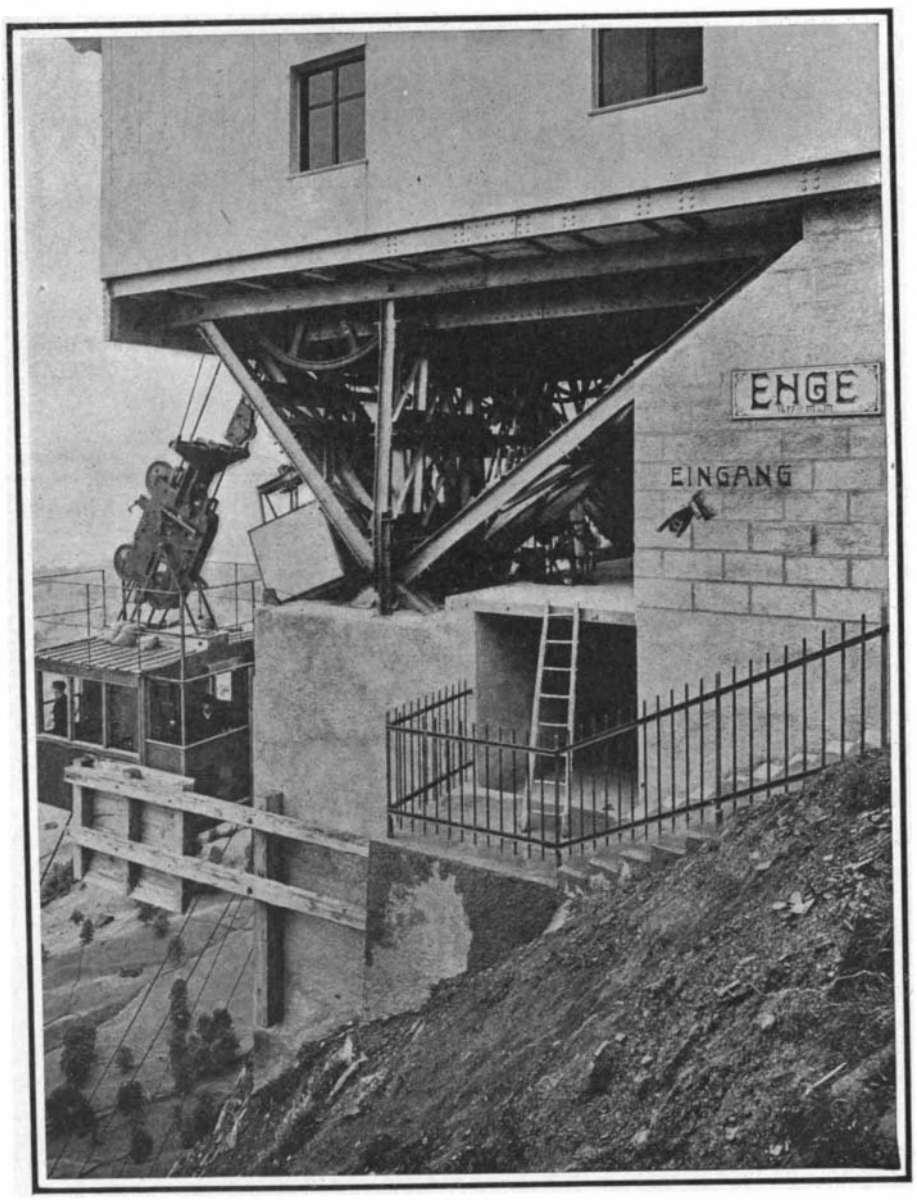
Under these circumstances the promoters of this enterprise decided to adopt an aerial system comprising two sets of cables each carrying a car and so disposed as to work in alternate directions simultaneously so as to secure a counterbalancing system. In evolving the system best adapted to the project, it was decided to combine the broad principles of the ordinary aerial cable system generally practised with those of the suspended railroad invented by the late Herr Eugen Langen and which is now in successful operation between Barmen and Elberfeld in Germany. It will be recollected that in this last-named idea the car is suspended from the running truck, which is mounted on wheels disposed in a single longitudinal line and running on *A* or inverted U-shaped supports according as the line is negotiating streets or passing over the river.

In the Wetterhorn railway the rigid rail of the Langen system upon which the trolley runs is represented by two stout cables placed one above the other. Upon these is mounted the trolley comprising two pairs of wheels disposed exactly one above the other in the vertical plane and a trolley body occupying the space between the two cables, thus forming a compact, almost rectangular truck of narrow width.

The car itself is supported from the trolley, being hung from a transverse axle passing through the center of the trolley body, and in such a manner that it is quite free, so that the car can always maintain an absolutely perpendicular position irrespective of the gradient. The suspension system, as may be seen, comprises an inverted V-frame on either side of the trolley, with the apex mounted on the carrying transverse axle, and the opposite extremities anchored to the roof members of the frame of the car beneath. At the prow of the trolley is secured a suitable transverse framing to the outer extremities of which are attached the ends of two hoisting ropes by means of which the carriage is hauled up the cableway. The track wheels are equipped with guide channels for



The car near the lower station, showing double cable track and method of suspending car.



Upper station, showing carriage at landing stage, the ironwork of the engine house, and method of attaching hauling cables to car trolley.

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directing the track ropes through the grooves of the upper and lower running wheels respectively, so that the two are kept the requisite distance apart and the wheels secure the maximum amount of adhesion and at the same time prevent derailment.

By means of this railway the traveler is hoisted through the air to a height of some 5,250 feet above sea level to Enge station, a halting point perched on a ledge on the face of the mountain. The lower or departure station is at the foot of the mountain some 4,000 feet above sea-level at the snout of the Grindelwald Upper Glacier and about an hour's walk from the terminus of the surface railroad at Grindelwald, and in close proximity to the Wetterhorn hotel, which is the center for mountaineering and other expeditions throughout the district. The situation of the lower station is such that the line to the upper terminus passes through an angle of 45 deg.

The higher station at Enge is situated on the goat path that climbs round the face of the mountain and is carried on a convenient ledge 5,250 feet above sea-level or 1,250 feet above the lower station. A substantial pier-like structure of masonry has been built at this point, projecting from the contour of the mountain, to serve as a convenient stage for the traveling carriage to enter to land and embark passengers. Above the station is situated the power installation. The power house at its outward end is carried upon a substantial heavy steel-work foundation, the side trusses being built diagonally and crossing and locking with the central vertical section at angles of about 45 deg., thereby giving the foundation ironwork the form of the letter V, as may be seen from the illustration. This plan was adopted not only on account of the great factor of strength rendered possible, but because it offered the most convenient arrangements in the disposition and operation of the hauling cables and drums. So precipitous is the ascent that on looking out from the landing stage of the Enge station, it appears to be a precipitous drop down the mountain side to the lower terminus below.

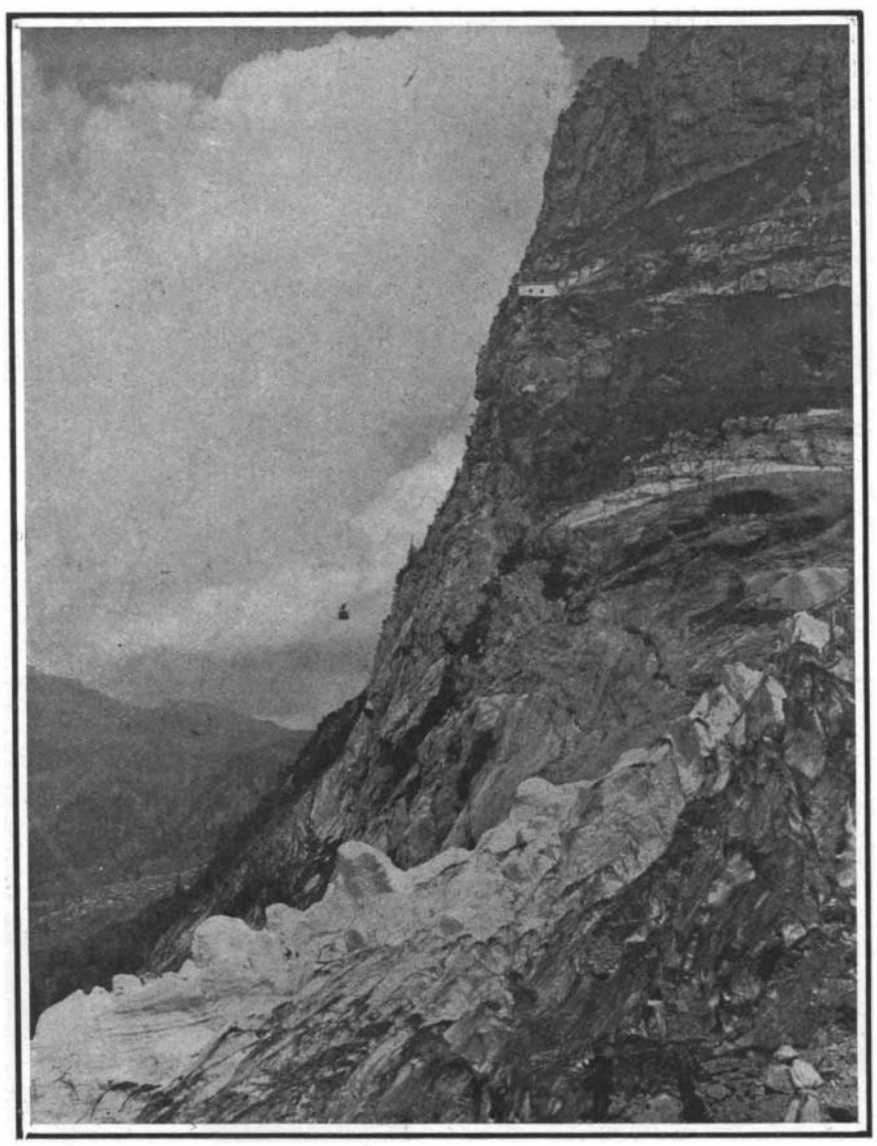
The winding station at Enge comprises two main horizontal winding drums driven by electric motors. The ropes from the drum pulleys pass through the station and over vertically placed grooved pulleys to the prow attachment of the car truck, to which they are attached as already described. These latter pulleys project partially through the power house flooring as shown in the illustration, so that a perfectly clear passage is afforded to the ropes between the car-trolley and the winding mechanism. Track cables are anchored at either end to a depth of 30 feet into the solid ground and are covered with cement piles and masonry. For the purpose of carrying out the work of construction, which was undertaken by the Fonderie de Berne, to whom we are indebted for the courteous permission to reproduce the accompanying photographs, a temporary aerial railway was erected between the departure and Enge stations for the transport of the requisite building material for the latter point, while the heavy track cables were hauled up from the lower point by means of a powerful windlass installed at Enge.

The distance between the two stations is about 1,300 feet and it is carried out in a single span, the alinement of the cable representing a gradient of about 80 deg. The motive power requisite for operating the railway is drawn from the Grindelwald power station supplied from a hydro-electric station on the Black Lütschine River. The power is transmitted to the Enge station by three overhead conductors on wooden poles.

The cars themselves have a carrying capacity of ten persons. They are of light construction and are fitted with every possible mechanism to insure safety in transit. The brakes, of a special type, are particularly powerful and capable of holding the car on the steepest sections of the line. The provision and testing of the brakes constituted one of the most important features of the installations, since it was realized that they would have to be of exceptional strength, in order to control the car upon the higher and steepest stretches of the cables.

In making the ascent the traveler is afforded a magnificent view over the glacier flowing beneath, while the situation of the upper terminus at Enge provides facilities for easily attaining sight-seeing points from which striking panoramas over the surrounding mountain peaks may be gained. The railway for this reason is certain to prove a powerful attraction to visitors, so that its commercial success is practically assured.

Owing to the railway being operated upon the "compensating" system—that is, one car descends while the other ascends—the consumption of electrical energy is very small, and materially contributes to the economics of the system. Wear and tear are also reduced to the minimum, as experience with ordinary cableways has already emphasized. Herr Feldmann, who is responsible for the idea here, shows that by this invention not only is the negotiation of mountains by railroads considerably simplified, and complete stability secured, but the initial cost and maintenance expenses are very materially reduced. Though this is the first instance to which the invention has been applied, the Fonderie de Berne are already completing arrangements for its adoption in other parts of the Swiss Alps where the prevailing conditions render a rack or other system of surface railroad impracticable owing to capital outlay. Even in the case of the Wetterhorn this first stretch is but part of a more complete scheme for reaching the peak of the mountain, which will mean the attainment of an altitude of some 12,150 feet above sea level. The preliminary surveys have proved that the project offers no insuperable difficulties. As experience of working is gained the projectors will become possessed of more reliable data upon which to extend its application, since pioneering is inevitably somewhat slow. The present installation, however, has certainly emphasized in no uncertain manner the celerity with which the system can be carried out, since the construction of this line occupied only about two years, which period in future operations can be considerably decreased. Certainly to the traveler the system possesses many attractive features. Transportation is rapid and comfortable, since the cars travel with remarkable steadiness and smoothness, while owing to the lower cost of installation tariffs can be proportionately reduced. In addition it will serve to bring within the reach of all, many points among the Alps which at present are inaccessible to aught but the daring and those animated by the spirit of mountaineering adventure.



Upper terminus perched on the mountain side. Railroad and car in mid-air.

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A convenient rule of thumb for ascertaining approximately the size of engine required to drive a direct-current dynamo is to multiply the kilowatts of output by 1.7 for small machines, 1.6 for medium sizes, and 1.5 for 500 kilowatts or over. The result will be about the brake horse-power required.—Power and the Engineer.

Phonograph Appliance for Visible Record.

A large proportion of public singers have a faulty pronunciation, as is well known. This defect is further exaggerated by the phonograph, even in the case of the best instruments, and it often happens that one's pleasure in hearing a record is lessened by not being able to understand the words. M. De Pezzer, a Paris scientist, overcomes the difficulty by using an apparatus which can be adapted to any phonograph and carries a paper strip with the words to accompany the music so that we see the words as the music is heard, and at the proper time. To this end a box is fitted to the phonograph and it has a guide in which the paper band can slide along. The band is unrolled from a roller on one side and it is driven along by perforations in the sides of the band which work with a toothed roller. At the other end, a roller winds up the strip as it is fed along. A groove or window cut in the box makes a part of the band visible. The toothed driving wheel of the strip is connected by gearing with the phonograph mechanism, but it can be thrown out of gear at any moment by a suitable device. An already prepared band is put in place and it is started at the moment the first note is heard. The essential point lies in preparing the paper strip, and this is carried out by obtaining a first graphic diagram which the apparatus furnishes. To this end a strip of white paper is mounted in the above box and there is mounted an electric registering device whose stylus, a lead pencil point, bears upon the paper as it runs along. Contact can be made for the electric device by a telegraph key. A phonograph disk being mounted in place, a skilled person listens to the piece of music and beats time by means of the telegraph key, so as to make a record of intervals or notes upon the paper by means of the stylus, thus giving the structural record of the piece. Each beat represents a note and the intervals between the notes are then shown. Afterward the proper syllable is written opposite each beat and we thus have the record of the musical piece. This first record gives a model from which printed records are easily made, the only essential point being to observe the time divisions of the original.

Visible Vibrations of the Atmosphere.

M. Raymond has communicated to the Astronomical Society of France a method of obtaining ocular evidence of the existence of waves and currents in the atmosphere, by projecting on a screen a magnified image of the sun. The first observation of this kind was made by Ventura. The focusing can be so adjusted as to bring out sharply the vibrations of the air in the form of markings which cross the sun's image. A remarkable regularity and parallelism of the markings, and consequently of the stream lines of the atmosphere, is frequently observed.

Puiseux has called attention to the analogy between these phenomena and the fringes and shadows which are so often seen moving over the ground and along walls during total solar eclipses, especially just before and after totality, when the visible disk of the sun is reduced to a narrow crescent. These fringes have given rise to numerous discussions. Their explanation is undoubtedly to be found in the refraction of the sun's rays by ripples in the upper atmosphere, running parallel to the general direction of the thin solar crescent. When the entire disk of the sun is visible the shadows cast by its various parts overlap and become confused and hence invisible. A parallelism between the course of the fringes and that of very high cirrus clouds crossing the face of the sun has also been observed.

Miss C. O. Stevens has discovered a method of seeing atmospheric waves, not as projections, but directly, and without waiting for an eclipse. If the eyes are protected by a screen of thin fabric it is often possible to see a series of bands, alternately light and dark, moving across the face of the sun. These bands are due to a moving train of air waves, which act as prisms.—Cosmos.

The city of Denver, Col., has recently installed a new bacteriological laboratory at City Hall, which is one of the most complete in the country. The physicians of the city depend absolutely on the bacteriological work of the department for diphtheria, and they are in hopes this season of doing efficient work in typhoid fever.

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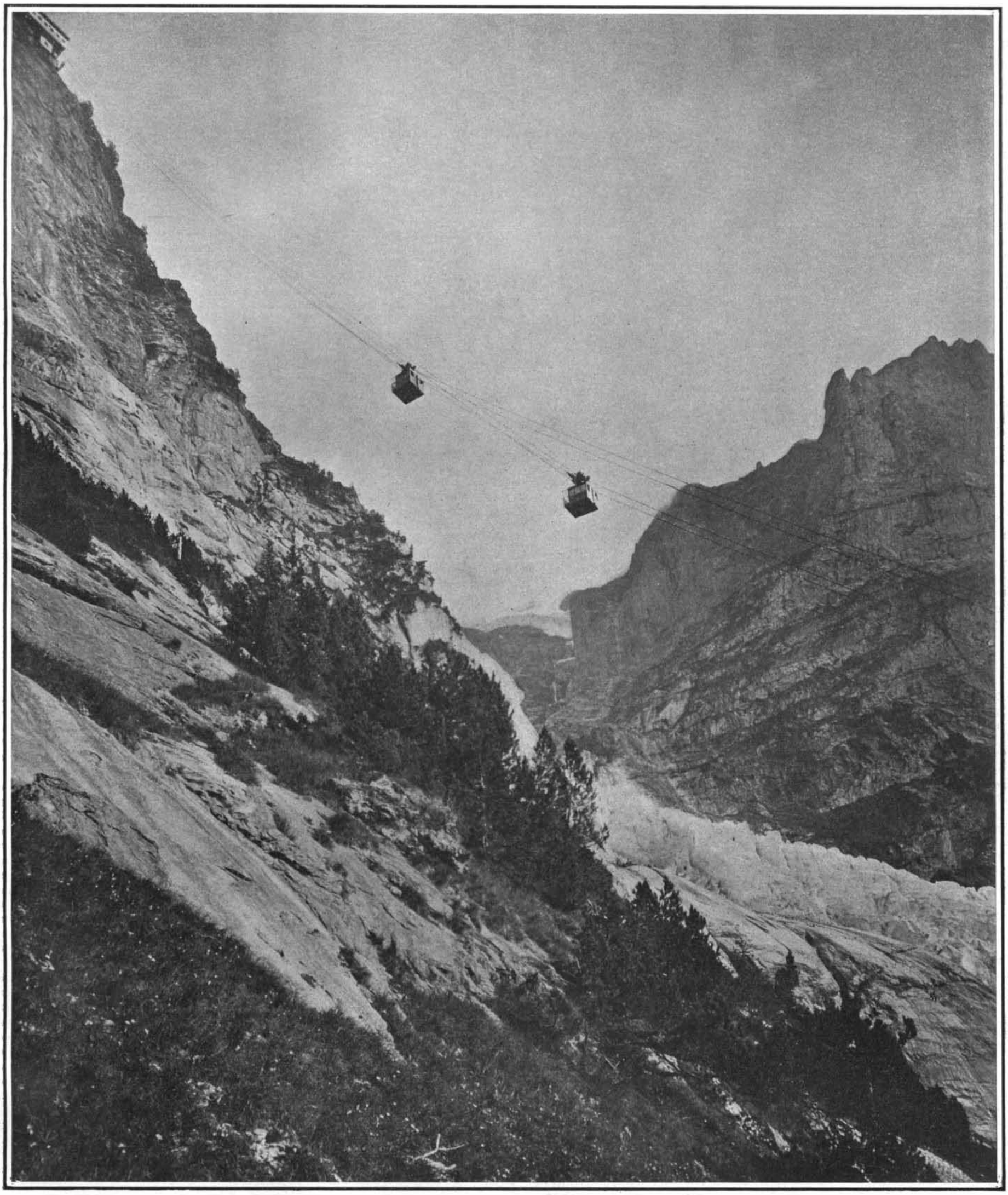

The two cars—one ascending, the other descending—in mid-air. Showing the glaciers below.

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