AN ELECTRIC MOUNTAIN RAILROAD.

The Mount Lowe Railway, in Southern California, is a remarkable achievement in mountain railroad building, both as regards the engineering difficulties overcome and the unique motor equipment of the road. Its purpose is to connect Pasadena, a beautiful and famous residence city near Los Angeles, with the summit of the Sierra Madre Mountains, nine miles distant and 6,000 feet above sea level.

The mountain road starts from Altadena, a point twelve miles from Los Angeles and three miles from Pasadena, at the terminus of a local steam railway which ascends the foothill mesa of the mountains to an altitude of 1,500 feet. The first two and a half miles of the Mount Lowe Railway is an electric trolley road, and climbs up the remainder of the mesa for a mile and a half, and then penetrates Rubio Canyon, a deep and romantic gorge, for another mile, much of this part of the road being terraced out of the side of the granite mountain, and conforming to the sharp curves of its lateral indentations.

The trolley terminates at Rubio Hotel and Pavilion, a unique structure built across the canyon at an altitude of 2,200 feet, being somewhat higher than the summit of the Alleghanies where they cross the State of Pennsylvania. Beyond the hotel the canyon narrows to a deep, tortuous gorge, or crooked chasm, with lofty walls of gneiss, richly striated with hornblende and feldspar. Terraced walks, bridges and stairways furnish access to a succession of beautiful waterfalls and other bits of wild and romantic scenery.

From Rubio Hotel, a double track, three rail, endless cable incline, 3,000 feet in length, lifts the passenger to the summit of Echo Mountain, 3,500 feet above the sea, overcoming in eight minutes an altitude of 1,300 feet, and passing over a varying gradient which ranges from 48 to 62 per cent.

Two cars of peculiar construction are provided with transverse seats arranged in three compartments, rising above each other like steps. These cars are permanently fastened to the cable, and one ascends as the other descends, passing each other at an ingenious automatic turnout in the center of the incline, 1,500 feet from either end. Like the trolley road below, this road is operated by electricity, and is said to be the only cable incline in the world operated by electrical power. The winding machinery and motor are located in a motor house on Echo Mountain, the entire plant having been designed and constructed by A. S. Hallidie, of San Francisco, builder of the first street cable railway ever operated.

The one and a half inch cable is driven by a seventy-five horse power Keith electric motor making eight hundred revolutions per minute, which, by three reductions, drives a horizontal clip pulley or grip sheave of the Hallidie type, making seventeen revolutions per minute. This grip sheave is provided with movable automatic jaws and with a band brake. The conductor of the incline car can signal the engineer at the motor house at any point on the incline and stop the car or proceed at will.

The dynamo which furnishes the current for the entire system is an Edison bipolar generator, manufactured by the General Electric Company, and is located in the company's power house at the Altadena station, and driven by two sixty horse power Otto gas engines, the gas being economically manufactured on the premises.

An eight inch pipe will soon be conveying an ample stream of water with a 1,400 foot head to a power house a mile below the hotel, and two large Pelton wheels will drive the dynamo at a nominal cost, represented by interest on cost of plant, wear of machinery and superintendence of works.

While this great dynamo furnishes power for the trolley road and cable incline, another supplies the electric current for an elaborate system of arc and incandescent lights to illuminate the hotels, canyon and adjacent grounds. The arc lights stationed along the steep incline, high above the foothills, form a striking object of interest at night as they gleam out from the mountainside and throw their bright rays far over the landscape, and are particularly noticed by passengers in the overland trains threading their way through the distant valley after dark.

THE GREAT CABLE INCLINE, MT. LOWE RAILWAY, CALIFORNIA.

The view from Echo Mountain facing the south is one of unsurpassed loveliness. It embraces the broad San Gabriel Valley, with its cities, hamlets, orange groves and cultivated fields, bordered on the east by a serrated horizon of mountain peaks, and on the south and west by a large segment of the Pacific Ocean, dotted along sixty miles of coast with pearly islands.

Excellent bridle roads, now leading from Echo Mountain to the summit of Mount Lowe, 6,000 feet above sea level, will be superseded by an electric trolley road, for which a suitable grade has been surveyed.

Professor T. S. C. Lowe, projector, builder and president of this mountain road, has distinguished himself in other fields of science, having invented the system of water gas now in general use for gas illumination. Professor Lowe was also the first to produce artificial ice on a commercial scale. For these, and other inventions useful to humanity, he has received from the Franklin Institute, of Philadelphia, three medals and a diploma, the highest award ever given to one man by that institution.

Professor Lowe now proposes to round out his series of honorable achievements by establishing upon the summit of the Sierra Madre range which has received his name, an astronomical observatory, well equipped for doing the best photographic and spectroscopic work in that department of science. On account of the high altitude, the clear atmosphere and the southern latitude, important scientific results are anticipated by such distinguished astronomers as Professor Lewis Swift and Dr. E. E. Barnard.

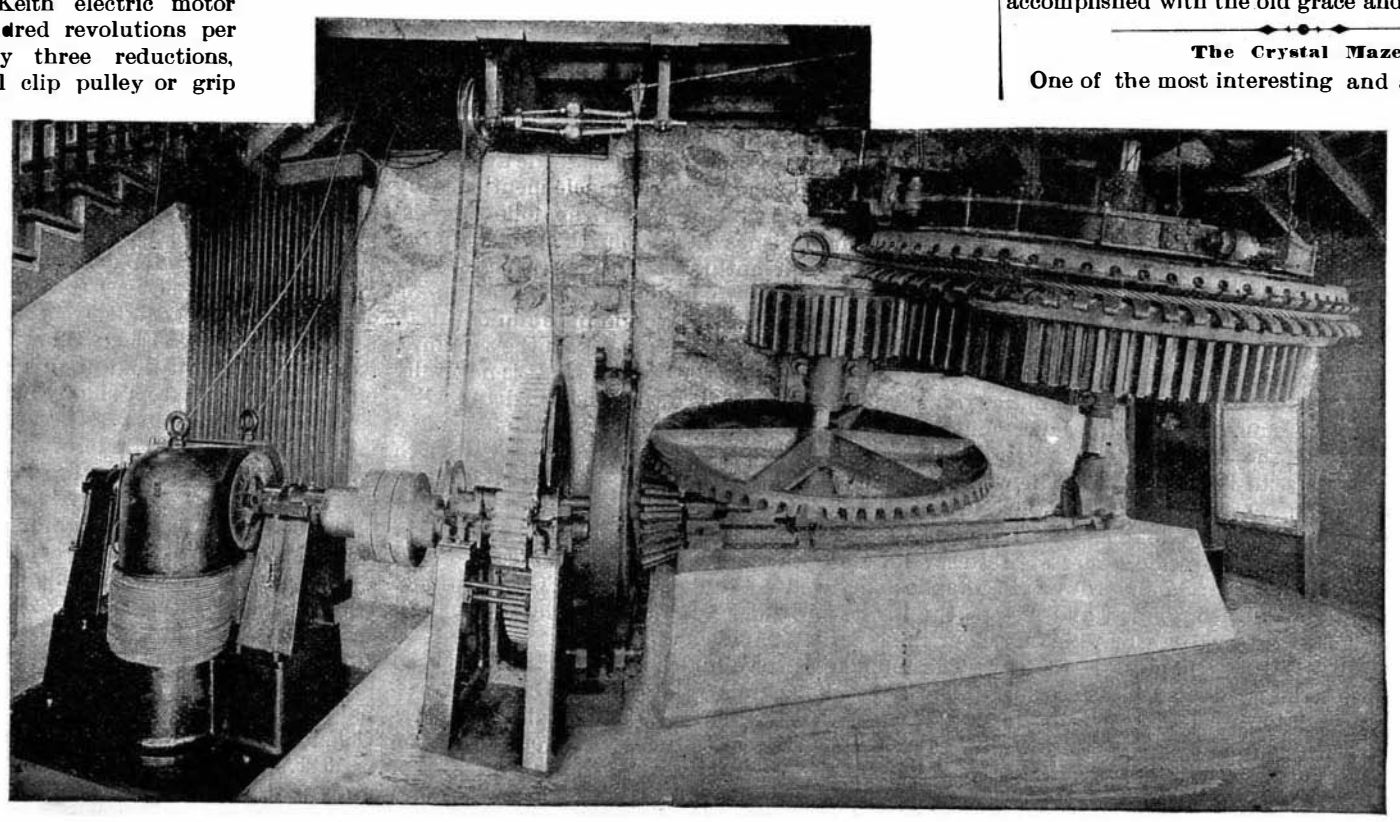
Blondin the Rope Walker.

M. Blondin, now in his 71st year, is giving marvelous performances upon the high rope at the Crystal Palace, London. In 1861, he walked across the Niagara Falls on a rope 1,100 feet long, stretched at a height of 160 feet above the torrent. At the Crystal Palace his performance is upon a rope stretched across the center transept at a height of 60 feet from the ground. The rope, which is an inch and three-quarters in diameter, is made of steel wire, covered with six strands of manila, and from anchor to anchor it is 400 feet long. Blondin walks across the rope blindfolded, stands on his head, carries a man on his back, and performs other feats, all of which are accomplished with the old grace and daring.

The Crystal Maze.

One of the most interesting and amusing lessons in optics and reflections is to be found in the Crystal Maze, Broadway and 38th St., this city.

By a scientific arrangement of mirrors placed at angles calculated to the fraction of an inch, effects in reflection are produced which would have been deemed impossible. One reflection is again reflected, and so on to infinitum, until, like specters, the lost image disappears.



THE CABLE WINDING MACHINERY, MT. LOWE RAILWAY.

[FROM THE POPULAR SCIENCE NEWS.]

The Ruby.

BY BENJ. F. MASON.

The true or oriental ruby is the gem of gems, and exceeds in value, when perfect, even the diamond. But to give it this great value its color must be of that peculiar shade of red called "pigeon's blood," which is a pure, deep, rich red, without a tinge of blue or yellow. And when of this deep, rich red the ruby is a magnificent and resplendent gem, which the ancients gave a heaven-born origin by a myth representing that it drops in blood-red crystals from the clouds amid the flashes of lightning.

In the language of gems the ruby is the emblem of elegance and beauty. By the ancients it was also considered to possess the power to correct evils resulting from mistaken friendship, and to reveal poison; and in the middle ages it was regarded as an amulet, protecting against the plague, sadness, evil thoughts, wicked spirits, ill health, danger and death.

The oriental ruby, the oriental sapphire, the oriental amethyst, the oriental emerald, and the oriental aquamarine are all corundum or pure alumina, having the same form of crystallization, like composition, and the same hardness. They are all, therefore, the same mineral, and difference in color is the only reason for changing its name, in calling the blue ruby a sapphire, the green ruby an emerald, and the purple ruby an amethyst.

The ruby is formed in rhombohedral crystals, usually imperfect. Though the cleavage is sometimes interrupted and imperfect, it is basal, that is, the crystal breaks across the prism with a flat surface. The luster of the gem is vitreous, and occasionally exhibits a bright opalescent star of six rays in the direction of the axis. It is very tough, when compact, and its colors vary from the lightest rose tint to the deepest carmine.

Its specific gravity is from 3·9 to 4·16, and its hardness is superior to any known substance except the diamond, being number nine in the scale, while the diamond, which stands at the head, is ten. It is transparent to translucent, and breaks with an uneven or conchoidal fracture. The composition of the ruby is alumina, colored by traces of metallic oxides, as the following analysis of a gem shows: Alumina, 98·5; oxide of iron, 1; lime, 0·5. The ruby is not acted upon by acids, and before the blowpipe remains unaltered, but with borax and salt of phosphorus dissolves slowly.

Rubies are usually found in association with sapphires, topazes, zircons, rutile, magnetic iron and gold. The crystals of the gem are sometimes found perfect, tapering at each end, but more often abraded or rounded; while frequently various colors in bands extend across the prism of the crystal, as when both ends of the crystal are white and the center red, or the reverse, or when any one of the colors is replaced by yellow, or even black. These gems are usually obtained from layers of earth or river beds and streams, near crystalline rocks, such as gneiss, mica, slate and granite. Rubies are found in Farther India, in the kingdom of Ava, in Siam, and in the Capelan Mountains, in Pegu. They also occur in Ceylon, at Hohenstein, on the Elbe, in the Rhine and Danube, in Australia, and in the rivers Auvergne and Iser, in Bohemia.

The ruby mines of Burma, from whence for ages the finest rubies have been obtained, are situated about seventy miles from Mandalay, and extend over an area of a hundred square miles. For centuries this district has been regarded by the natives with a reverence almost approaching veneration, and no stranger has ever been permitted to approach the mines where the precious stones are obtained. All that is known of them is that they are worked by sinking pits in the earth until the ruby-bearing stratum is reached, which varies in depth from two to twenty feet. These mines produce annually vast quantities of rubies and sapphires, besides oriental amethysts and topazes, together with chrysoberyls and spinel rubies. For centuries these mines were regarded as the special appanage of the crown, and one of the highest prized titles of the King of Burma was "Lord of the Rubies." Though the government did not work these mines, but leased them at a monthly rental, yet it reserved for the royal treasury all stones that were worth more than fifty dollars, thereby giving the king almost a monopoly of the ruby fields, for it is only very small rubies that are worth less than this sum. Though the superintendents closely watched the miners, many large stones were carried away by stealth, and again, when a ruby or a sapphire worth more than fifty dollars was discovered, the finder, in order to be able to retain the gem, broke it in twain, and thus many fine stones were ruined. When an unusually large and fine ruby was found, a procession of grandees with soldiers and elephants was sent to bring it to the royal treasury. When the late King Theebau wished to impress a visitor with his immense wealth, he conducted him into his treasury and permitted him to thrust his arm into the great jars of rubies and sapphires which stood in rows around the apartment. In this collection, the rarest and finest in the world, were many gems of almost priceless value. When Theebau abdicated the throne, he took with him many rare and beautiful gems, but most of the jars of rubies and sapphires were looted during the interregnum that followed the sovereign's departure. The rubies from Ceylon, though not found in as large quantities as those in Burma, are very fine, and are discovered in river beds and large streams.

The oriental or true ruby is often confounded with the spinel ruby, which is an inferior and entirely different gem, containing about twenty-eight per cent of magnesia. These stones are often sold through error, or with the intention to defraud, but the difference may be easily detected by the inferior hardness and lower specific gravity of the spinel ruby. This is particularly the case with Ceylon spinels. This is an old error, for in ancient times all red stones were called carbuncles and rubies, and even at the present time this name is applied indiscriminately to various red gems, which is very deceptive to the novice, who imagines the ruby to mean only the red corundum. Even the two large stones exhibited by Queen Victoria as rubies at the London Exhibition of 1862 were found on an examination of their specific gravity and hardness to be spinels.

In experimenting in the manufacture of rubies, chemists have succeeded in producing artificial crystals of the same form of crystallization and of equal hardness with the natural gem, but they were very small and of little value, being no larger than those used for watch jewels, which can be bought by the pound. The artificial rubies are formed by melting alumina and borax in a platinum crucible. The borax dissolves the alumina, after which it evaporates, leaving the alumina in a crystallized state. Blue and red crystals have also been produced by bringing the volatilized fluoride of aluminum into the vapor of boracic acid, when decomposition takes place, and fluoride of boron escaping, leaves the crystals of alumina.

In the United States rubies have been found in association with sapphires at Vernon, N. J., but they were generally opaque and unfit for gems, although a number of stones have been cut and polished. In the Jenksmine, at Franklin, in Macon County, N. C., while mining for corundum, over fifty rubies and sapphires were discovered, of which nearly one half were really fine gems. The colors were blue, violet blue, pink, yellow, and ruby red. The smaller gems were the richest in color, and a few of the best found here were sold for nearly a hundred dollars each. Rubies, with their invariable associates, sapphires, have also been discovered near Helena, Mont., near Santa Fe, N. M., and in Colorado and Arizona. In this gem-producing district, formed by a part of New Mexico, Arizona, and southern Colorado, rubies and sapphires occur in sand, and are particularly found on ant hills, which abound there, associated with peridots and garnets. Perfect red rubies and blue sapphires have occasionally been found, but most of the gems are of a light green, greenish blue, light blue, light red, and red color, with also the intermediate shades. Though no mining or systematic search has ever been prosecuted in this wonderful district, rubies and sapphires sold and cut into gems bring annually over $2,000, not including the large number that is disposed of as specimens for mineral cabinets.

From the earliest ages of antiquity the ruby has been regarded as one of the most valuable of gems. An Eastern legend runs that a ruby was suspended in the ark of Noah to diffuse light, and the Vedas of the Brahmins mention a place lighted by rubies and diamonds, which emitted light like that of the planets. In China and India rubies have been employed from the earliest times for the ornamentation of a great variety of jewelry. They are also mentioned in the Bible, in the Proverbs of Solomon and in the twenty-eighth chapter of the book of Job, in verse eighteen: "No mention shall be made of coral or of pearls; for the price of wisdom is above rubies." The anthrax of Theophrastus and the Indian carbuncle mentioned by Pliny were undoubtedly rubies, as the following description by an ancient writer confirms beyond doubt: "The carbuncle or anthrax is an elegant stone of a deep red color, which when held against the sun resembles a glowing coal. It is found pure and faultless, and of the same degree of hardness with the sapphire, which is only second to the diamond. It is naturally of an angular figure, and bears fire unaltered and without parting with its color." It is the third stone mentioned as being in the breast-plate of the Jewish high priest, under the Hebrew name of *baraketh*, translated carbuncle, and it is also found among the royal ornaments worn by the king of Tyre (Ezekiel xxviii. 13). In several European museums are ancient cameos and intaglios engraved on rubies, about B. C. 500, which, as the historical reader is aware, was one of the most flourishing periods of Greek art.

The number of large and fine rubies that has been discovered—not including those in the Burmese treasury, of which little is known—is very small. The largest ruby of which there is any record is reported, upon the authority of Marco Polo, to be in the possession of the King of Ceylon. "It is a span long (nine inches), as thick as a man's arm, and without a flaw." In the French crown, adorning the order of the Golden Fleece, is a fine ruby cut in the form of a dragon with extended wings.

Hygiene of the Eye.

Dr. F. C. Heath, of Indianapolis, says: Rest should be considered as one of the most important factors in treating diseased or strained eyes—rest of eyes, body and mind. Avoidance of wind, dust and smoke, or protection from their evil effects, must not be neglected.

Personal habits enter into the question of causation of eye disease, and their regulation becomes, therefore, a part of the preventive or hygienic treatment. Sexual excesses undoubtedly contribute to the production of muscular asthenopia and hysterical amblyopia and photophobia, besides affecting the conjunctiva indirectly through their influence on nasal catarrh. Tobacco and alcohol have their well recognized amblyopias. Lack of bathing the eyes properly may result in conjunctival trouble. Use of water, both cold and hot, may have a place in the hygienic treatment of diseased eyes. Employ, as a rule, that which is the more grateful to the patient, cold usually for conjunctival diseases and injuries, hot for iritic and deeper troubles, avoiding anything like a poultice. Indeed, there should be a limit to cold applications, lest the nutrition of the cornea become enfeebled, while that delicate tissue requires still greater care in the use of hot applications (seldom exceeding one hour at a time), from fear of maceration and consequent ulceration. Diet is important, chiefly through its effects upon indigestion and general health, which frequently have much to do with the condition of the eye.

A few words as to abuse of eyes may not be amiss. The first offense in this line is reading with a poor light—requiring the ciliary muscle to do extra work to sharpen the vision. This applies to dim light, twilight, sitting too far from the light, etc.

The second offense is error of posture—stooping or lying down congests the eye, besides requiring unnatural work of the eye muscles.

Reading on trains is our third offense, the motion causing such frequent changes of focus and position as to tax the muscle of accommodation as well as the muscles of fixation, so to speak.

Reading without needed glasses or with badly fitting ones is our last, but not least, offense. Aside from the various well known reflex effects of eye strain, the danger to the eye itself is not to be slighted. Eye strain is certainly a factor in producing disease of almost every part of the eye, its most serious effects being choroiditis, glaucoma and cataract.

Old age is the time of retribution for eye sinners—it calls for little in a special hygienic way beyond the occasional stimulating washes and the careful husbanding of what sight remains.

Fortunately the surgeon's skill can give nearly all sufferers from cataract a greater triumph over their troubles than is afforded any other sufferers whatever, yet it is only after quite a period of darkness in waiting the ripening of the cataract.

Accidents from Thawing Dynamite.

The most fruitful source of accidents with dynamite is the thawing of the cartridges, which solidify and become inert at a comparatively high temperature, namely, about 40° F. To thaw the cartridges, tin warming pans are, or should be, provided, and if used with ordinary care, they form a safe and efficient means of carrying out this operation. They are constructed on the principle of the glue pot, the cartridges being placed in the removable portion and covered up, the bottom part being filled with warm water. So reasonably safe is the use of this contrivance that the author can only recall one instance of an accident occurring in its use. On the other hand, a very large number of persons have been killed, and a still larger number seriously injured, and much property destroyed through the improper thawing of dynamite. Much misapprehension and misplaced confidence has been caused by the fact that small quantities of unconfined nitroglycerine, and explosives containing it as their chief constituent, will sometimes burn quietly away when ignited by direct contact with a flame. It has, therefore, been thought that if this was the case, no ill effects could arise from simply heating it. This idea, as the author has already observed, is a terribly mistaken one. If a cartridge of dynamite or its congeners is lighted or placed in a fire, it may burn harmlessly away. But if a similar cartridge is placed on the hob of a stove or an oven, and gradually heated up to its exploding point, which is from 350° to 400° F., a violent explosion will almost inevitably result, and before that point is reached the explosive will become extremely sensitive to the slightest shock. Nobel states that, when dynamite is heated to 440° F., it is liable to explode. But Nobel is the apostle of dynamite, and is liable to look a little too favorably upon its faults. Colonel Cundill, one of her Majesty's inspectors of explosives, gives 360° F. as its exploding point, and eissler, in his work on explosives, states that when dynamite is heated to 350° F., a dime falling upon it will explode it.—*B. F. Nursey, Society of Engineers.*