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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE RELOCATION OF OUR RAILROADS.

An observant traveler over the trunk lines of this country will be struck with the fact that many of them are undergoing a relocation and reconstruction which, in many cases, will cost two or three times as much per mile as the original line. One of the most notable instances of this is to be found on the main line of the Pennsylvania system between Pittsburg and Altoona, where the work of straightening out the line and lowering the grades involves an amount of excavation and embankment whose great cost is evident even to the casual traveler on the road. This work of reconstruction is not to be taken as in any sense a reflection upon the engineers who located the original lines. It simply means that the growth of traffic and the increase in wealth of the road are such as to justify the reconstruction of a road on a scale of excellence which, on account of its great cost, was unwarranted and indeed, impossible, when the lines were first projected.

When an engineer sets out to locate a line through a tract of country, his natural inclinations will lead him to make the line as nearly level and as nearly straight as the topographical conditions will allow, and it is only because he is handicapped by arbitrary conditions, chiefly of a financial nature, that his location shows the endless succession of curves and grades which characterize a preliminary survey. So true is this, that it may safely be said that the sharpness of the curvature and the severity of the grades will be in strict proportion to the resources of the company that sends him out. In the early days of railroads, when the present bewildering cobweb of lines was commencing to be spun out over the face of the continent, population was sparse, funds were limited, and the steam railroad as a means of transportation was yet something of an experiment. In marking his survey and submitting his preliminary estimate of the cost of a new road, the locating engineer was frequently tied down by rigid restrictions of economy in the shape of a limit of cost of so many thousands of dollars per mile, which he was informed the road was not to exceed. Working on this basis he was naturally careful to disturb the natural surface of the country as little as possible. In developing his line through hilly country he would swing round a bluff with a ten-degree curve, rather than involve the quadruple expense of cutting deeply into the bluff with a six or seven-degree curve. Similarly he would carry his line over the summit of a divide with a three or four per cent grade, rather than face the costly alternative of a lighter grade and a two or three-mile tunnel at the summit. The line was laid down with strict regard to economy in first cost, and with little or no regard to economy of operation. It was regarded as a temporary expedient, and the present costly relocations which are taking place are not the remedying of defects in the work of our earlier railroad builders, but are merely the completion of plans which they themselves had in mind from the beginning and would have followed had they been financially able. We note that our esteemed contemporary, The Railroad Gazette, has taken exception to the following statement made in the Report of the Master Mechanics' Committee on the "Maximum Monthly Mileage." "We cannot resist comment on the poor judgment, frequently displayed by our civil brothers in engineering, when, in selecting the cheapest line in the first instance, instead of one with a given maximum grade curve, they only prepare for work that must be done later at enormously increased cost." We think that the exception is certainly well grounded, and, indeed, we are of the opinion that of all the men who contributed to the construction of the pioneer railroads of this country, none are more deserving of credit for their general skill, good judgment, and foresight than the civil engineers who did their work subject to most harassing financial embarrassments. If blame is to be laid, it should be upon the financial and not the engineering aspects of these early roads. Just here, indeed, we would draw attention to the too-frequently-forgotten fact that the credit which is due for the conception and carrying out of engineering works is very intimately dependent upon the plenitude or scarceness of funds available for the engineer; and there is no doubt that as great resourcefulness and skill is frequently necessary in carrying out small works on a limited capital, as in directing the monumental structures of modern days where every facility in the way of men and material and unlimited capital, is available.

SOME RESULTS OF THE ALBANY FILTRATION PLANT.

The recently completed Albany filtration plant, of which we gave a fully illustrated description in the SCIENTIFIC AMERICAN of March 24, 1900, has afforded an excellent opportunity to obtain accurate data, both as to cost of operation and efficiency of results. Fortunately the responsible authorities have turned the opportunity to the best account, and the engineer of the works, Mr. George I. Bailey, has recently been able to present accurately compiled figures of the results already obtained. Although there were plenty of records of a kind on this subject, there were but few that gave comprehensive details. The method of treatment adopted at Albany is that of slow filtration through sand. The water is raised 18 feet by pumps into a large settling basin, from which it passes to eight filter beds, consisting of various superposed layers, ranging from gravel of about the size of a baseball at the bottom to fine sand at the top, the top layer of sand being about 4 feet in depth and the total depth of the sand and gravel being 5 feet 2 inches. The water is led in over this prepared bed to a depth of 4 feet, and is allowed to pass downward through the gravel and sand to a system of underdrains, at the rate of about 4½ inches an hour, the yield per acre of the filter-bed being about 3,000,000 gallons in every twenty-four hours. From the bottom of the filter-beds it is drawn off to a central pumping station, from which it is distributed throughout the city. The first purification takes place in the large settling basin, where the heaviest suspended impurities are deposited. In passing down through the filter-bed the silt and bacteria are deposited in the top layer of sand, and the greater part of it at the top of the bed. So perfect is this filtration, at the slow rate at which the water passes through, that the finest particles and most of the bacteria are strained out at the surface and not carried down into the bed of sand. Periodically, the top layer of sand containing the silt and bacteria is scraped off, cleansed in special washing machines, and redistributed over the bed.

It is justly claimed that the truest test of efficiency of a system of filtration is its effect upon the public health of the city which uses it, as shown in the lowering of the death rate due to certain well-known, water-distributed diseases. Now, comparing the average number of deaths per year in Albany for the year 1900 with that of previous years, it is shown in the report of the operation of the filtration plant that whereas the average for the previous decade had been 2,186 per year, the number of deaths for the year 1900, during which the plant was in operation, was only 1,742, a decrease of 444 deaths. Special significance is given to these figures by the fact that before this year, the number of deaths from all cases throughout the State of New York exceeded the mortality of the year 1899 by 6,647, and exceeded the average for the past five years by 8,000. Moreover, typhoid fever, a water-borne disease, was unusually prevalent throughout the State in the autumn, causing 1,948 deaths, or 350 above the average. In view of these facts, which are stated in the Monthly Bulletin for December, issued by the State Board of Health of New York, the reduction in the death rate of Albany from 2,186 to 1,742 must be considered as a decided tribute to the efficiency of sand filtration. Judged by the typhoid standard, the Albany plant has proved itself a great and decided success. The average yearly deaths from typhoid during ten years had been 84, whereas the number of deaths during 1900 was only 39, 14 of which were unmistakably alien or imported cases.

The efficiency of a filter is judged by counting the bacteria in the raw water and those remaining in the water after filtration, and thus obtaining the percentage of removal. In a table of results for the sixteen months from September, 1899, to December, 1900, showing, month by month, the work accomplished, the lowest percentage is 97.6 in September, 1899, and the highest 99.6 in April, 1900, the average percentage of removal for the whole sixteen months being over 99 per cent. The report shows that the cost of filtering at Albany per million gallons is $1.66, while the total cost of the whole plant, including the care of the filter beds, care of the grounds, pumping the water from the Hudson River and the laboratory expenses, was $4.52 per million gallons.

AN EPITOME OF AMERICAN RAILWAY METHODS.

On another page we publish an article on the extremely interesting ore-carrying railroad between Conneaut, on Lake Erie, and the city of Pittsburg. This road was originally built for the express purpose of carrying iron ore from the lakes to the steel works of Pittsburg, and it now promises to have an equal importance in the transportation of finished steel from Pittsburg to the lakes, for shipment to Europe. We commend this subject to the careful attention of our readers for the reason that the railroad exhibits the distinctive American principles of railroad operation in their most modern development. The principle of concentration, which has underlain the latest industrial developments of this country, has received its highest expression in the world of transportation, whether on sea or land, and in the moving of freight on railroads it has acted to produce by far the biggest engines and cars that are to be found anywhere in the world. The Pittsburg, Bessemer & Lake Erie Railroad set out to solve the problem of carrying over a given line the greatest possible amount of freight at the least possible cost in time, labor, fuel and repairs. The management, working with a free hand, and using 115 to 125-ton locomotives, 50-ton cars, 100-pound rails in the track, and easy gradients and curvature, have reduced the cost of operation below that of any other railroad in this country.

THE FUTURE POSSIBILITIES OF SIBERIA.

The world has now to deal with a new factor. Ten years ago the name Siberia called up only a picture of wastes of snow and ice, boundless steppes and coasts white with icebergs, but to-day the same Siberia is a land filled with thriving villages of peasant farms, producing grain and vegetables. The railway has succeeded in breaking down the bars between the world and Siberia. The vast country is now beginning to show its resources of gold, iron, copper, manganese, mercury, platinum and coal, the yearly output of which at present is but a favorable index of what it will be when the deposits are developed. In the past three years several American mining engineers have traversed various parts of Siberia and Central Asia, and they testify that the lack of exploitation of such evident mineral wealth as is found here is unparalleled in other parts of the civilized world.

Of this, gold is by far the most important, and, strange to say, it is the least developed product, being approximately $25,000,000 a year, thus placing Russia fifth among the gold-producing countries. It is almost entirely placer gold, and the quartz veins and original deposits of gold, though exposed to view in many places, both in the Ural Mountains and Siberia, have been hitherto unworked in any but the most inefficient manner. Furthermore, antiquated and expensive methods are in use by even the largest companies for working the placer deposits. These methods have undergone no improvements during the last fifty years. At numerous mines in Siberia 2,000 men and 500 horses are used on a single property to produce gold not exceeding $2,000,000 per annum; and in some of the platinum mines of the Urals the above-mentioned quota of men and horses is employed for an output not exceeding $800,000. The properties may be easily worked with the employment of dredges and mineral excavators, and even the auriferous gravel could be advantageously carried to the washing machines by wire rope gravity conveyers. The gold output of the Russian empire could be increased to three times its present amount by the use of modern mining machinery. Of the quartz deposits in Siberia it may be said they are entirely undeveloped. There are probably to-day not over a dozen stamp mills operating in the whole country, and it is doubtful if over 150 stamps are in use. Notwithstanding this fact the operations frequently pay large profits. Deep mining is unknown. It is doubtful if there is a single shaft in the limits of the Russian empire which has penetrated a precious metal deposit to a depth greater than 700 feet.

The difficulties of transporting machinery to the deposits is much less than is generally supposed. Of high mountains, such as the Rockies and Sierra Nevada, Siberia has practically none. The interior is penetrated by a network of vast waterways, rendering inland transportation easy and cheap. Heavy freight can be laid down in central Siberia at the majority of the mines, the freight not exceeding $40 a ton from New York, and if water transportation is made use of this price may be reduced nearly one-half. The freight loaded at Hull, England, is transported via the Arctic Ocean to the mouth of the Yenisei River, where, after being reloaded to steamers of lighter draught, it is shipped direct to the crossing point of the Trans-Siberian Railway. From San Francisco to east Siberia it is a matter of water transportation entirely. Regular steamer lines furnish excellent accommodations for passengers, and it is now possible to go from New York via Berlin, Moscow and Irkutsk to Vladivostock on the Pacific in twenty-five days. A railway which shall connect Asia and America at the Behring Strait will probably be built in the near

future, and, notwithstanding the terrific cold of winter, it will not be so difficult to build as it was to construct the line of the White Pass and the Yukon Railway.

The prices paid for labor in Russia and Siberia are exceedingly low, varying from 15 cents to $1.50 per day, the laborers feeding themselves out of their earnings. This large range in the price of labor depends greatly upon the locality and whether food is plentiful or not. In central Siberia men can be contracted for by the year at $15 per month; the workmen are of the peasant class. It is not thought that laborers in Siberia will at once alter their methods, but this will probably come in time. The mining laws of Russia allow the taking up of mining claims by Russians or foreigners, but there are many severe restrictions. The claims consist of 200 acres of land, generally surveyed at the locator's option.

Cities of 10,000 to 50,000 inhabitants are now numerous in Siberia. Hotels with comfortable rooms, restaurants which may be said in many cases to be truly palatial, with electric lights and telephone connections, are not difficult to find, says Consul Thomas Smith, of Moscow. Anyone can traverse Siberia in great luxury in superb trains supplied with bath, piano, dining saloon, drawing room, easy chairs, observation cars, etc., the whole being lighted by electricity. The cost of the journey from Moscow to Irkutsk, 3,200 miles, including sleeping car, is only $44. Siberia is practically unknown to most Russians, and they have an idea that furs are always necessary on account of the intense cold. Actual experience in the city of Krasnoyarsk shows that the thermometer reaches 110 degrees for days together in the month of August, and any clothes but those made of silk and linen were absolutely unendurable. To those who wish an unhackneyed trip, Siberia offers an excellent opportunity.

THE HEAVENS IN AUGUST.

BY EDGAR L. LARKIN.

THE SUN.

The sun moves east 1 h. 53 m. in August—not 2 h.—because the earth's velocity is less than the average, moving 54′ 40″ daily instead of 59′ 8″, the mean. Part of this loss of speed is accounted for by its increased distance from the sun, having been at its most distant point on July 3. Therefore, not quite one-twelfth of the sky will be lifted up in the east or sunk in the west. The sun will be 9° 21′ 22″ nearer the equator on August 31 than on the 1st. At this writing (July 7) it is free from spots.

MERCURY.

This planet will reach its maximum elongation, west, on the 2d (19° 22′), and must, therefore, rise before the sun, because, being west, it sets before the sun does. Its right ascension—distance east from the first point of Aries—will be 7h. 31 m., but that of the sun will be 8 h. 48 m. The advancing horizon will overtake Mercury first because it is at a less distance from Aries, 1 h. 17 m. earlier, hence it will be morning star. Since it is 2° 29′ further north than the sun, it ought to be seen without optical aid from the entire Atlantic coast of the United States. Here in the marvelous air of the Sierra Madre Mountains it will glitter with brilliancy unknown in the Eastern States. Mercury will rise up through its node on the 9th; that is, it will come from the south to the north side of the plane of the earth's orbit. Thus: (2) N. / (1) S. the line is cut out of the plane, and the circle, 1, is Mercury before passage and 2 after. The planet will be nearest the sun on the 13th, farthest north on the 23d, from which position it rapidly declines and retreats to the opposite side of the sun from the earth on the 27th, so that the centers of the earth, sun and Mercury will be nearly on the same straight line.

VENUS

is evening star and will be unimportant throughout the month, since it is farther away than the sun. Its eastern advance being only 20m.

THE EARTH.

Stand back to the sun at sunset on August 1, and look toward the opposite side of the universe; then the earth will be slightly west of θ Capricorni, and on the 31st a little west of λ Aquarii.

MARS

is so far away that, being in the solar glow, it will not appear of special interest, but a study of its motion is highly instructive. Its R. A. on the 1st is 12 h. 40 m., and on the 31st 13 h. 50 m.—gain 1 h. 10 m., while its declination south increases from 4° 16′ to 11° 44′. But this track carries it through the plane of the ecliptic from north to south, and it passes its descending node on the 5th at the 19th hour, when its R. A. will be 12 h. 51 m. and its declination south 5° 27′ 58″, which point is in the ecliptic plane, when for an instant the latitude of the center of Mars will be zero. This affords a fine opportunity for locating the earth's orbit among the stars. For Mars will slide along near and below the plane for several days, while Venus to the west will be advancing slightly above it, the equator, ecliptic and equinoctial colure, or 12th hour circle, all crossing between the two planets. August 5 will be of great interest, for Jupiter and the earth's orbit coincide, with Saturn only 1° above it. Remember where the sun disappeared on that day—make a note of where the center of the earth is, then in succession pass the eye from the sunset point to Regulus, Venus, Mars, Spica, Jupiter and Saturn, and an arc of the orbit traversed by the earth will be cut out. On the 18th Mars will pass the first magnitude star Spica 2° 7′ to the north, while on the 21st the distance between the star Regulus and the sun's center is only 15′, but since the radius of the sun on that day is 15′ 50″, Regulus will vanish behind the sun, or make an exceedingly close approach.

JUPITER.

The R. A. of Jupiter on the 1st is 18 h. 19 m. 35 s., and on the 31st 18 h. 14 m. 4 s., hence he loses 5 m. 31 s.; that is, retrogrades during the month. But on the 31st he stops, hesitates a moment and then begins a race with Saturn that will be one of the most impressive spectacles of modern times. Thus, at noon on the 29th the seconds, only, of R. A. are 4.35, 30th 4.06, 31st 4.59; thus 4.06 is the least—planet farthest west—and the next day it is east again. The entire world where the splendor of the approaching conjunction (November 27) is visible, cannot fail being lost in admiration.

SATURN.

Saturn also loses 5 m., and is in training for the race when he will strive to outrun Jupiter, but will fail. Both planets are in Sagittarius, and, in the splendid air of California, burn and blaze with a supernal light, unseen where the atmosphere is impure.

URANUS.

This distant world is in Ophiuchus and almost at a standstill, moving only 35 s. in the month.

NEPTUNE

sets before the sun and is invisible in the evening. Therefore in August, 1901, α Cancri and the cluster Præsepe, Regulus and both Lions, with the head of Hydræ, Sextans and the mast of Argo Navis will vanish in the west, and at this observatory, if not consumed in solar flames, will be cast into the ocean. In the east Cygnus, the Fox and Dolphin, with Capricornus, Aquarius, Equleus and the head of the steed Pegasus, will be new.

Mount Lowe Observatory, California, July, 1901.

TWO EMINENT CALIFORNIA SCIENTISTS.

By the death of Prof. Joseph Le Conte and Dr. Harvey Wilson Harkness, California has been deprived of two of its most eminent scientists. Both were men approaching four score years, and had been residents of the State from early manhood. Though as investigators each pursued a different branch of science, yet each rendered great service to the community and well deserved the high estimation with which they were universally regarded.

Probably no man has studied more industriously or arrived at conclusions that are more entitled to respect as to the complex geological system of California than Prof. Le Conte. From 1869, the year he became one of the faculty of the University of California, as teacher of natural sciences, all of his unoccupied moments were spent as a student. He was one of the first to scientifically explore the Yosemite Valley and the very first to describe and define the geological conditions and attractiveness of that wonder of nature. It was an appropriate spot for the old professor to give up his last breath. Prof. Le Conte was among the first who explored the region east of the Sierras in Inyo County, finding traces of the great lake that once covered that country to great depths, defining boundaries, and luminously detailing the remarkable geological problems there presented. Prof. Le Conte was the author of many scientific textbooks and a strong advocate of evolutionary doctrines.

The branch of science in which Dr. Harkness gained his great eminence was the obscure one relating to fungi, particularly as concerned the abundant plant and fruit life of California. The service he rendered to an important and expanding industry of the State in the definition and cure of this class of disease entitles him to grateful remembrance. For many years Dr. Harkness was president of the California Academy of Sciences and devoted his leisure to the development of that great institution. At the beginning of his administration the academy was ill housed and dependent upon contributions for an existence. Later James Lick left it over $1,000,000, and the building which it now occupies, filled with a priceless collection of natural objects, is worth three-quarters of a million and is of splendid usefulness.

Both of these eminent men lived lives simple and unostentatious. Their friendships were wide, and in the world of science they will be greatly missed.

SCIENCE NOTES

The Guttenberg Museum at Mayence was opened on June 23.

Wherever the Romans penetrated they were sure to erect great baths. Recent excavations on an estate in Scotland have revealed the foundations of an immense bath with concrete floors and walls, lead-pipe connection, hypocaust and stoke-hole with a flue extending from it, says The Architect. The foundations of the piers in the hypocaust are now displayed. The walls of the rooms are formed of stone and lime covered with strong concrete, with a polished surface and painted a brick-red color. The floors are all of concrete.

An attempt is to be made by the British authorities in Uganda to utilize the zebra for transport purposes in that country. It is contended that the characteristics of the animal render it specially suited to this district, since it is naturally immune against the ravages of the tsetse fly and horse sickness. The plan suggested is the domestication of the adult animal. The young zebra cannot be reared apart from its mother, and it is considered that if the animal were accustomed to the presence of man from its birth, in the course of a few years a large supply of zebras will be available for work.

The study of languages by those who are not able to obtain actual instruction from the professor has always been hampered by the fact that notwithstanding the grammar might be mastered there was always trouble with pronunciation. This phonetic difficulty has been overcome by the International Correspondence Schools of Scranton, Pa. The system employed is highly interesting, for each student in the language courses is furnished with a phonograph. The instruction proper is given by mail. The lessons are dictated by the professors at Scranton, and the phonograph cylinders are sent to the students. The cylinders are not copies, but are "master records," so that they are so clear that the students are easily taught the correct pronunciation. The courses in the foreign languages are under the direction of Prof. David Petri-Palmedo, who will give instruction in German; Prof. Edouard Lamaze, who will teach French, and by Prof. Antonio Llano, who will teach Spanish.

NEW WEAVING DEVICE.

A new contrivance, which it is anticipated will modify the process of weaving, has been invented by a young weaver named Bernard Crossley, of Burnley, Lancashire, England. By means of this little device, which can be attached to existing looms, one weaver can attend to eight looms, and as stoppages are avoided, each loom will produce 12½ per cent more cloth in the same time. The invention is a small device capable of attachment at a comparatively small cost to the present single box looms. There are at present some 850,000 power looms in England, and of this aggregate 600,000 can be fitted with the Crossley invention. Its mechanism is simple; it works at a tremendous speed, and effects the shuttle changes with remarkable rapidity. For example, if a loom is working at the good average rate of 250 picks per minute, this device, without any pause in its action, changes the shuttle in one four hundredth part of a minute—half a revolution of the first shaft. This change is accomplished without any of the faults in the general type of loom. The cloth is woven very evenly; that is to say, there are no thick and thin places in the cloth caused by the insertion of too much or insufficient weft. After the change of shuttle the loom resumes work without leaving any trace of the change having taken place, with the exception, perhaps, of a broken pick. It consequently produces a far superior cloth to that woven upon the present loom. In view of the remarkable merits and advantages of this loom the invention has been acquired by a wealthy syndicate, and it is stated that it will be attached to the looms in several of the leading cotton mills of Lancashire without delay.

THE FASTEST TRIP OF THE "DEUTSCHLAND."

The Hamburg-American steamer "Deutschland," which sailed from the port of New York July 11, arrived at Plymouth July 17, making the trip in 5 days, 11 hours and 5 minutes. It is true that this was not the quickest trip which the "Deutschland" has made between Sandy Hook and Plymouth, but on this trip she ran on the long course. Her best time on a short course of 2,080 knots was 5 days, 7 hours and 31 minutes; but on the trip just completed she made an average run of 23.51 knots an hour, which beats her best previous record of 23.36 knots an hour. Her hourly average of 23.51 knots, if maintained over the short course, would enable her to cross in 5 days and 3 hours. Her greatest day's run on the recent trip was 557 knots, and on this day her average speed was about 24 knots per hour, allowing 23 hours and 10 minutes as the length of a nautical day going east.