SCIENCE

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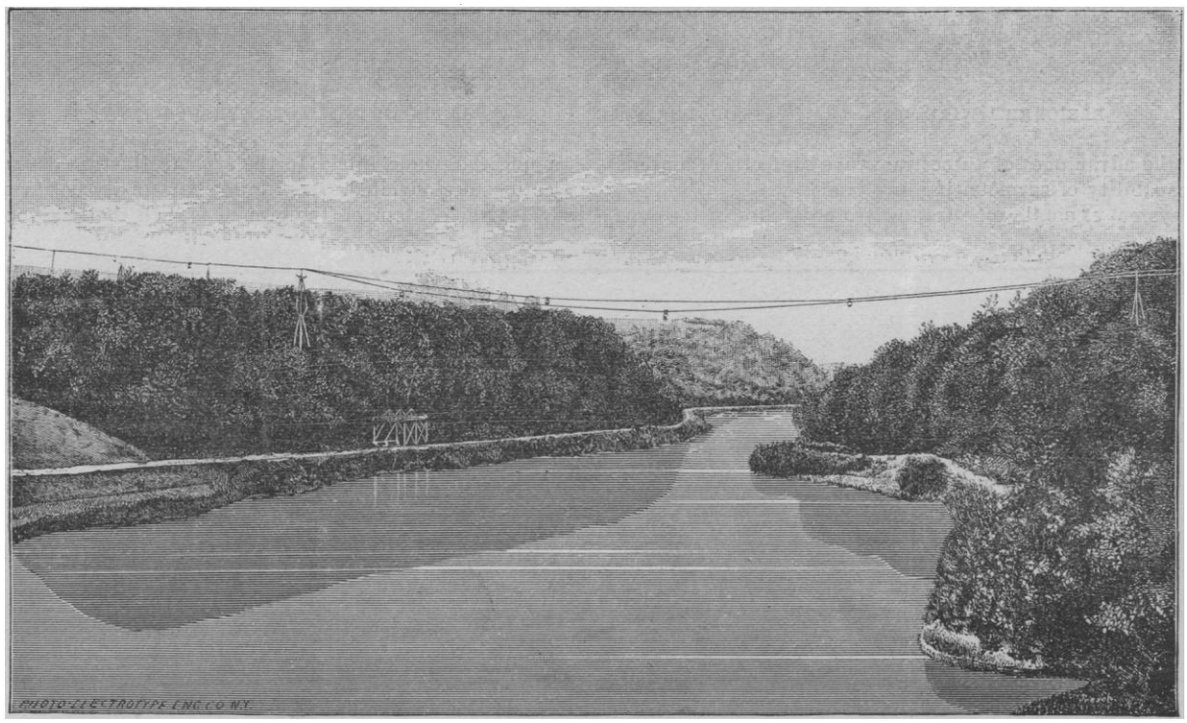
WIRE-ROPE TRAMWAYS.

WIRE-ROPE tramways, as a means of cheap transportation, are too well known to require any long dissertation on their advantages. As feeders to established systems of railroad or water communication, their low cost of construction through countries where, from the rugged contour of the surface, ordinary railroad or even wagon-road building would be scarcely practicable, except with long and costly détours, has always made them very attractive to the miner and quarryman, to whose use in this country they have been heretofore almost exclusively confined. The earliest tramways of this kind which were successfully introduced consisted of a single, moving, endless rope, from which the loads were suspended. In one system the buckets or carriers are attached to saddles, which ride on the rope, but can be separated from it. In another system the carriers are attached permanently to the rope. But in each of these systems one and the same rope both supports and moves the load.

This fact is really the reason that aerial transportation has hitherto not become general in the United States. Lines constructed with the single moving rope, while very efficient for certain purposes, are not available for general use as a means of transportation, because of their limited capacity for carrying individual loads, which in no case can exceed 300 pounds, and in practice have been much smaller. The original single-rope systems are the ones chiefly used hitherto in this country. In Europe, however, while these single-rope lines were also first in vogue, the double-rope system has of late years almost entirely supplanted them, and has established itself, as a general means of transportation, to an extent hardly yet dreamt of here.

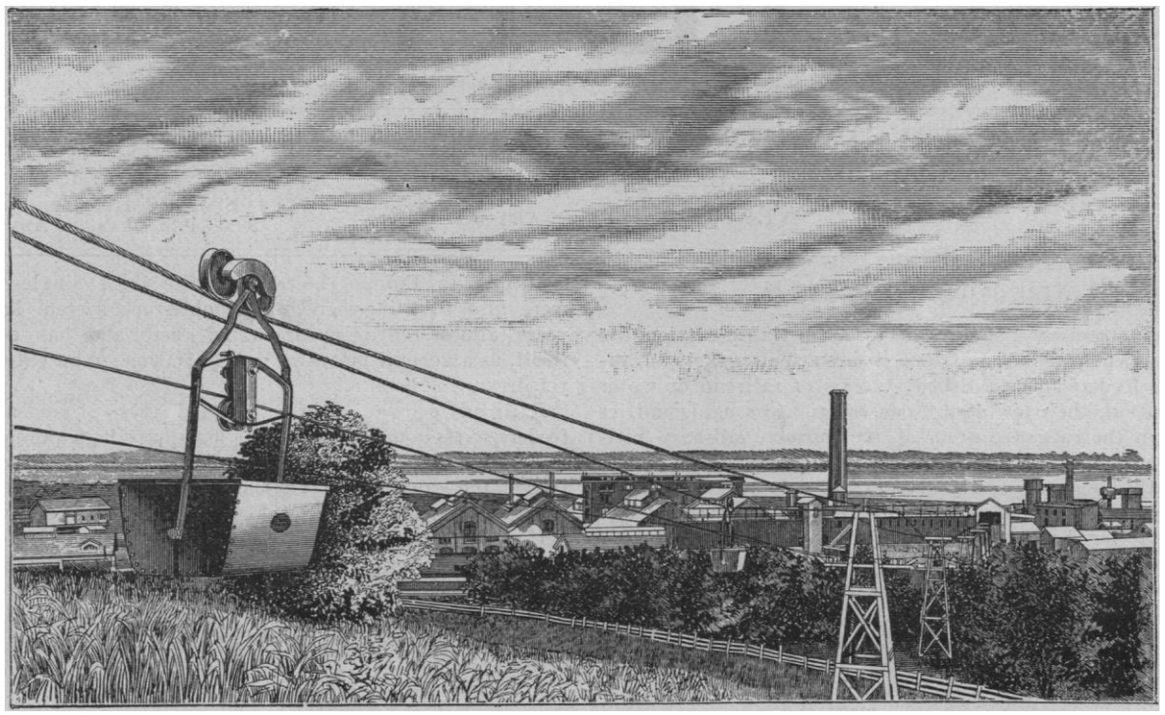
Railroad companies have adopted these lines as regular feeders to their main roads, and laws have been promulgated in different European countries regulating their construction and traffic, the same as for ordinary railroads. This extension of their application is due principally, if not entirely, to the perfection attained under the Bleichert system, some features of which are shown in the accompanying illustrations. While the individual loads to be carried by the single-rope lines should, for convenience and economy, preferably not exceed 150 pounds, and are, in fact, seldom over 100 pounds, the lines of this system are adaptable to individual loads up to 1,000 pounds each, and in special cases even heavier loads have been carried.



THE BLEICHERT WIRE-ROPE TRAMWAY, 1,000 FOOT SPAN, OVER THE WEINBACH VALLEY.

Single-rope systems of tramways, where the moving rope carries the load, must necessarily move slowly; otherwise there is great danger that the rope may jump out of the carrying-sheaves. These carrying-sheaves are very shallow, so as to permit the passage over them of the saddle or clip. The dropping of the rope from the supporting sheaves has always been a source of more or less trouble and expense in operating these lines. In this system this trouble never occurs, since the stationary carrying-cable has no tendency to leave the saddle

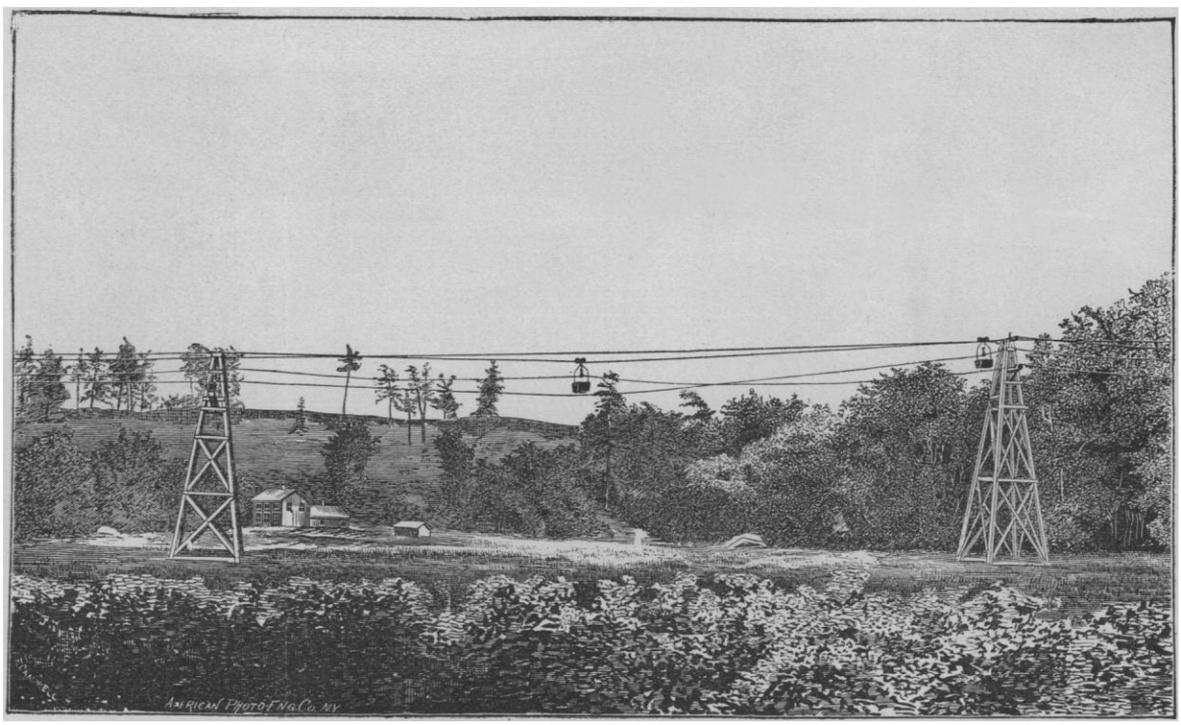
in which it is carried. This being the case, there is no difficulty in moving the cars of these lines at a speed of three or four miles an hour.



BLEICHERT WIRE-ROPE TRAMWAY OF THE SPLIT ROCK CABLE ROAD COMPANY, SYRACUSE, N.Y.

One of the advantages of these tramways over others consists in their capability of surmounting any grade.

In one system of single-rope tramways, no grades in the rope are permissible steeper than 1 in 3½. In fact, 1 in 4 is really about the limit. On steeper grades there is danger of the load slipping on the rope. To obviate this danger, another system employs a clip which fastens the bucket permanently to the rope. While this corrects the danger of slipping, it gives rise to the objection that the buckets must be both loaded and unloaded while moving, since they cannot be stopped without stopping the whole line. In the system illustrated, both these objections are obviated. Any grade can easily be surmounted, provided the contour of the ground is such that the inclination of the carrying-cables is not steeper than 1 in 1. The inclination of these cables does not necessarily follow the contour of the ground in all cases. For instance: in crossing valleys and streams this system permits the use of long single spans,

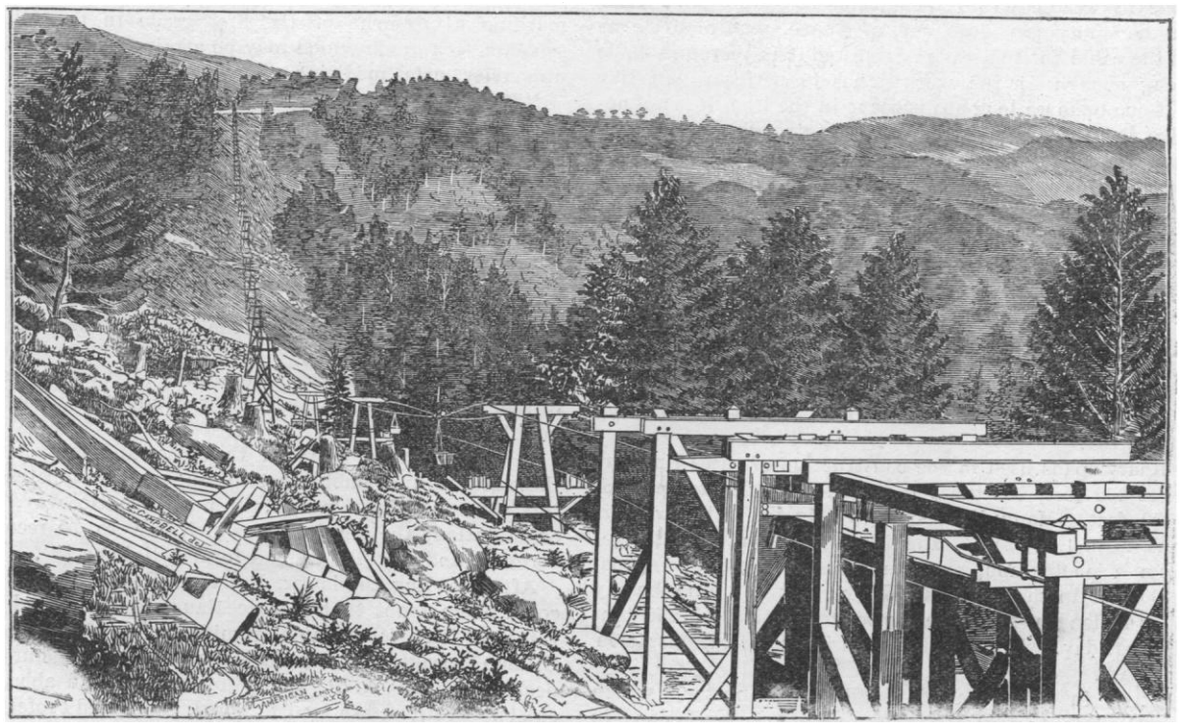


BLEICHERT WIRE-ROPE TRAMWAY OF THE SPLIT ROCK CABLE ROAD COMPANY, SYRACUSE, N.Y.

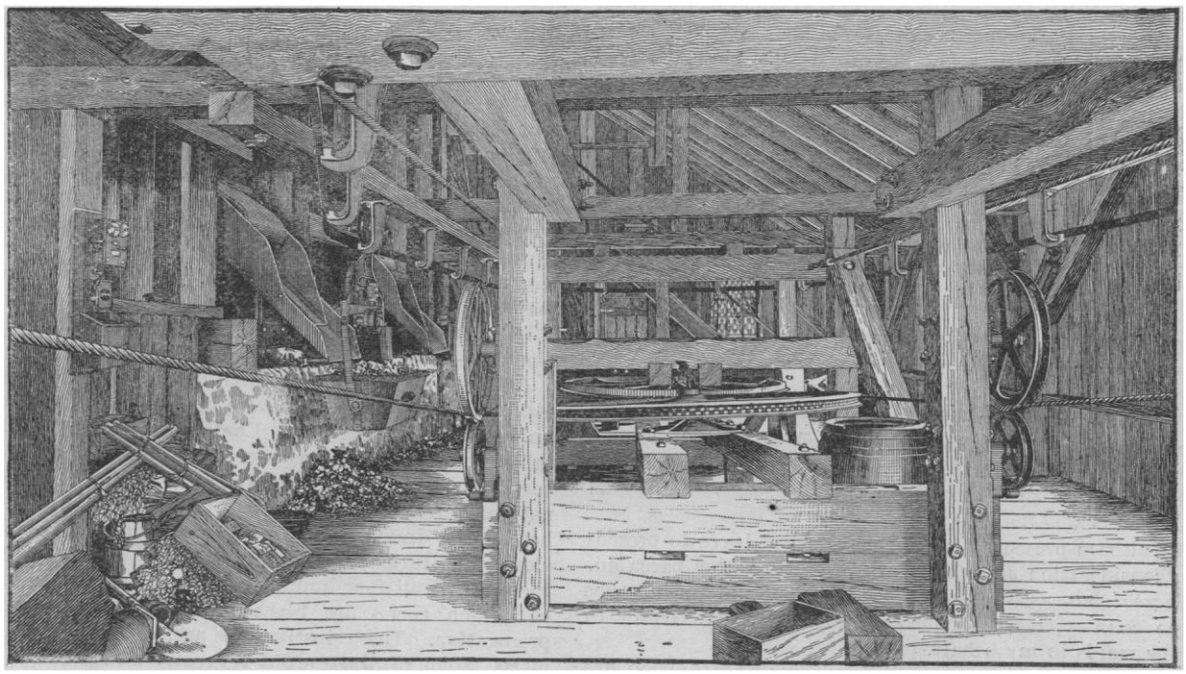
which, in the case of the single-rope tramways, would be impracticable. Again: a precipitous rise in the ground presents no insuperable difficulties, since the curves can usually be laid out so as to bring the inclination of the carrying-cables within the proper limits.

The other objection is obviated by the arrangement that when the car reaches either terminal, or any switch or turn-out on the line, it can be automatically disconnected, and run off to any point required for loading and discharging. This system also permits the introduction at any point on the line of movable or temporary switches or terminals, without the erection of special structures for their support.

The cost of both construction and maintenance is greatly increased for single-rope tramways by the use of spans longer than 100 feet, or the occurrence of very steep grades. Even if only one such span, or one such grade, is present in a whole line, it becomes necessary to make the entire double length of moving rope strong enough for the special strain due to tha one spot, over which, in its endless travel, every part of the rope must pass; and this increase in the size of the rope affects the dimensions of the supports, sheaves, and other fixtures throughout the line, thus requiring a general increase of cost, nearly as great as if all the spans were equally long or all the grades equally heavy. The wear of the rope is also increased by reason.



BLEICHERT WIRE-ROPE TRAMWAY AT GRANITE, MONTANA.



INTERIOR OF LOADING TERMINAL OF BLEICHERT WIRE-ROPE TRAMWAY AT GRANITE, MONTANA.

of its greater diameter and the more unfavorable conditions of the catenary curve, or sag, on long spans and steep grades; and these sources of increased cost of maintenance affect every part of the rope. In this system the carrying-cable, being stationary, can be locally graduated to the strains it has to bear. The cable for the empty cars does not, of course, require to be as strong as the cable for the loaded cars, and it is therefore made only strong enough for the work it has to perform. In like manner, if one or more long spans occur in the line, it is not necessary that the whole cable should be made strong enough to bear the extra strain at this one point: on the contrary, it is sufficient to so strengthen only the portions exposed to this extra strain, and this is easily practicable. On very long steep grades also, where the cable at the head of the incline must be able to bear not only the ordinary working strain due to the cars, but must also sustain the whole weight of the cable on the incline, this is effected by making the cable in sections of gradually diminishing area, thus effecting great economy in the total weight of the cable. A further advantage is, that the traction-rope used, instead of being loaded down by the cars, as in other systems, is itself carried and supported by them, thus lessening greatly the wear.

The ordinary spans used in the construction of these lines are from 150 to 200 feet, but there is no real objection to spans of 500 to 600 feet. Many lines built within the last few years have spans up to 1,500 feet. The illustration on the first page, taken from a photograph, represents one of these long spans. It is 1,000 feet in the clear, and forms part of a line nearly seven miles in length, built for the transportation of 250 tons of iron ore per day. This line has been in successful operation for many years.

There exists in nature hardly a difficulty or obstacle which would bar the introduction of this system of transportation: in fact, in many cases it is the only one that can be used. While this is eminently true where the contour of the ground is much broken up and long spans are necessary, this system possesses economical advantages even where there are few or no natural obstacles to the building of any kind of road. The service is regular; stoppages for repairs are rare; no interruptions due either to atmospheric influences or storms are liable to occur; the line being elevated, the service is entirely free from interference with surface traffic; wear and tear and expense of operating are relatively very low; terminals can be so arranged that the material transported can be delivered at the exact spot where it is needed, thus saving all expense of re-handling. This could not be done with a surface road, since, even if the cars could be brought close to the point at which the material is required, there would still be a further expense for unloading, irrespective of the cost of switching and hauling them.

This system of transportaton is controlled in this country by the Trenton Iron Company of Trenton, N.J.

THE SIGNIFICANCE OF THE DEGREE OF BACHELOR OF ARTS.

AT the conference of college presidents and professors in Philadelphia, Nov. 26, 1889, Professor E. H. Griffin read a letter from President Gilman, dated Oct. 17 (published in the February number of the *Johns Hopkins University Circulars*) as follows: —

"If I had been present, I should have asked leave to present to your consideration some thoughts respecting the baccalaureate degree; but as I cannot attend, on account of absence from the country, I have requested Professor E. H. Griffin to say a few words in my behalf.

"The points to which I should have directed attention are these: —

"1st, The American propensity to multiply academic titles so that the real significance of a degree is obscured.

"2d, The tendency to confer the baccalaureate degree in so many forms and phrases that its meaning cannot be discovered even from the name of the institution which confers it, but must often be worked out by a study of catalogues constructed in different orders of complexity.

"3d, The enumeration of the manifold forms of the baccalaureate degree now given in this country.

"4th, The historical significance of the bachelor's degree as marking attainment of the first grade in the fellowship of scholars, — a grade which may be attained in any faculty of a university, arts, medicine, theology, and law.

"5th, The value of a certificate the meaning of which is obvious at first sight, considered from the point of view of the holder of a diploma, and, second, from that of the public.

"6th, The importance of restoring, if possible, the baccalaureate degree to an honorable significance before it is altogether lost.

"7th, The importance of acknowledging that it is not essential that any one curriculum should be followed in order to attain the degree of bachelor of arts.

"8th, It is essential that the candidate who receives that degree should have received much instruction in (*a*) ancient and modern languages and literature, (*b*) in mathematics, (*c*) in the natural and physical sciences, and (*d*) in historical and moral sciences.

"9th, It is also essential that the candidate should pursue these studies in a public institution, under competent instructors, for a definite period, in a systematic way, subject to examination, the results of which are to be recorded, proclaimed, and certified to by a formal diploma." . . .

After reading the letter, Professor Griffin stated that there could be no doubt that the baccalaureate degree had lost something of the "honorable significance" of which President Gilman speaks. A recent writer in one of our magazines declares that "A. B. is as meaningless an abbreviation as exists." This, we are glad to know, continued Professor Griffin, is an exaggeration; but it is an exaggeration which contains an uncomfortable element of truth.

So far as it is true that the bachelor's degree has declined in dignity and value, the evil is a serious one. In view of its historical significance, the interests of learning and the credit of the fellowship of scholars require that this title, which marks the completion of a defined stage or period of training, should be kept in its original repute. It is a grave injustice that one who has gained the degree, at great expenditure of money, time, and labor, should find that others have gotten it upon so much easier terms that it becomes almost worthless as a guaranty of acquisition. The public have a right to assume that learned distinctions are bestowed in good faith, and upon some basis of common understanding, and ought not to be compelled to go back of academic titles to find out what they mean. Whether it be considered from the point of view of the public, or of the individual, or of the general interests of learning, few academic questions are of greater consequence than the proper significance, and most effective defence and maintenance, of the bachelor's degree.

The causes which have contributed to this loss of consideration are — some of them, at least — obvious.

As is well known, the institutions of higher learning first established in this country were modelled, not after the English universities, but after the English colleges. This was inevitable under the circumstances, and the American college has certainly shown itself well adapted to the conditions of our national life. As respects academic titles, however, the system has had its drawbacks. In Great Britain and Ireland there are eleven institutions conferring degrees; in the United States there are about four hundred, not counting colleges for women, of which there are perhaps one hundred exercising this prerogative. These institutions are, of course, of all grades of merit. Some of them are not greatly unlike the college in the Far West, of which Professor Bryce speaks in the "American Commonwealth," whose president had much to say about the views of his faculty, and what his faculty were going to do; the "faculty" consisting at the time, as it appeared, of that dignitary and his wife. A peculiar infelicity has attended our system as applied to honorary degrees, — as in theology and