The advance from stone implements to bronze, from bronze to iron and steel, by which the progress of civilization has been marked, is indicative of man's increasing acquaintance with the force of the material world.

If even the simplest instrumentalities, without which human life could scarcely be rendered endurable, derive an increased efficiency from the exactness of the science with which they are used, it is evident that there must be an infinitely larger sphere and a more imperative demand for such exactness of science in the use of the complicated machinery, which has expanded to its enormous proportions the industrial production of our day. It is a fact which is remarkable, although on reflection not unintelligible, that the extended application of machinery, instead of lessening the demand for skilled labour, has only led to increased requirements in reference both to its quantity and its quality. To handle a complicated machine even with safety, requires a considerable amount of technical skill; to work it with economy, requires still more; and the deplorable accidents, as well as the deplorable waste, by which industrial occupations have been in the past, and still are in many cases, accompanied, are generally due to inadequacy of technical training rather than to any moral want of conscientious care.

The accidents, arriving from ignorance of the forces at work in the machinery and materials of modern industries, are suggestive of a fact involved in the complicated civilization of our time. In consequence of the numerous and elaborate applications of practical science to the conveniences of human life, men are becoming more and more dependent on each other for the advantages of the technical knowledge which they severally possess. Accordingly the enjoyment of the very benefits, which science is conferring on mankind, renders it every day more and more imperative that those, who profess to perform any work, shall be adequately equipped for performance by a previous technical education. The vast increase, which the last few years have witnessed, in schools of technology, and in the numbers of men eager to obtain their advantages, affords a reasonable ground for the hope that a technical preparation will, in the near future, become a compulsory provision for all the more important industries of human life.

CABLE TRACTION FOR TRAMWAYS AND RAILWAYS.

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TRACTION by means of a rope and stationary engine was the way in which steam power was first applied to locomotion, though it is only recently that it has been utilized for passenger transport on a large scale. George Stephenson's opponents went so far as to maintain that no locomotive engine could be made which would haul its own weight up a moderate grade even without any cars attached. The triumph of the locomotive has however been so complete, and its manufacture has been brought to such a pitch of perfection, as to blind even those most accustomed to study the broader aspects of such questions to the fact, that there are special cases, and those of the greatest importance, in which a stationary engine and cable have an immense economical advantage over any form of locomotive, besides being free from many of its objectionable features. The case of most common occurrence to which cable traction is applicable is that of a road of moderate straightness on which there is a traffic requiring cars at frequent intervals. Not to go here into details, there are two great sources of economy in the cable system as compared with any kind of locomotive, steam, electric or other; firstly, the avoidance of all the dead weight hauled over the road in the shape of engines, boilers, etc., and otherwise required in order to give sufficient adhesion to the driving-wheels of the locomotive. In the case of a street railroad operated by any form of locomotive it would be a fair case to suppose a car weighing with its full complement of 30 seated passengers 12,000 lbs., to be drawn by a locomotive weighing 12,000 lbs. By getting rid of the locomotive we should here save 50 per cent. of the total weight hauled over the track; in other words the mass moved would be reduced from 800 lbs. per passenger to 400 lbs., etc., and the only corresponding increase would be the weight of the cable itself, which is trifling in comparison and carried in a cheaper way, viz., by pulleys with fixed bearings. The second saving is in substituting stationary engines and boilers, with the modern coal-saving appliances, for a number of locomotives. Where cars run at intervals of a few minutes the saving from these causes is so great that the consumption of fuel with a stationary engine and cable would not be more than 1-10th of what locomotives would take to do the same work, and possibly a good deal less. As, in most parts of the world locomotive traction is cheaper than animal traction, the economy of the use of the cable over the use of horses or mules would be equally great under favourable circumstances.

This being the case, the question will be naturally asked how it comes to pass that a means of traction apparently so simple and straightforward is only now coming into any general use. The answer is that there are two practical difficulties to be confronted in adopting cable traction, which have until recently seemed to be prohibitive. First, the case, as before said, to which cable traction is most markedly applicable is that where a frequent succession of cars or trains has to be run. In any special case by studying all the circumstances it could be determined just what frequency of cars would make cable traction cheaper than that by animals or locomotives, but probably with moderate grades, and circumstances otherwise ordinary, cars must be run at a headway of somewhere between 5 min. and 15 min., to give the economical advantage to the cable. Now this case only arises in the streets or suburbs of a large city and this is just the case where a running cable, except far overhead, or concealed underground, would be impossible, because of the other traffic along or across the road. Secondly, no practical means were ever known by which a car could be so attached to an endless moving cable that the car could start and stop at will, without jerk, unless the cable were stopped also. The first of these difficulties would be avoided by making use of the modern idea of the elevated railroad to which we shall have to refer hereafter, but this would not meet the requirements of our cities except in special cases. The first intimation of the practical solution of the problem, as regards ordinary street travel, of which we have any knowledge is contained in a patent granted in the United States to